
The Urban Unit
Urban Sector Planning & Management Services Unit (Pvt.) Ltd.
AGRICULTURE
DEVELOPMENT
PLAN

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DISCLAIMER

Urban Sector Planning and Management Sector Unit (Pvt.) Ltd. has prepared this report on the Agriculture Development Plan of Multan Division. Maximum care and caution have been observed while developing this document.

The opinions expressed in the document are solely those of the authors and publishing in any way constitutes an endorsement of the opinion by the Urban Unit.

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EXECUTIVE SUMMARY

Agriculture is the backbone of Pakistan's economy, and while its contribution to the GDP has decreased, it still plays a significant role in the country's socio-economic framework. With 60% of the population residing in rural areas and relying on agricultural activities for their livelihood, Punjab is a major contributor to agriculture, with crops such as wheat, cotton, rice, sugarcane, citrus, oilseed, and various fruits and vegetables being grown. Despite a favorable growing environment, declining yields and livestock productivity persist due to water shortages, soil fertility decline, water quality degradation, and limited agricultural areas. Interventions by the government have failed to produce a significant increase in productivity due to a lack of focus on the comparative advantage of each area and value chain development approach.

Nevertheless, the Multan division encounters significant challenges in terms of productivity and efficiency. These challenges arise from inadequate modern water distribution infrastructure, limited availability of modern farming techniques, machinery, transportation, storage facilities, electricity, inputs, and improved seeds. Additionally, there is a lack of value addition in high-value crops, further exacerbating the issues.

To address these challenges, investment projects have been proposed, encompassing both ongoing initiatives and new ventures. These projects are divided into different phases, considering their position within the value chain. The priority of each project is determined based on its relative order and its potential to contribute to overall agricultural development.

Efforts are underway to enhance agricultural productivity in the Multan region through a comprehensive regional development plan. This plan focuses on specific zones dedicated to cultivating major and high-value crops, complemented by targeted infrastructural support. The overarching goal is to shift from subsistence agriculture to a lucrative export-oriented agricultural sector through an integrated planning approach.

The Multan region plan entails the identification and designation of clusters or zones for each crop based on the prevailing agroecological conditions. A total of 16 crops have been recommended for cultivation in the Multan region. To optimize the agricultural value chain, a phased implementation

approach will be adopted, encompassing various interventions. These interventions include the provision of certified seeds, specialized extension services, quality inputs, mechanization, packaging, storage, transportation, efficient harvesting techniques, post-harvest management, and market development.

To encourage farmers to adopt the recommended 16 crops, incentives will be provided. Moreover, specific high-value cropping zones have been identified to maximize yields and ensure the cultivation of crops with substantial economic value. Through the implementation of this plan, it is expected that agricultural productivity in the Multan region will be significantly improved, leading to greater prosperity for farmers and the overall development of the agricultural sector.

1. CHAPTER

1.1 INTRODUCTION

The agriculture sector contributes 22.7% to the GDP and generates 37.4% of the employment of Punjab's Labour force (Economic Survey, 2021-22). This sector comprises crops, livestock, fishing, and forestry. During 2021-22, agriculture sector recorded a remarkable growth of 4.40 percent and surpassed the target of 3.5 percent and last year's growth of 3.48 percent. This growth is mainly driven by high yields, attractive output prices and supportive government policies, better availability of certified seeds, pesticides and agriculture credit. The crops sector outperformed and posted a growth of 6.58 percent during 2021-22 against 5.96 percent last year. The growth in production of important crops namely cotton, rice, sugarcane and maize are estimated at 17.9 percent, 10.7 percent, 9.4 percent and 19.0 percent respectively. Other crops having share of 13.86 percent in agriculture value addition and 3.14 percent in GDP, grew by 5.44 percent on the back of increase in the production of pulses (29.82 percent), oilseeds (24.75 percent), vegetables (11.52 percent), fruits (1.53 percent) and fodders (0.36 percent).

However, the agriculture sector of Pakistan and Punjab as well suffers from low productivity due to poor quality and inadequate agriculture inputs, poor farm management practices, limited availability of key agriculture inputs to the subsistence farmers due to limited knowledge, and high cost, and limited accessibility. Small farmers are unable to make use of modern machinery due to their poor economic conditions and high cost of technology. Although large farms do use mac

hinery and equipment, they are unable to match international production standards. Therefore, the share of agriculture in total GDP has been declining since independence in 1947. Agriculture contributed more than 50 percent to GDP in the 1970s. Moreover, compared to major crops, livestock had a smaller contribution in the 1970s.

1.2 SALIENT FEATURES OF PAKISTAN AGRICULTURE SECTOR (2022)

Crops	Forestry	Fisheries	Livestock
34.8 % Value Addition in Agri.	1.65 % Value Addition in Agri.	1.65 % Value Addition in Agri.	61.9 % Value Addition in Agri.

Table 1: Crop Wise GDP Share of Pakistan

Crops	Share in GDP (%)	% Value Addition in Agriculture
Major Crops	**4.4**	**19.5**
Cotton	0.6	2.4
Sugarcane	0.8	3.7
Rice	0.5	2.4
Wheat	1.8	7.8
Maize	0.7	3.2
Other Crops	**3.8**	**15.3**

Fruits Vegetables & Horticulture (4 to 6 % only)

Source: Economic Survey of Pakistan (2021-22)

1.3 PAKISTAN RANKING IN THE WORLD (PRODUCTION)

The position of Pakistan's ranking in crop production has been steadily decreasing when compared to the global production ranking. Over the period of 2010 to 2021, wheat remained relatively stable, slightly declining from 7th to 8th place in the ranking of Pakistan's commodities. Similarly, cotton and rice experienced drops in their rankings, with cotton moving from 4th to 7th place and rice moving from 13th to 9th place. These declines indicate a concerning trend of decreasing production in the global market share for these major crops. The figure below shows the Market share of Pakistan's ranking in different crops production:

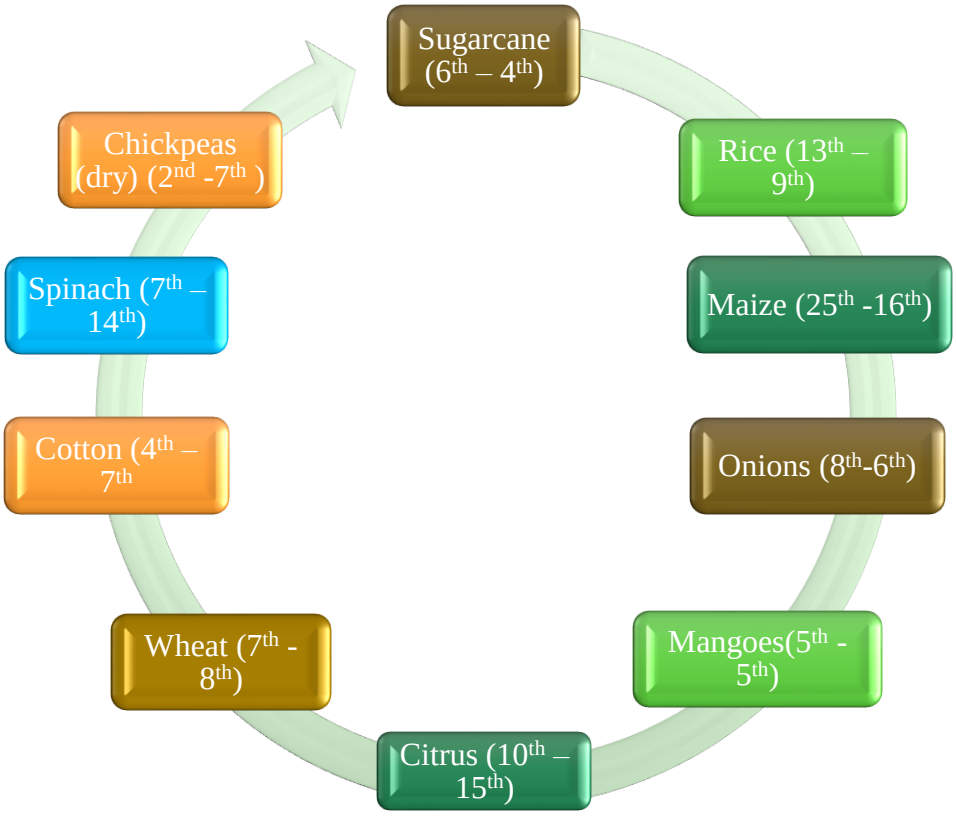


Figure 1: Pakistan Ranking in the World (Production)

Source: FAO Ranking

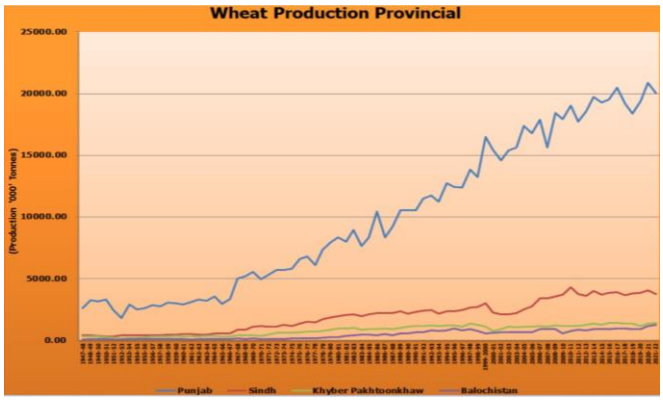
1.4 CHALLENGES AND CONCERNS IN THE AGRICULTURE SECTOR'S GROWTH AND DEVELOPMENT

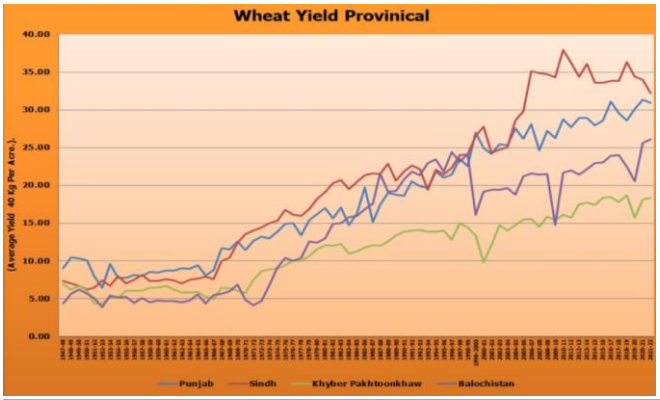
The challenges and Concerns in the Agriculture Sector's responsible for the current status of growth and development are as follows: The proportion of Agriculture GDP is witnessing a decline.

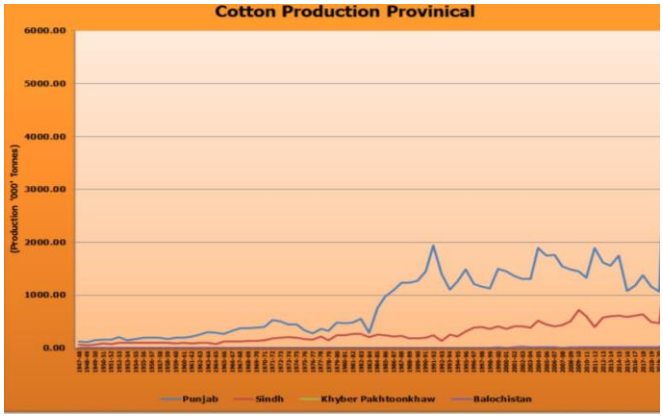
- ***There is a decreasing trend in the share of agricultural employment.***
- ***The Agriculture GDP per worker has remained stagnant at approximately $1400.***
- ***Issues within the value chain and value addition are evident.***

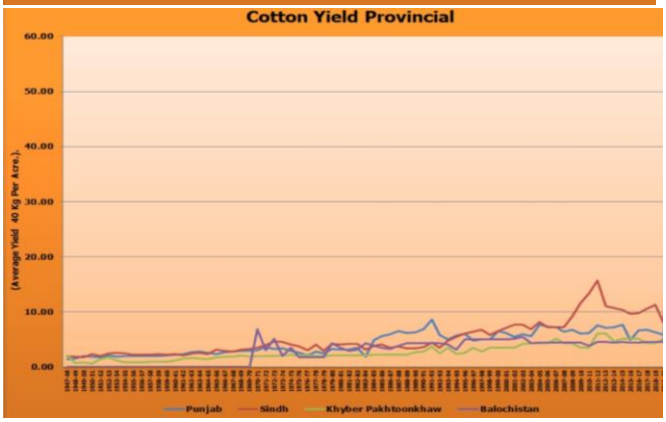
The figures below show the challenges and concerns in the Agriculture sector growth and development:

- ***Crop production within the value chain has remained stagnant, particularly since 2007-2008, and yields are declining.***
- ***The per capita requirement for crops is increasing significantly, but the industry is struggling to meet the demand.***
- ***The region is falling behind in the international market, and the share of exports is decreasing.***
- ***There is a lack of value addition in the agricultural process.***



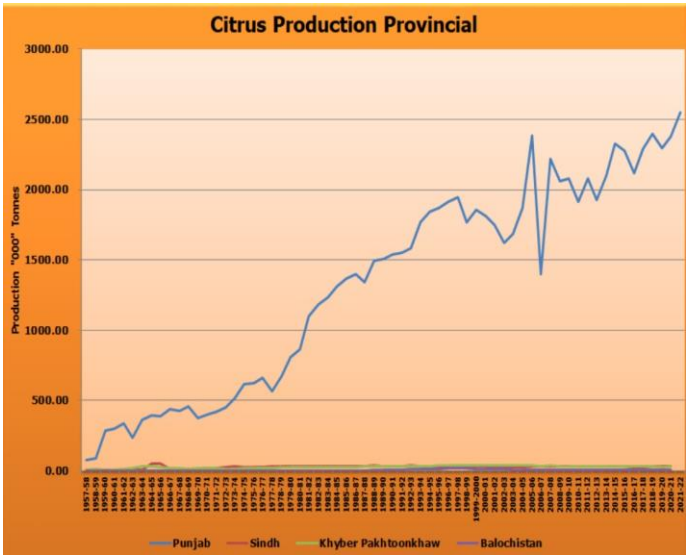


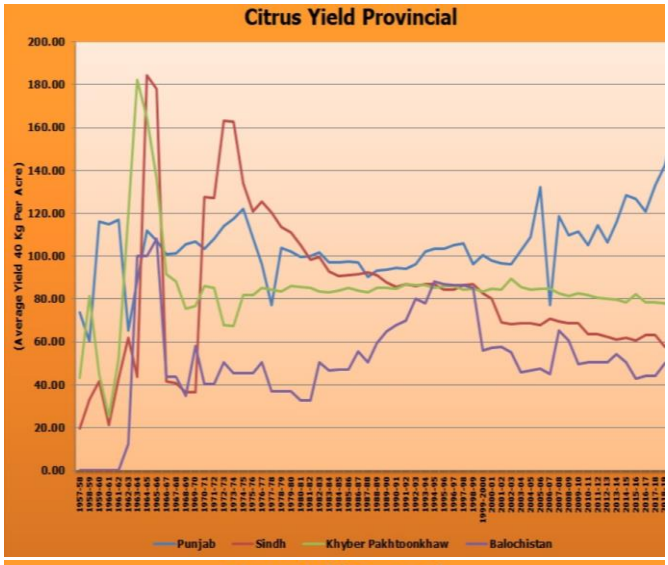


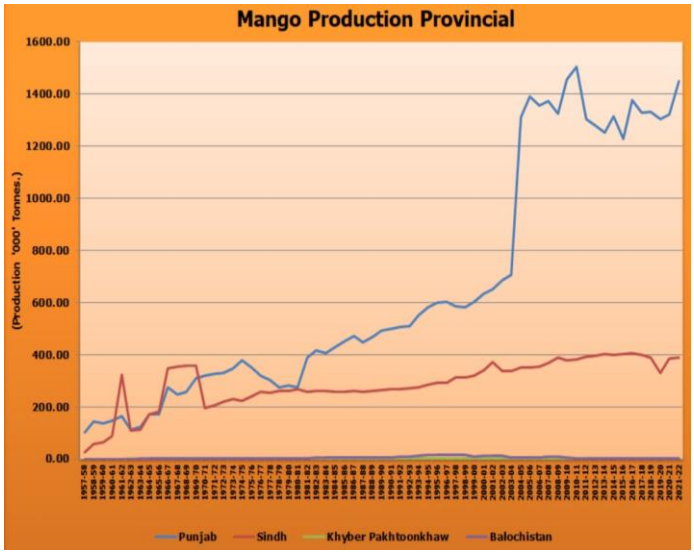


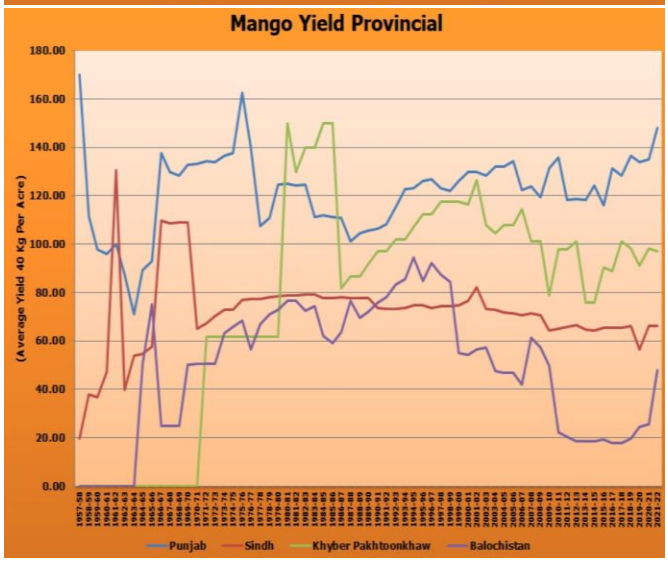
- ***Similarly, the citrus and mango yields are declining as a result of disease outbreaks and pesticide attacks.***

- ***Moreover, the share in the international market for citrus is experiencing a downward trend, and both crop orchards have been significantly impacted by these challenges which is seen below.***









Source: AMIS

1.13.1 CITRUS & MANGO EXPORT STATUS IN THE INTERNATIONAL MARKET

Over time, competing countries in the export market of citrus, guavas, and mangoes have been able to gain a larger market share by diversifying their product offerings and taking advantage of their products' longer shelf life. This strategic approach has allowed them to sustain their presence in the market for extended periods. In contrast, Pakistan's position in the citrus, guavas, and mangoes market share has either worsened or remained stagnant. Unfortunately, while the export status of competing countries has consistently increased over time, Pakistan has struggled to make significant progress in capturing a larger share of the market for these fruits.

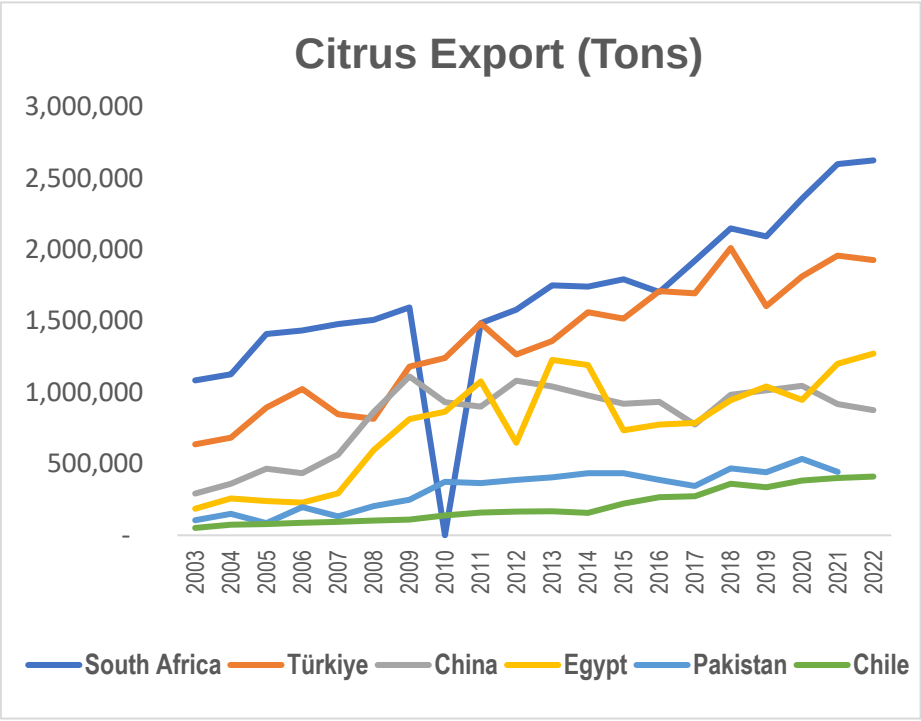


Figure 2: Citrus Export (Tons)

Source: Trade Map

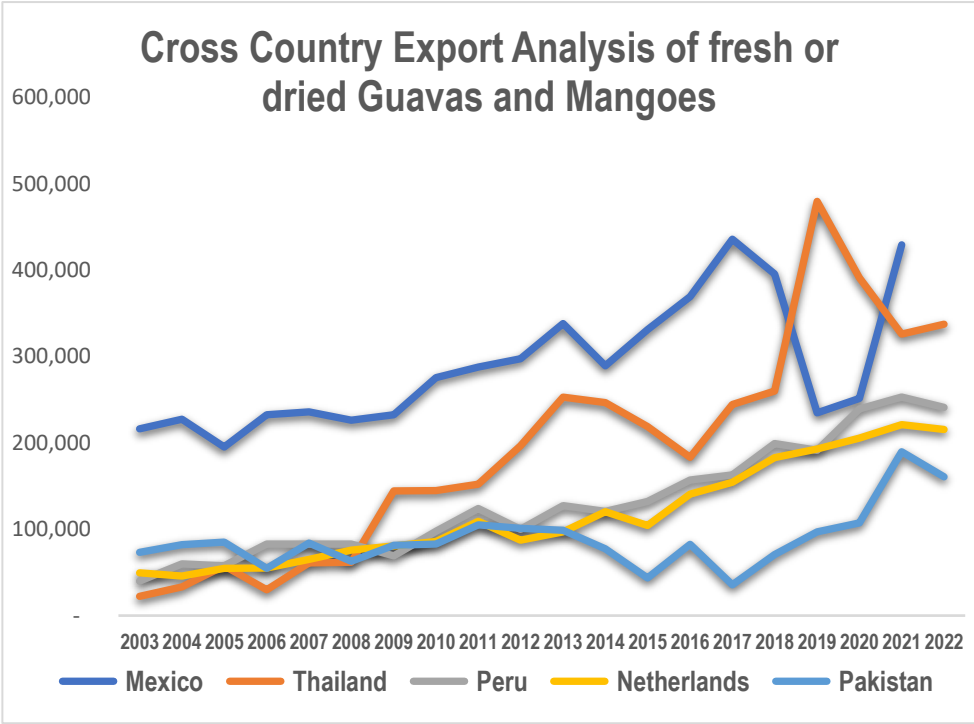


Figure 3: Cross Country Analysis

Source: Trade Map

1.5 ISSUES AND CHALLENGES OF AGRICULTURE

Pakistan's agriculture sector is faced with several issues and challenges, including water scarcity, land fragmentation, lack of mechanization, an inefficient supply chain, limited access to finance, and the impacts of climate change. These challenges have led to decreased agricultural productivity, increased costs, and limited the sector's ability to compete in the global market. Addressing these challenges requires policy reforms and investment in research and development, infrastructure, and modern technologies, among other things, to increase productivity, efficiency, and competitiveness in the agriculture sector.

The current issues and challenges in the agriculture value chain can have significant impacts on the agricultural sector, including reduced productivity, decreased farmer incomes, and a lack of competitiveness in the global market. However, some common issues and challenges found after the ground assessment are following:

Labor Shortage

- Labor shortage along the cities due to a huge shift towards the industrial sector
- Urbanization is occurring as a result of a decrease in agricultural areas, particularly fruits and vegetables
- Causing difficulty for harvesting purposes, & simultaneously increasing the cost of production

Climate Change

- Disrupting food availability has decreased the productivity of crops especially wheat and guava which got severely affected last year
- Increases the incidence of pests and diseases
- Cropping pattern & cropping season is changing drastically

Lack of Quality Seed

- High seed prices
- Unavailability of quality seeds especially for F&V and Oilseed markets
- Seeds are mostly imported

Low Value Addition

- Pakistan has seasonality advantage over the countries who supply the same crop
- The dearth of dehydration units, grander process, and paste processing units
- Lack of storage facilities, & export markets
- Requirement of modern markets

Overall, addressing these issues would require a combination of policy measures, investment in infrastructure and technology, and education and training programs for farmers. Encouraging sustainable farming practices and investing in research and development to improve crop and livestock productivity would also be beneficial. Additionally, government and private sector partnerships to support farmers, improve market access and increase access to finance for farmers and rural communities could help to mitigate these issues.

Factors impeding agricultural progress include suboptimal irrigation water distribution and an absence of efficient clusters of high-value crops, a lack of timely adoption of new techniques and innovation, policy distortions, and insufficient marketing development. Addressing these challenges will require a comprehensive approach that includes investments in infrastructure, the development of new technologies and best practices, and the creation of supportive policies that promote sustainable agriculture. This will help to increase productivity, improve farmer incomes, and enhance the competitiveness of the agricultural sector in the global market.

1.6 ENABLING THE BUSINESS OF AGRICULTURE

Enabling the Business of Agriculture, a study by the World Bank, evaluates agricultural regulations and their impact on domestic farmers. It uses indicators to measure performance, identify market barriers, and promote innovation. Countries with better agricultural business regulations have lower poverty rates and greater development outcomes. However, Pakistan ranks low in the study and needs to improve its agricultural enabling environment.

RANKING	COUNTRY	SCORE
1	France	93.7
2	Croatia	92.68
3	Czech Republic	92.32
4	Hungary	91.77
5	Spain	91.71
12	Brazil	75.25
55	Malaysia	51.68
57	Mexico	69.46
40	India	62.23
99	Vietnam	61.41
68	**Pakistan**	**48.87**

Figure 4: Enabling the Business of Agriculture

Source: **Enabling the Business of Agriculture 2019**

Water scarcity is a significant challenge affecting agriculture globally, including in Pakistan. The country's water productivity is the lowest among the compared countries. While the United States and China have high water productivity, Pakistan has room for improvement.

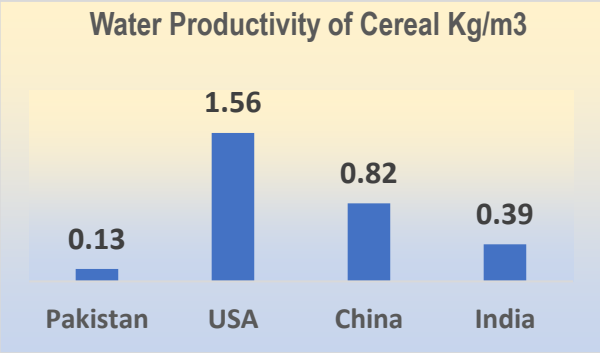


Figure 5: Global Water Productivity Gap

Source: (INP, 2019)

Total Factor Productivity (TFP) in Pakistani agriculture is declining, mainly due to outdated practices and inadequate resources. Improving agricultural productivity is vital for economic growth, poverty reduction, food security, and job creation, particularly in rural areas.

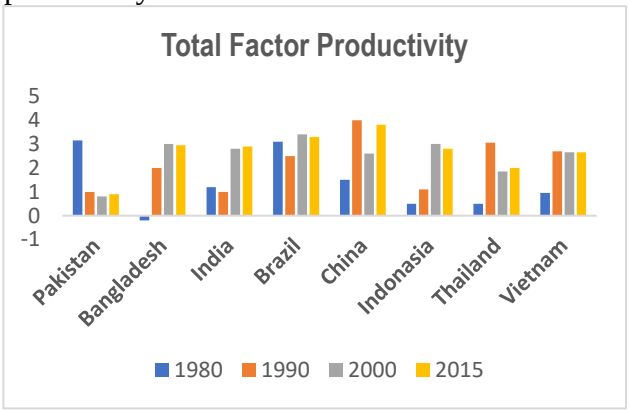
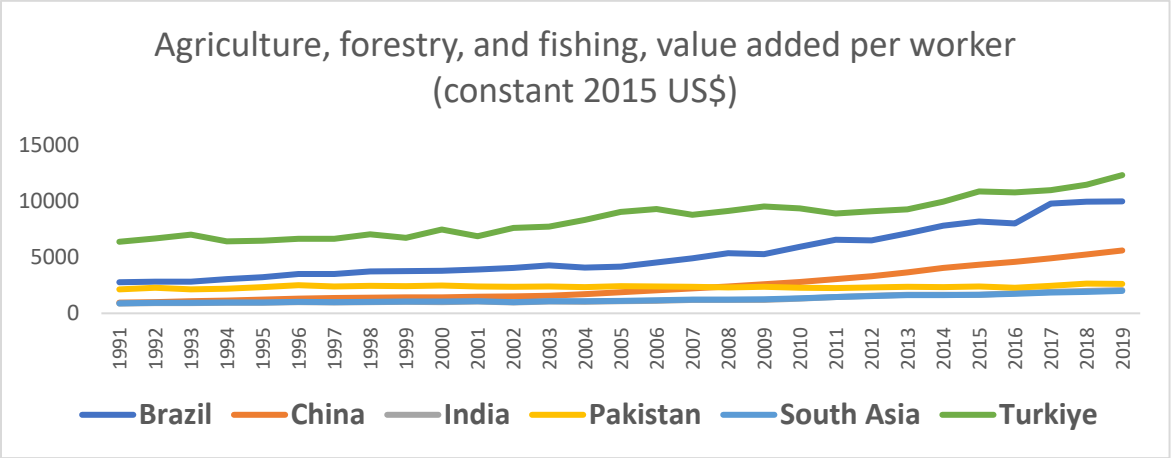


Figure 6: Total Factor Productivity Since 1980's

Source: Sector Plan 2015

1.7 AGRICULTURE, FORESTRY, AND FISHING, VALUE-ADDED PER WORKER (CONSTANT 2015 US$)

A measure of agricultural productivity is agriculture value added per worker. In agriculture, value-added is defined as the output of the agricultural sector less the value of intermediate inputs. Agriculture includes the value added by forestry, hunting, and fishing, as also crop cultivation and livestock farming. Argentina ranks first in the world in terms of agricultural value-added per worker. Argentina's agriculture value added per worker in 2019 was 2.76 million US dollars, accounting for 50.19 percent of global agriculture value added per worker. The top five countries (Iceland, Canada, Singapore, and Norway are the others) account for 58.52 percent of it. However, in 2019, the total agricultural value-added per worker was estimated to be 5.5 million US dollars. In addition, South Asia's agriculture value added per worker in 2019 was 1.99 million US dollars while that of Pakistan's agriculture value added per worker was 2.63 million US dollars 2019.



The value-added per worker in the Agriculture, Forestry, and Fishing sector across the selected countries reveals some interesting insights. Firstly, it is apparent that the value-added per worker is quite low in the South Asian region, including countries like India and Pakistan. This could be due to several reasons, such as the low use of technology, poor infrastructure, and limited access to credit and market information for farmers. In contrast, Turkey, China, and Brazil have much higher value-added per worker in this sector. This could be due to several factors, such as higher mechanization, the use of modern technology and techniques, better access to financing and market information, and a more developed value chain. As a result, the data highlights the significant differences in the productivity and efficiency of the Agriculture, Forestry, and Fishing sector across different countries, and suggests that there is significant scope for improvement, particularly in the South Asian region.

Figure 7: Agriculture, Forestry, And Fishing, Value-Added Per Worker (Constant 2015 US$)

Source: World Bank

1.8 COMPREHENSIVE AGRICULTURE TRANSFORMATION PLAN

Keeping in view the problems, the Government needs to focus simultaneously on three broad strategies, the first one being to identify the potential areas for each crop and make clusters/zone of each crop and provide all facilities and specialized support systems for each crop in cluster/zone particular to their needs. It will increase efficiency in the system (efficient use of resources like land, labor, water, inputs) and facilitate government to easily manage the whole value chain of each crop (management of inputs, extension services, technology, R & D, and providing subsidy).

Secondly, gradually shift crop-mix patterns from low-value crops to high-value crops by identifying potential areas of those crops. In this regard, identify some potential crops from high-value crops on a priority basis for the next five years and to develop a complete value chain for those crops. Crops like Cotton, and Mango are identified based on profitability; demand; high potential for value addition; export, and comparative advantage in international markets for the upcoming five years ultimately resulting in the growth of the agriculture sector in Punjab. Lastly, the yield of major and other crops (other horticulture, food grain, oilseed, and minor crops) can be increased so that the production is achieved from a limited area and hence the remaining area is optimally utilized to produce high-value crops.

Punjab spatial strategy is a long-term spatial development framework for the province of Punjab, across all sectors including agriculture, livestock, irrigation, food, forestry, industries, environment, urban planning, and social development. The strategy aims to ensure integrated spatial planning by identifying the comparative advantage of each area that will structurally transform Punjab into an economically developed region.

Furthermore, in PSS a comprehensive agriculture transformation plan was prepared which focuses on the comparative advantage of each region/division of Punjab. In this regard, the Urban Unit has been given the task to devise a comprehensive agriculture development plan for the Multan region which covers detailed agriculture and livestock plan by value chain of each potential/identified crop of the region.

1.9 REGIONAL PLANNING (SCOPE OF WORK)

The agriculture sector is one of the most important sectors of the economy of Punjab; an increase in agricultural productivity will make a massive contribution to increasing the growth rate of Punjab's economy. However, there is no spatial lens through which development projects can be assessed and evaluated for the targeted economic growth. Therefore, the Punjab Spatial Strategy focuses on the potential for economic growth in the agriculture of the province.

Considering the Punjab Spatial Strategy framework, the agriculture sector of Punjab must reposition itself to transform the agriculture sector in the province of Punjab to increase crop productivity, bring the additional uncultivated area under cultivation and improve the crop mix to create maximum value addition in the province to contribute towards inclusive economic growth. This would be done by transforming the farmers of Punjab into progressive farmers, equipping them with state-of-the-art support and knowledge, providing them with quality and timely inputs as well as creating an enabling environment.

This work will be to develop and validate agro-ecological conditions and socio-economic profiling of agriculture and livestock sectors of the region focused on;

a. Assessment of physical environment (land cover, geology, natural resources, climate and meteorology, hydrology, population, land use, community social structure, etc) to determine optimal cropping pattern for intensification
b. Cropping pattern identification with yield, price, cost of production, profit per acre, etc
c. Proposed cropping pattern for intensification
d. Identification of problems in the product-level value chain (seed to market), resource, and financial constraints.
e. Proposing solutions and interventions at each stage of the value chain to enhance production and exports
f. Focusing on exportable surplus and finding value propositions for interventions leading to economic growth in the area
g. Water availability and utilization assessments for natural resource preservation
h. Economic activities (livestock and agro-based industries, employment, and labor market) assessments.

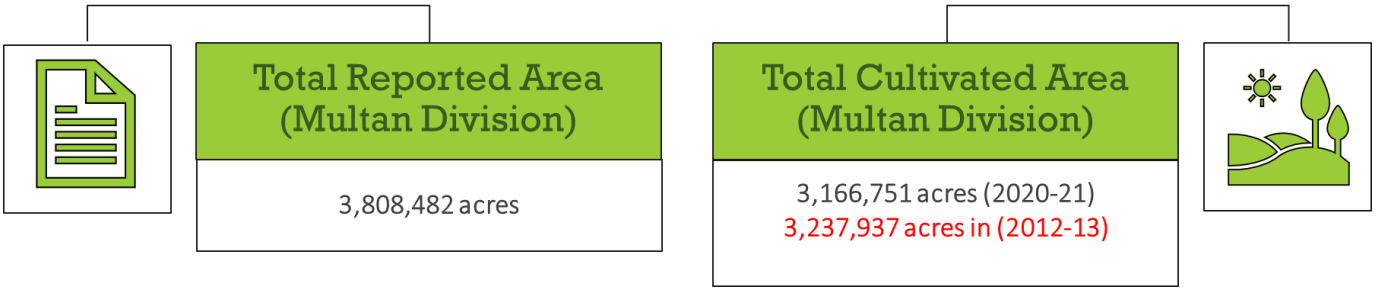
i. Key facilities assessments (agricultural markets, farm mechanization, breeding and seeding facilities, etc) for infrastructure and policy interventions

Therefore, the regional development plan for Multan Division focuses on the need to change our current cropping pattern from low-value crops to high-value crops. So that farmer income is increased and the agriculture sector may flourish. This is achieved by making clusters of these high-value crops in the areas where we have a comparative advantage with respect to yield and productivity as well as suitable ecological conditions.

MULTAN DIVISION PROFILE

Given the aforementioned situational analysis of the agricultural sector of Punjab, it is essential to address the current status of agriculture and livestock in the Multan region through a proposed development plan. The primary objective of this plan is to highlight the existing conditions and challenges facedby the region. By doing so, it aims to provide a comprehensive understanding ofthe current state of agriculture and livestock, including factors such as production, infrastructure, market access, and resource management. This proposed plan will serve as a roadmap for implementing targeted strategies, interventions, and initiatives to uplift the agriculture and livestock sectors in theMultan region. The ultimate goal is to foster sustainable growth, enhance productivity, improve the quality of produce, and create favourable conditions forfarmers and stakeholders. Through this development plan, the Multan region can position itself as a thriving hub for agriculture and livestock, making significant contributions to the overall economic progress of the area.

1.10 MULTAN DIVISON AGRICULTURE PROFILE



Contiguous Urban Development in Multan District	Total
1995-2005	74%
2005-2015	40%

Annual Area Growth Rate in Multan District	Total
1995-2005	5.7%
2005-2015	3.4%
1995-2015	4.6%

Figure 8: Continuous Urban Development and Annual Area Growth rate in Multan District

Source: Urban Unit

Employment by Sector (%) **(Agriculture)**	Total
MULTAN	35.5
LODHRAN	49.0
KHANEWAL	57.0
VEHARI	51.2

Figure 9: Employment by Sector

Source: LFS 2021

1.11 MULTAN AGRICULTURE SECTOR PLAN

1.13.1. VISION

The vision is driven by elaborating the policy areas, targets, key actions, and stakeholders in the Multan division. The Agriculture Development Plan in the Multan region focuses on;

"Efficient use of resources to enhance productivity and generate value addition in agriculture through improving the regional and country positioning in terms of attractiveness and competitiveness by leveraging existing natural endowments for the economic wellbeing of people, especially rural communities."

1.13.2. AGRICULTURE OBJECTIVES

The main objectives of the regional plan for the agricultural sector are:

01 ***Enhance the competitive position of the agriculture sector to capture global demand and cater to domestic demand through the modernization of traditional agriculture practices.***

02 ***Ensure food security by improving food quantity, quality, and nutrition diversity through higher yields, better crop mix, and farmer profitability.***

03 ***Enhance sustainability and resilience in the wake of climate changes by conserving agricultural resources through efficient use of land & water.***

04 ***Strengthen and promote private sector participation in agriculture value chains with increased investment, technology infusion, and resource management.***

05 ***Improving breed development, on-farm mechanisms, medical facilities, and providing high-quality nutritional feed for enhanced productivity.***

06 ***Contribute towards poverty alleviation and economic development of the province through the provision of an enabling environment and farmer support services.***

07 ***Strengthen local markets and price mechanisms and increase accessibility to the international market by adopting international standards and certification.***

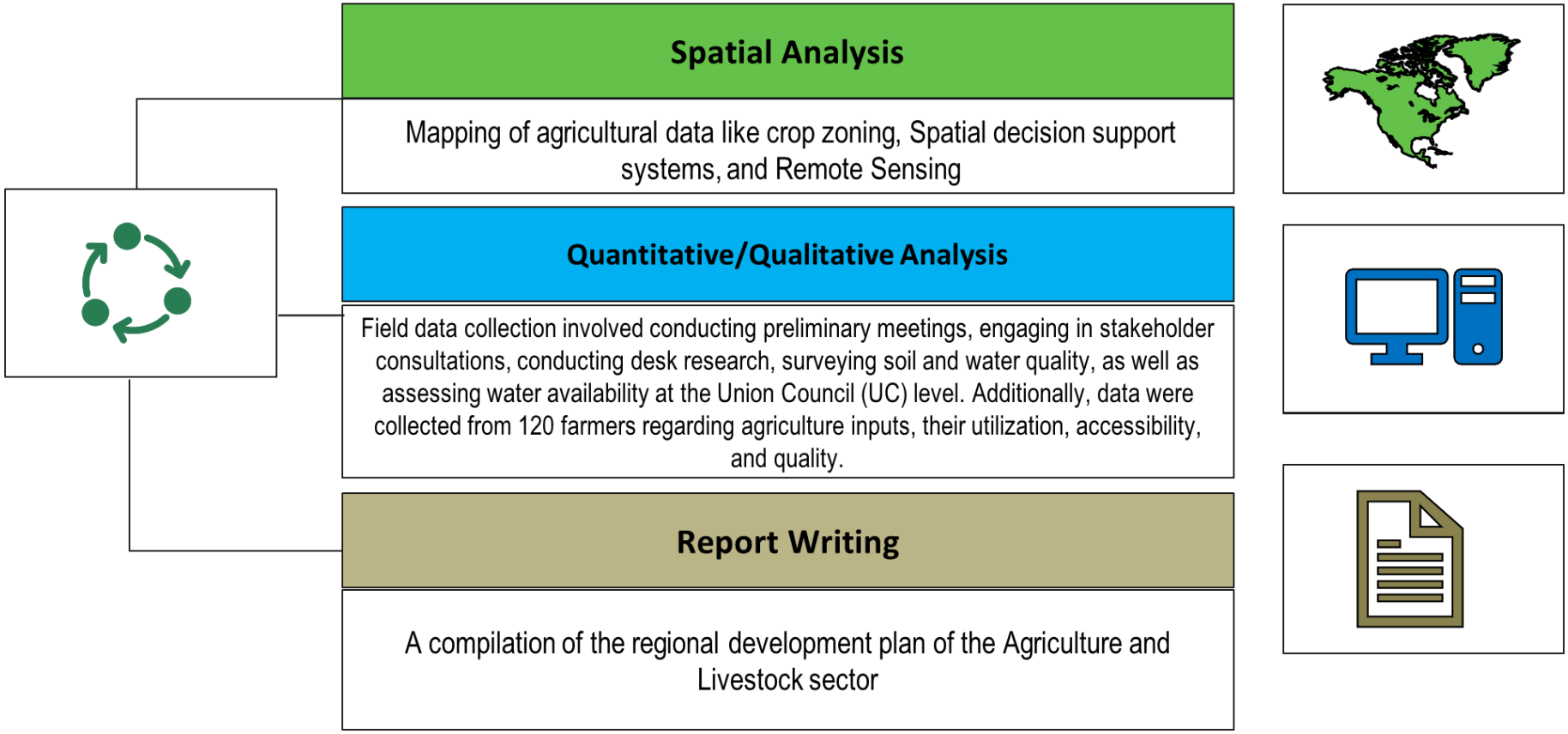
1.13.3. POLICY FOCUS AREAS IN AGRICULTURE AND LIVESTOCK

To achieve the above-stated objectives, the following policy focus areas should be adopted strictly to increase the income of the farmer, improve their standard of living and bring overall development to the rural areas.

- Low productivity to high productivity (Lessening the productivity gap in all crops, livestock)
- Identify the potential areas for each crop and make a cluster/zone of each crop
- Provide all ancillary facilities and specialized support systems for each crop in the cluster/zone.
- Gradually shift crop-mix pattern from low-value crops to high-value crops (identifying potential crops from high-value crops on a priority basis for the next five years).
- Wasteful use of water to efficient use of water and develop 24 agriculture corridors along 24 main canals and focus on integrated rural development in these corridors.
- All departments coordinate and implement integrated action plans by using the maximum agriculture potential.

1.12 **METHODOLOGY**

This section provides detail about the methodology used for the analysis.

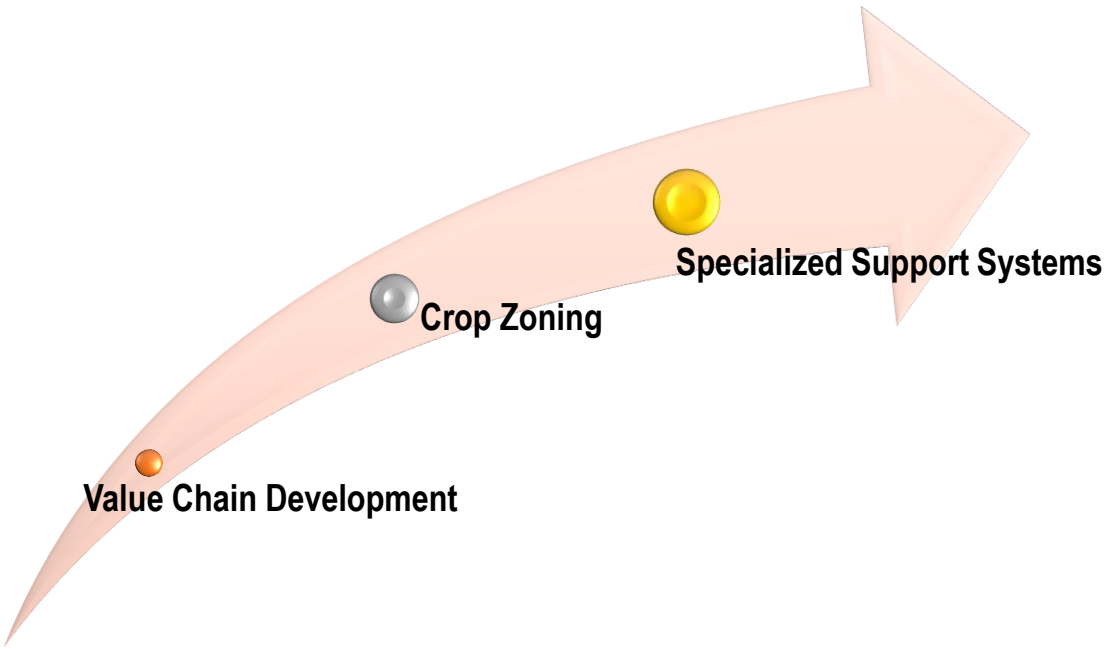


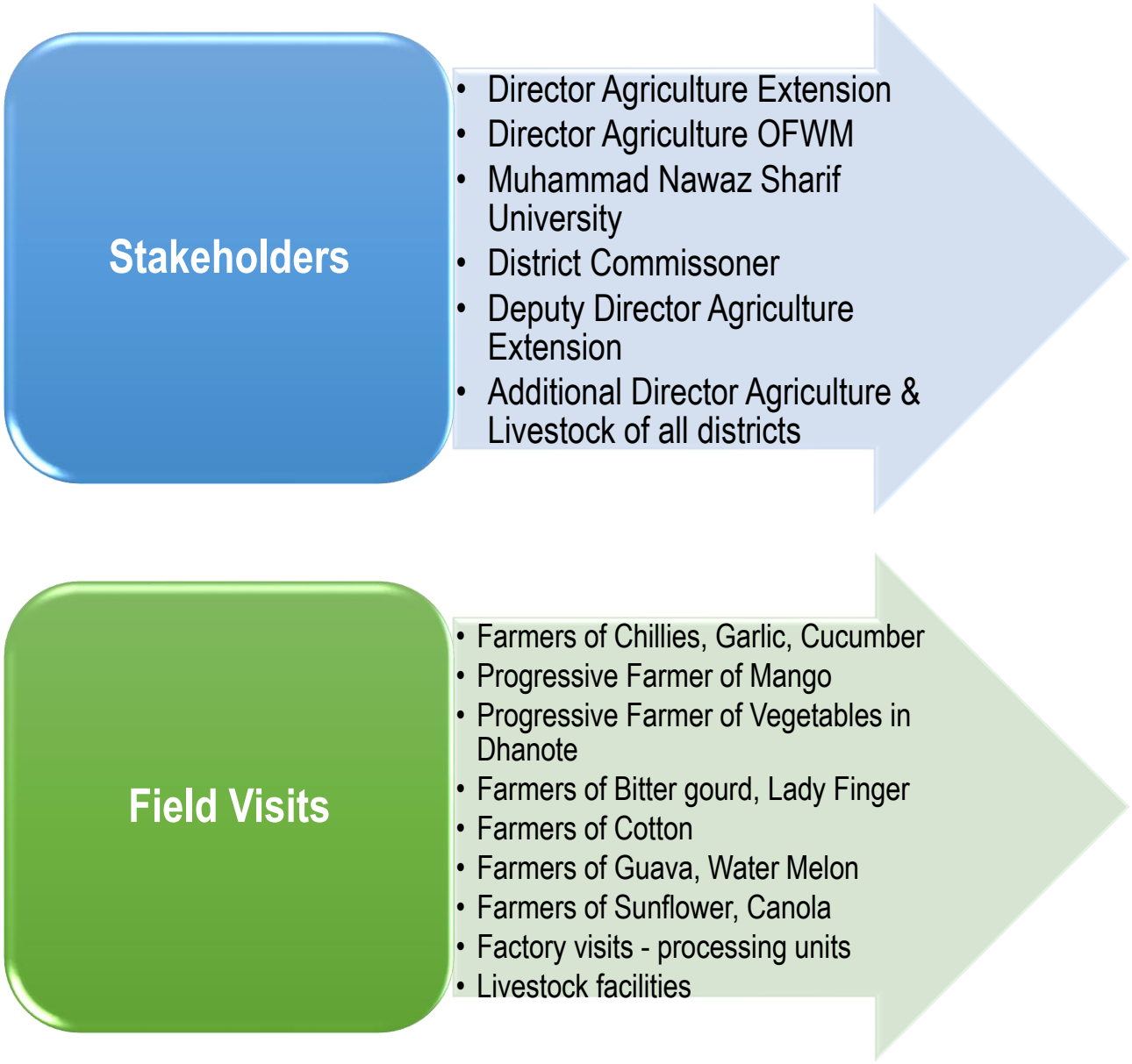
1.14.1. DATA ANALYSIS

Once the team collected the data, all of the information was then discussed and analyzed. The data was cleaned, integrated, and rechecked if any gaps were found in the collected data. Additional information was gathered from Agriculture and Livestock departments via email and telephone conversations. Based on the information collected in the field, the descriptive maps for the proposed Rabi and Kharif crops based on agro-ecological conditions were developed. Further analysis was then produced by the Agriculture and Livestock team.

1.14.2. IDENTIFIED POTENTIAL CROPS IN THE MULTAN DIVISION

The potential crops in the Multan Division exhibit the importance of Value Chain Development through Crop Zoning and Specialized Support Systems which are considered the key strategies to improve the productivity and profitability of the region. Cotton & Mango are the identified high-value crops as recommended by the Research Institutes.




Stakeholders
Director Agriculture Extension
Director Agriculture OFWM
Muhammad Nawaz Sharif University
District Commissoner
Deputy Director Agriculture Extension
Additional Director Agriculture & Livestock of all districts
Field Visits
Farmers of Chillies, Garlic, Cucumber
Progressive Farmer of Mango
Progressive Farmer of Vegetables in Dhanote
Farmers of Bitter gourd, Lady Finger
Farmers of Cotton
Farmers of Guava, Water Melon
Farmers of Sunflower, Canola
Factory visits - processing units
Livestock facilities

a. Rapid Assessments – Field Visits

The Urban Unit Agriculture sector teams visited the Multan division during visits in March 2023

Meeting in Mailsi Tehsil

Field Visit in Khanewal

Field Visit in Vehari Tehsil

Maize Field Visit

Progressive Farmer

Phalsa Farms

1.13 MULTAN AGRICULTURE SNAPSHOT

1.15.1. PRODUCTION OVERVIEW

The data shows the production contribution of different crops in the Multan Division as a percentage of Punjab's total production. Chilies have the highest production contribution at 66%, followed by Mango at 52% and Phalsa at 51%. Maize stands at 41%, while Musk Melon, Onion, Brinjal, and Lady Finger contribute 35%, 31%, 27%, and 24% respectively. Dates, Litchi, Tomato, and Wheat have lower production contributions of 23%, 21%, 15%, and 12% respectively. Similarly, the production of Vegetables & Fruits crops is also noteworthy. With the view to enhancing the production of the Multan division, the government should introduce a specialized support system and introduce modern technology for the cultivation of high-value crops, while minimizing the utilization of input factors such as land, water, and labor. Based on the current pattern of crops, it is evident that the Multan region is of immense importance and can significantly boost the production of these crops.

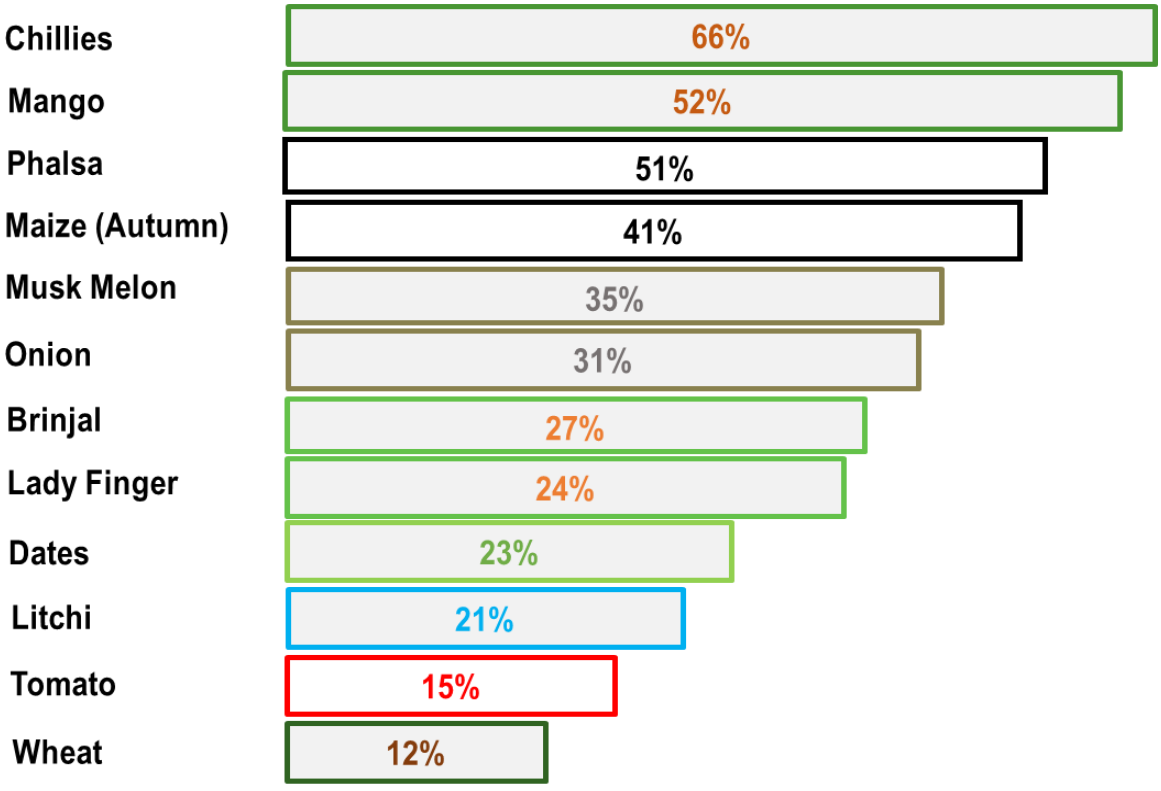


Figure 10: Production contribution as a percentage of Punjab's total
Source: **Crop Reporting Service**

1.15.2. CURRENT CROPPING PATTERN

The Rabi and Kharif cropping patterns in the Multan division of Pakistan refer to the seasonal cultivation of crops. Rabi crops are typically planted in the winter and harvested in the spring, while Kharif crops are planted in the summer and harvested in the fall.

Figure 8 presents the Rabi cropping pattern of the Multan Division. The total Rabi area of this region covers 2,635,490 acres of land. Unfortunately, 527,824 acres remain unutilized due to water scarcity and unfavorable soil conditions. Additionally, it is observed that the majority of the cultivated area is occupied by low-value crops, and the area under cultivation of high-value crops is negligible. For this reason, the Multan Division yields only Rs. 66,940/ acre output in Rabi despite.

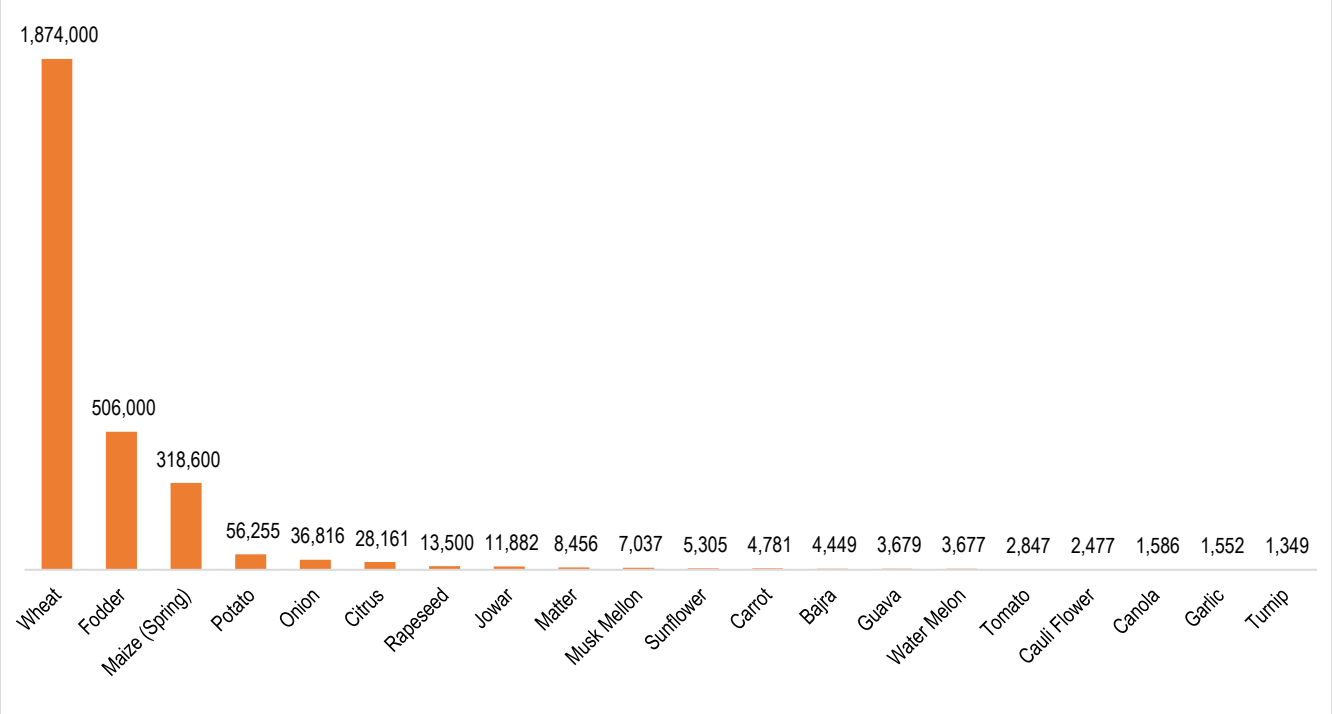


Figure 11: Current Cropping Pattern in Rabi
Source: Crop Reporting Service

Figure 9 below illustrates the current Kharif cropping pattern. This season, Cotton Fodder, Maize and Rice make significant contributions to the area's output. The Multan Division is only seeing an output of Rs.117,709 per acre in the Kharif season. This area has a total Kharif area of 2,561,390 acres, of which 601,924 acres remain unutilized.

To shift the cropping pattern towards higher value crops, it is essential to identify the agroecological conditions, the appropriate crops for the region, and the development of the value chain. The region has great agricultural potential that, however, has not been fully tapped. Plugging the gap in the existing supply chain of agricultural products with a specialized support system will help bridge this deficiency. Diversifying agriculture and addressing the barriers to production enhancement and increased profitability are essential steps to achieving the desired goals. By considering the agroecological conditions, certain crops have been proposed to effectively reach these set targets.

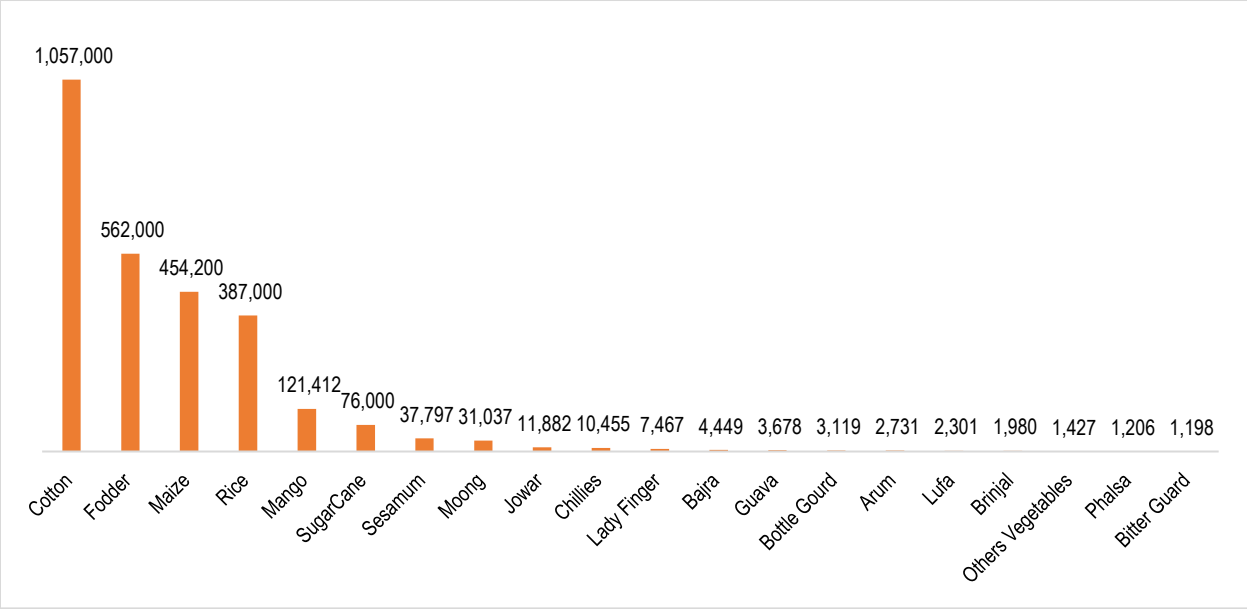


Figure 12: Current Cropping Pattern in Kharif
Source: Crop Reporting Service

1.15.3. TIME-SERIES ANALYSIS OF CROPS IN THE MULTAN DIVISION

It can be seen in the graph below that Cotton and Mango, which are prominent export-oriented crops in the region, have witnessed a continuous decrease in cultivation area. Over the years, cotton has experienced a consistent downward trend, while rice and maize have shown fluctuations. Sugarcane cultivation faced a decline followed by a slight recovery, whereas mango cultivation remained relatively stable in the Multan division during the analyzed period.

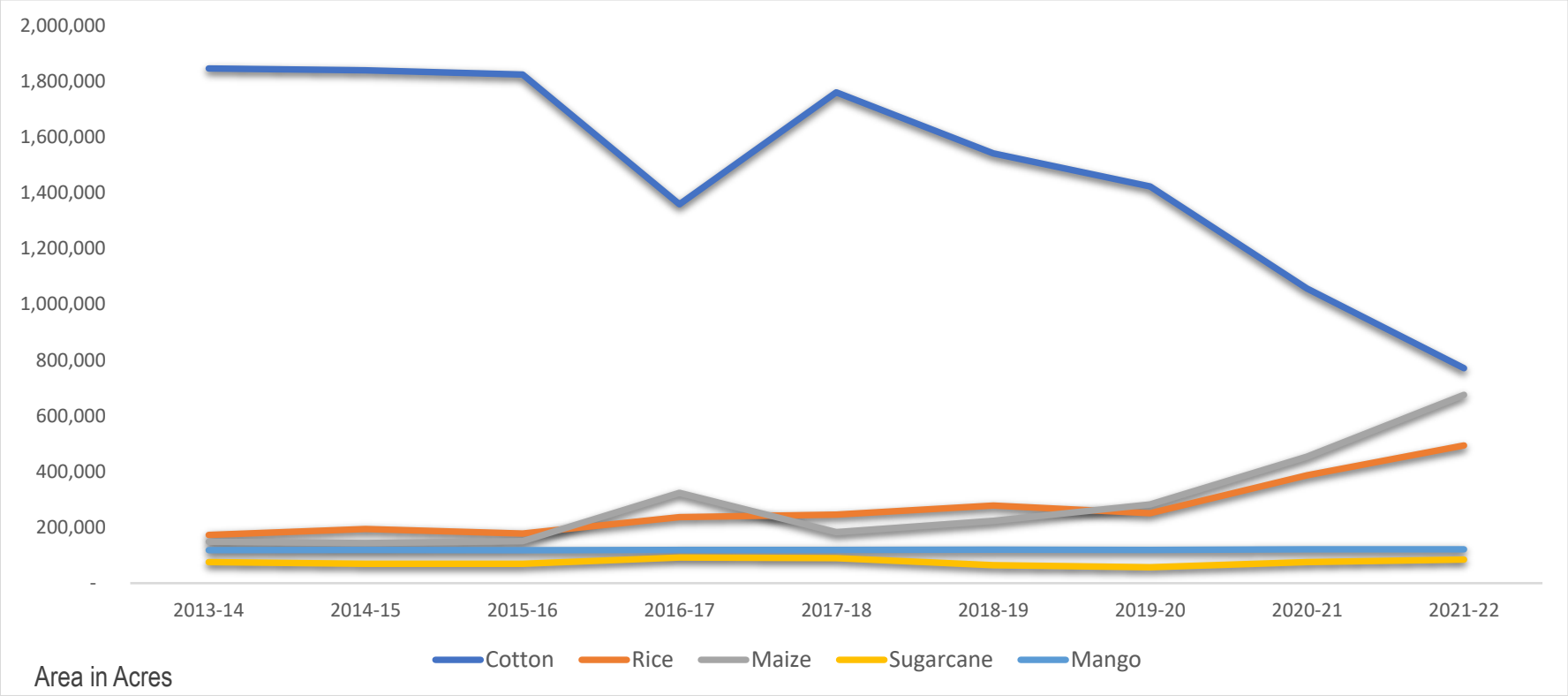
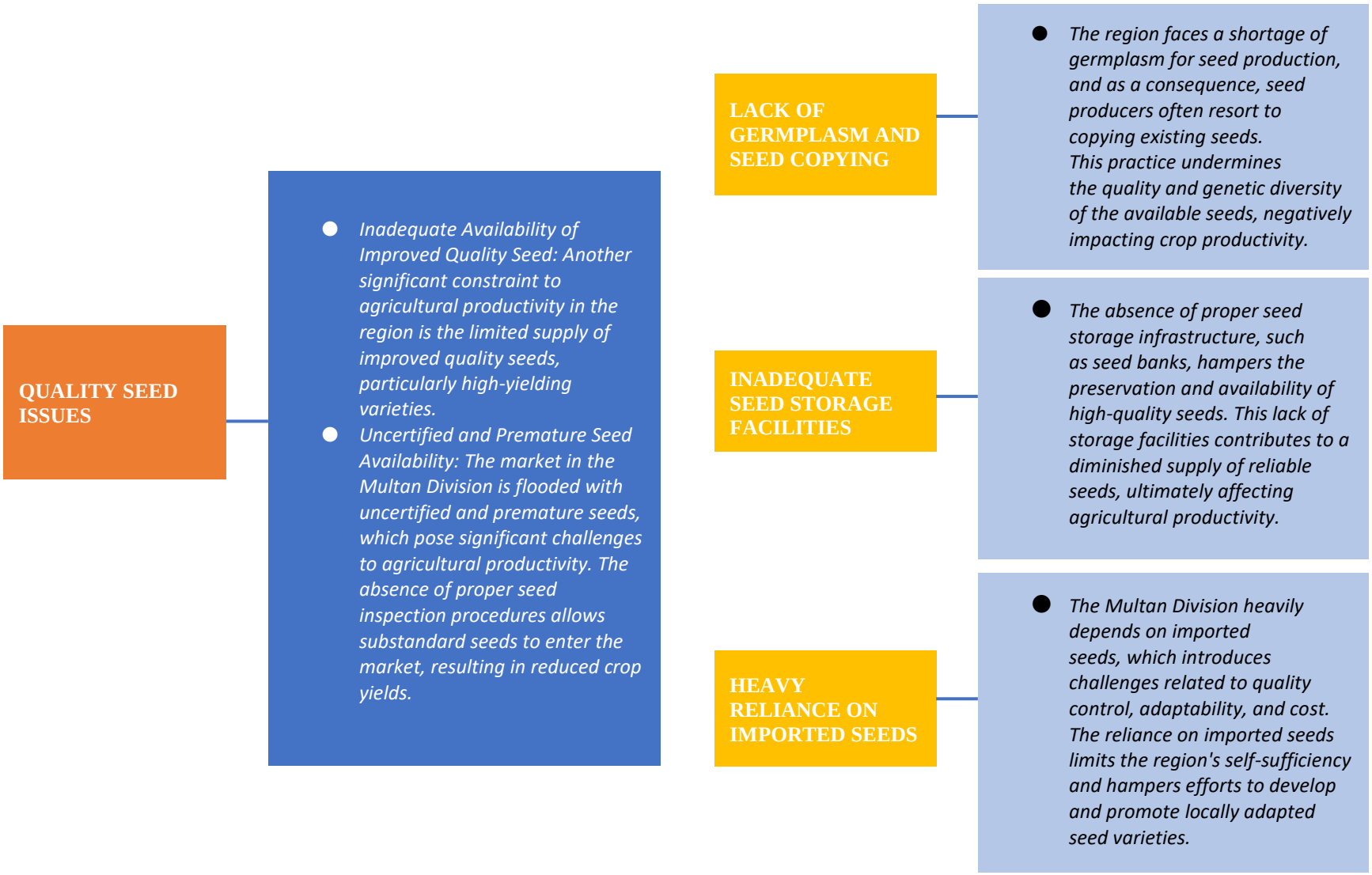


Figure 13: Time series Analysis of crops

Source: Crop Reporting Service

1.15.4. ISSUES AND CHALLENGES IN THE MULTAN DIVISION



SEED THEFT

- *The problem of seed theft is prevalent in the region, leading to the unauthorized and uncontrolled distribution of seeds. This illegal practice not only undermines the intellectual property rights of seed producers but also contributes to the availability of uncertified and low-quality seeds in the market, negatively impacting crop productivity.*

IMPACT OF PLANT DISEASES

- *Pests and plant diseases significantly impact crop yields in the Multan Division. Rice, wheat, cotton, and sugarcane crops are particularly susceptible to pest attacks. Inadequate use of quality pesticides, including improper dosage and timing, further contributes to reduced crop yields.*

LOW-QUALITY INPUTS

- *The region faces challenges related to the availability of low-quality inputs, which adversely affect agricultural productivity.*

HIGH PRICES AND NON-AVAILABILITY

- *Inputs required for farming, such as seeds and fertilizers, are either unavailable or obtained at exorbitant prices, creating obstacles for farmers.*

ABSENCE OF QUALITY INSPECTION AND PRICE CONTROL

- *There is a lack of mechanisms for inspecting the quality of inputs and controlling their prices, resulting in uncertainties and potential exploitation in the market.*

Soil Salinity: The salinization of soil is greatly undermining the land's productive potential, leading to lower crop yields in the region. In Pakistan, around 4.5 million hectares (Mha) of land are affected by salinization due to the presence of saline groundwater near the surface and irrigation with poor-quality tube well water.

Waterlogging: Waterlogging is another environmental issue that is reducing the productivity of the land.

Soil Fertility Depletion and Soil Erosion: Inefficient fertilizer use leads to low soil fertility, resulting in poor land productivity. Each harvest depletes more nutrients from the soil than are added due to the imbalanced use of fertilizers. No use of soil nutrients like Sulphur, zinc, boron, iron, or copper are seen in the entire Multan Division. Also, soil erosion is leading to significant soil nutrient depletion, reducing soil fertility and agricultural productivity in the Multan Division.

Climate Impact: Adverse weather conditions such as heavy rainfall, floods, heatwaves and droughts are negatively impacting agricultural productivity in all districts of the Multan Division. The huge Devastation of the Mango orchards is shown in the coming slides.

Unequal Distribution of Canal Water: Within the watercourses, disparities in canal water distribution, coupled with variations in outlet discharge, are resulting in low irrigation application efficiency, leading to significant reductions in crop yields.

Inappropriate Conjunctive Use of Canal and Groundwater: Direct utilization of saline-sodic tube well water without a proper soil, water, and crop management system in place is adversely affecting crop productivity in the region. Unfortunately, many farmers fail to adopt appropriate conjunctive use practices and utilize poor-quality groundwater for irrigation without considering proper soil, water, and crop management. This practice is leading to secondary salinization, resulting in diminished land productivity.

1.15.4.1. CONSTRAINTS OF TRADITIONAL AGRICULTURAL TECHNOLOGY ADOPTION IN THE MULTAN DIVISION

Limited Awareness and Poverty of Farmers

Farmers lack awareness about modern agricultural technology that can enhance land productivity. Additionally, poverty hinders their access to and adoption of modern technology. Small landholdings further impede the adoption of advanced practices in all districts of the Multan Division.

Insufficient Upscaling of Modern Agricultural Technologies

Despite the proven benefits of technologies like laser land leveling, zero tillage, and high-efficiency irrigation, their widespread adoption remains limited. Factors such as financial constraints, high costs, lack of access and timely availability, machinery limitations, small landholdings, lack of familiarity, inadequate guidance, and preference for traditional practices contribute to the slow adoption of new technologies, especially among small farmers. Farmers also lack comprehensive knowledge and training on selecting and utilizing modern agricultural technologies.

1.15.4.2. SOCIO-ECONOMIC CONSTRAINTS IN THE MULTAN DIVISION

1. Fragmented/Small Land Holdings: Due to population growth and land division, land holdings have become small, leading to inefficient and uneconomical land use. Small land holdings also hinder the adoption of modern agricultural technology.
2. Large Land Holdings: A significant portion of land is owned by big landlords in the Multan Division, with tenant farmers working on their lands. This arrangement often lacks incentives for tenant farmers to invest in capital and results in low agricultural productivity.
3. Lack of Access to Improved Inputs and Services: Small farmers, typically with 2 hectares of land, struggle to access credit facilities and improved quality inputs such as seeds, pesticides, and fertilizers. They also lack access to extension services, limiting their crop productivity.
4. Illiteracy and Poverty: The illiteracy and poverty of farmers contribute to low agricultural productivity. The lack of education and training hinders their ability to adopt high-productivity farming practices.

1.15.4.3. INSTITUTIONAL CONSTRAINTS IN THE MULTAN DIVISION

I. Insufficient Institutional Seed Production Capacity: Public sector seed production institutes in the Multan division face limitations in seed production capacity due to financial, human resource, and infrastructural challenges.

II. Inadequate Agricultural Research and Extension: The pace of technological advancement in agricultural yields per hectare has been slow in recent decades, compared to the 1960s and 1970s. Research institutes have not effectively contributed to developing new varieties or improving water utilization practices. Lack of coordination between research and extension organizations hinders the dissemination of improved inputs, technologies, and practices to farmers, who continue to rely on inefficient traditional methods.

III. Absence of Specialized Extension Services: There is a lack of dedicated extension services specifically tailored for agriculture in the region. Farmers do not have access to specialized guidance and support to enhance their agricultural practices.

IV. Overburdened Extension Workers: Extension workers often have additional duties that divert their focus from their primary responsibilities. This overburdening prevents them from carrying out their core duties effectively, impacting the delivery of crucial agricultural information and assistance.

V. Ineffectiveness of Agricultural Education and Training: Insufficient education and training opportunities for farmers result in low agricultural productivity. Inactive and ineffective agriculture extension services fail to provide guidance on modern and improved agriculture practices, irrigation management, and soil health strategies. Farmers lack training on innovative techniques and strategies for enhancing land productivity, and the transfer of knowledge from progressive farmers to others is limited.

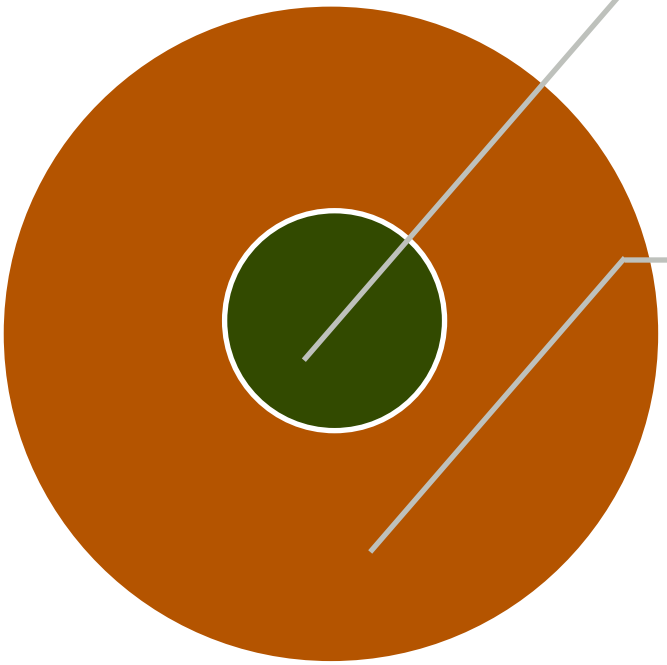
VI. Inadequate Credit Facilities: Limited access to loans, high-interest rates, and untimely availability of credit negatively impact crop productivity. The lack of dependable credit options prevents farmers, especially those with low incomes, from purchasing quality agricultural inputs, leading to lower crop yields.

VII. Insufficient Capacity Building: There is a lack of initiatives for capacity building within agricultural institutions. The absence of training and skill development programs prevents extension workers from gaining the necessary knowledge and expertise to provide up-to-date and internationally relevant guidance.

VIII. Lack of Promotion and Monitoring: Extension workers often face limited opportunities for professional growth, with outdated promotion systems in place. Moreover, there is a lack of effective monitoring mechanisms to assess the performance and impact of extension services.

IX. Lack of Integration among Departments: The coordination and integration among different agricultural departments are insufficient. This lack of collaboration hinders the seamless flow of information, resources, and services required for agricultural development in the Multan Division.

1.15.4.4. POLICY CONSTRAINTS IN THE MULTAN DIVISION



Lack of Policy Integration: There is a lack of integration between policies and the specific needs of the agriculture sector in the region. This results in a mismatch between policy objectives and their effective implementation.

Non-Implementation of Targets and Goals: Despite the presence of targets and goals in agricultural policies, their implementation is often inadequate. This leads to a failure to address critical issues, such as the negative impact of subsidies on cotton production due to preferential support for sugarcane and rice.

1.15.5. PRODUCTIVITY COMPARISION OF AGRICULTURE SECTOR

Agriculture is the foundation of the Punjab economy. Moreover, the agricultural sector's growth has been hampered by shrinking arable land, climate change, water scarcity, and a large-scale population and labour shift from rural to urban areas. The rising cost of inputs such as fertilisers, pesticides, and seeds is yet another point of concern for crops. Early-generation seeds are rare and expensive, and preliminary research to develop new varieties resistant to pests, diseases, and climatic pressures is inadequate.

Figure 1 compares yields of some important crops in the Multan region to progressive farmers and international best yields. Despite advances, a significant productivity gap has been observed in all crops when compared to the global average. It has also been observed that the gap between progressive farmers in Punjab and Punjab average farmers is very large, indicating potential otherwise.

This reflects the goal of increased agricultural productivity, which could be achieved throughout the Multan Division by investing heavily in agricultural research and extension systems, accelerating the diffusion and adoption of the latest agricultural and irrigation technologies, and improving inputs use, irrigation water management, reclamation, and drainage to increase productivity in the proposed crops.

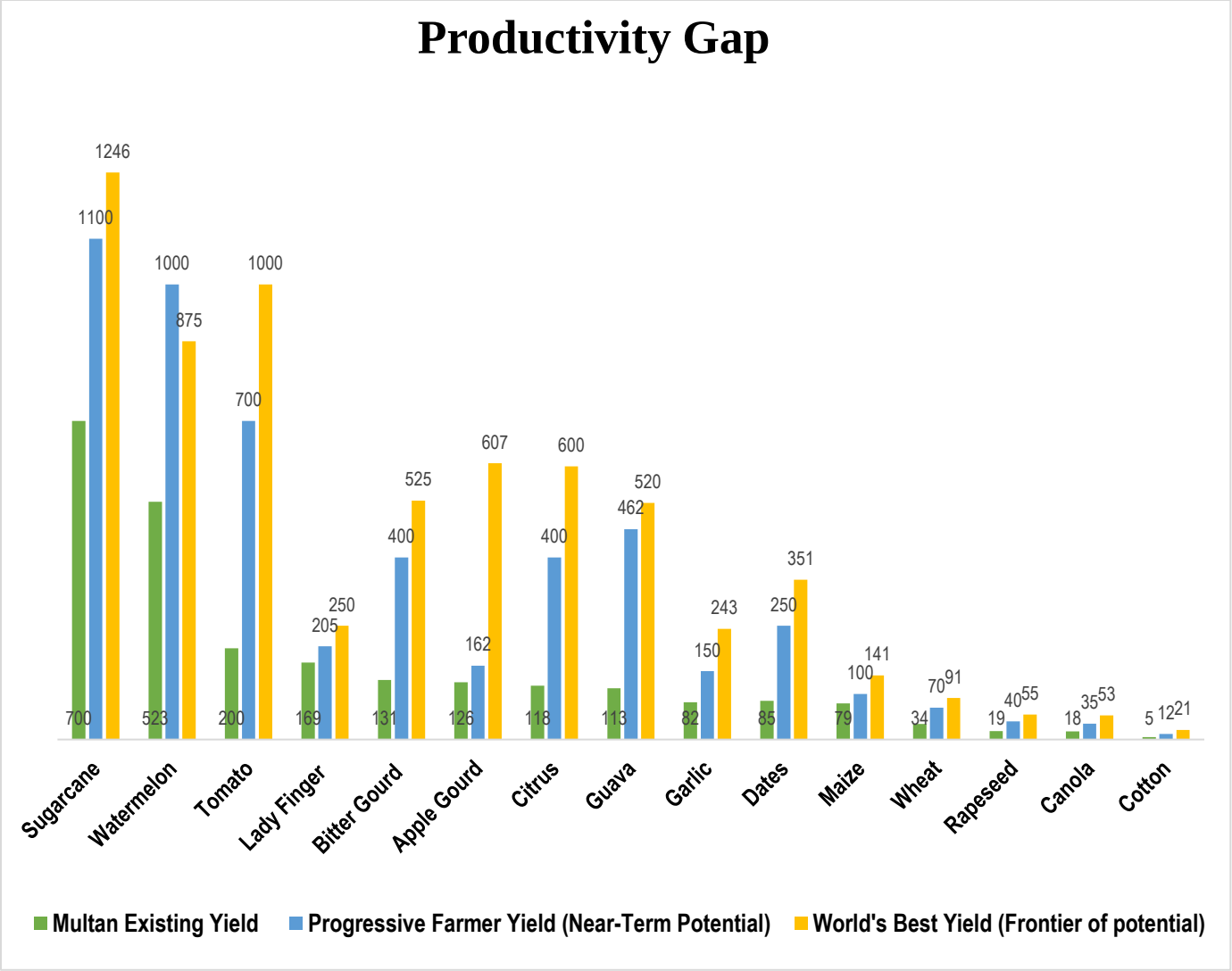


Figure 14: Yield Comparisons (Mund/Acre)

Source: FAO and Crop Reporting Service

1.15.6. INEFFICIENT WATER MANAGEMENT & POOR GROUNDWATER SUITABILITY

The region is grappling with a severe problem of water scarcity, a challenge that has far-reaching consequences. The scarcity of water has a significant impact on the growth and development of vital crops such as cotton and mangoes. Unfortunately, the timely supply of water remains unavailable, leading to negative repercussions for agricultural practices. One disheartening fact is that approximately 50% of the groundwater in the area is deemed unfit for use, exacerbating the crisis further.

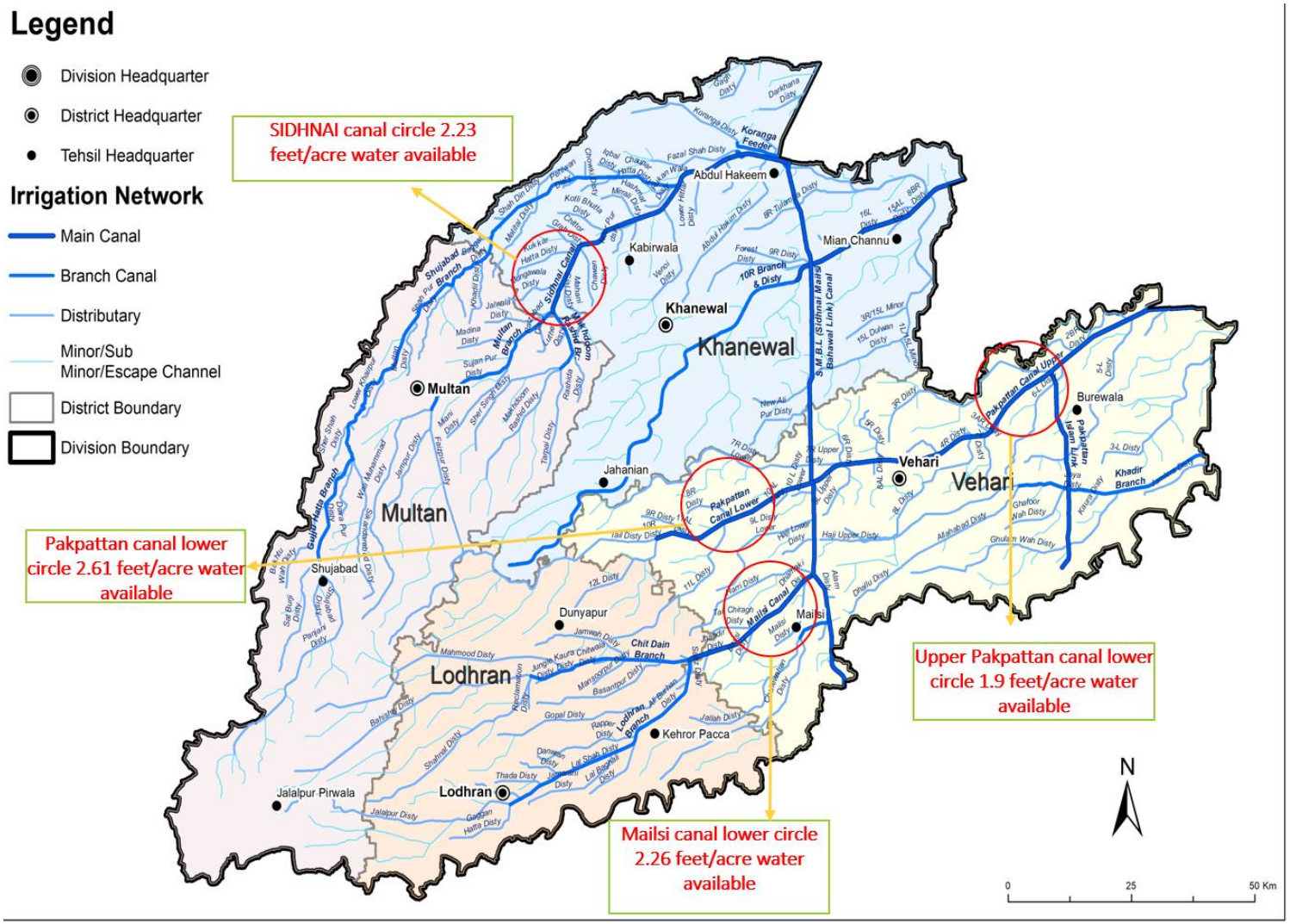
Among those affected, the farmers located at the tail end of the irrigation systems bear the brunt of this issue. They find themselves particularly vulnerable to the detrimental effects of insufficient water supply. Shockingly, nearly 70% of farmers receive water allocations that fall short of the designated amount. To compound matters, the current groundwater depth stands at a worrisome 145 feet.

Taking a closer look at the situation in Multan division, it becomes evident that the available water for agricultural purposes is lower compared to the average for Punjab. Specifically, the division receives 2.25 feet/acre of water, which falls below the Punjab average of 2.5 feet/acre. To manage the water resources, the division is divided into four canal systems: the Upper Pakpattan Canal System, the Lower Pakpattan Canal System, the Mailsi Canal System, and the Sidhnai Canal System.

The Upper Pakpattan Canal System, within the Multan division, offers a water supply of 1.9 feet/acre in its lower circle. In the Lower Pakpattan Canal System, farmers have access to 2.61 feet/acre of water in its lower circle. The Mailsi Canal System, another component of the division, provides a water supply of 2.26 feet/acre in its lower circle. Lastly, the Sidhnai Canal System contributes 2.23 feet/acre of water in its designated circle.

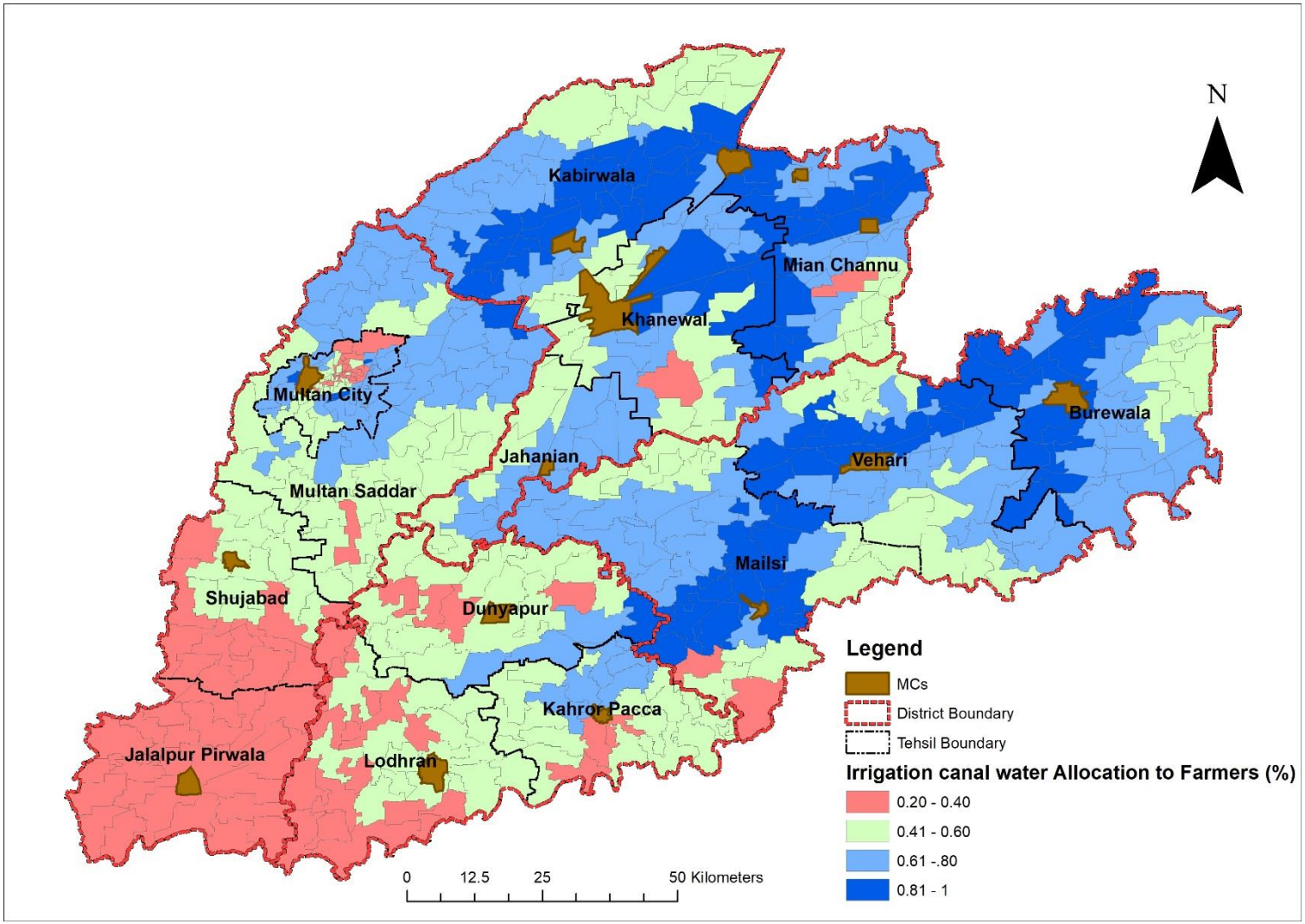
Therefore, as a result, the region faces a severe water scarcity problem that has far-reaching implications. The shortage of water negatively affects crucial crops like cotton and mangoes, while timely water supply remains a persistent issue. Farmers located at the tail end of irrigation systems

suffer the most, receiving lower water allocations than designated. The situation in Multan division is particularly concerning, with the average available water falling below the Punjab average. The division's canal systems play a vital role in distributing water resources to farmers, albeit with varying amounts in each system.



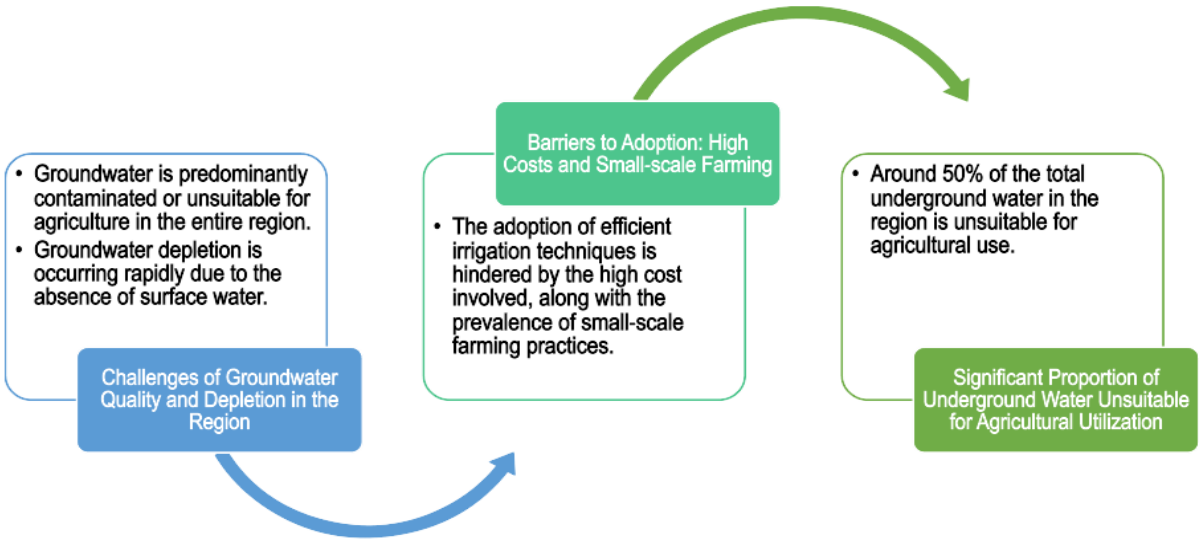
Map 1: Irrigation Network

Source: Punjab Irrigation Department/ Urban Unit



Map 2: Irrigation Canal Water Allocation to Farmers

Source: Urban Unit

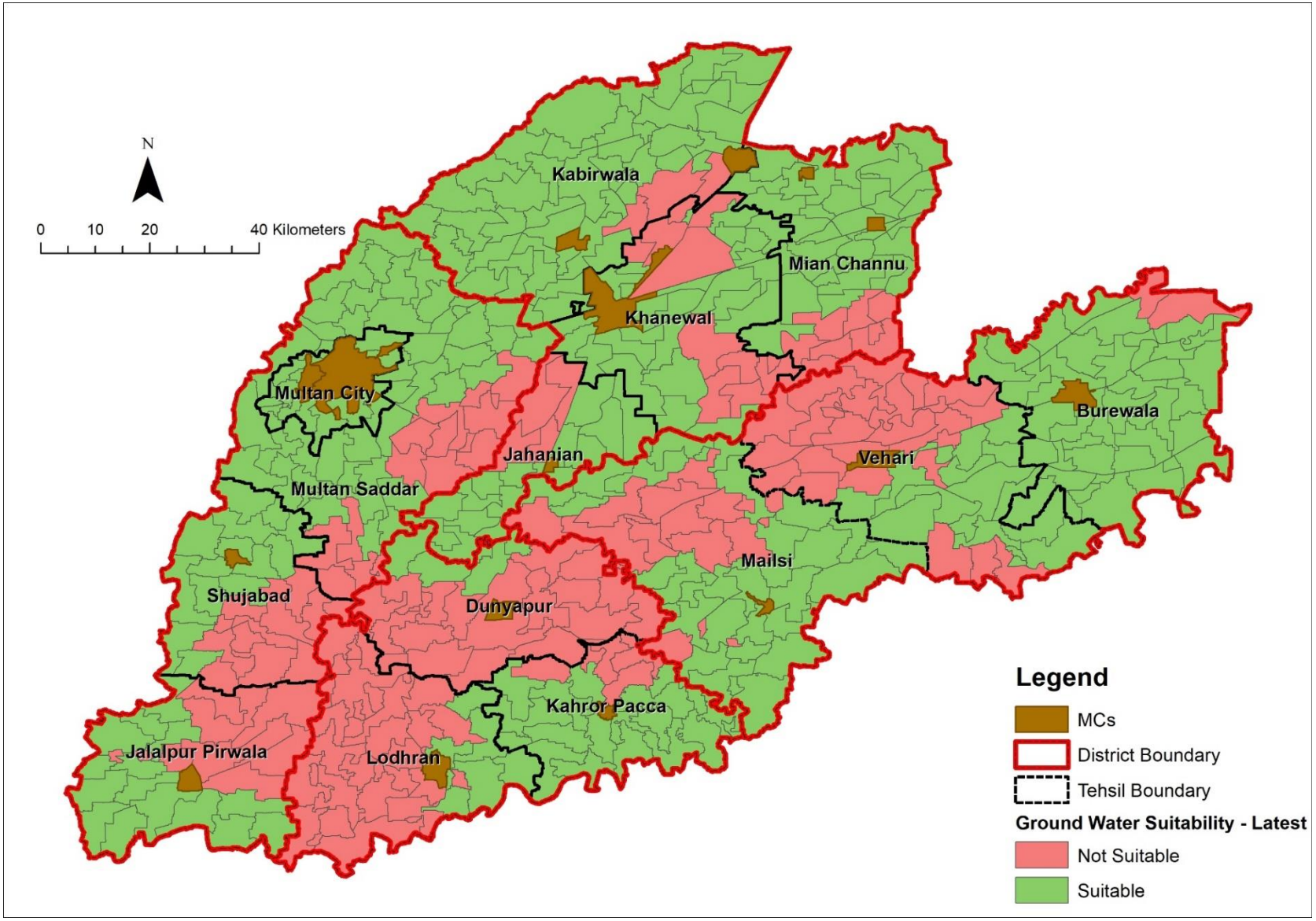


The groundwater suitability for crops in the Multan Division has experienced a decline over the years as shown in the table below. In 2010, the average suitability was measured at 63%, but it has since dropped to 50% currently. This indicates a decrease in the overall quality and suitability of groundwater for agricultural purposes in the region.

Table 2: District-wise Groundwater Suitability Comparison

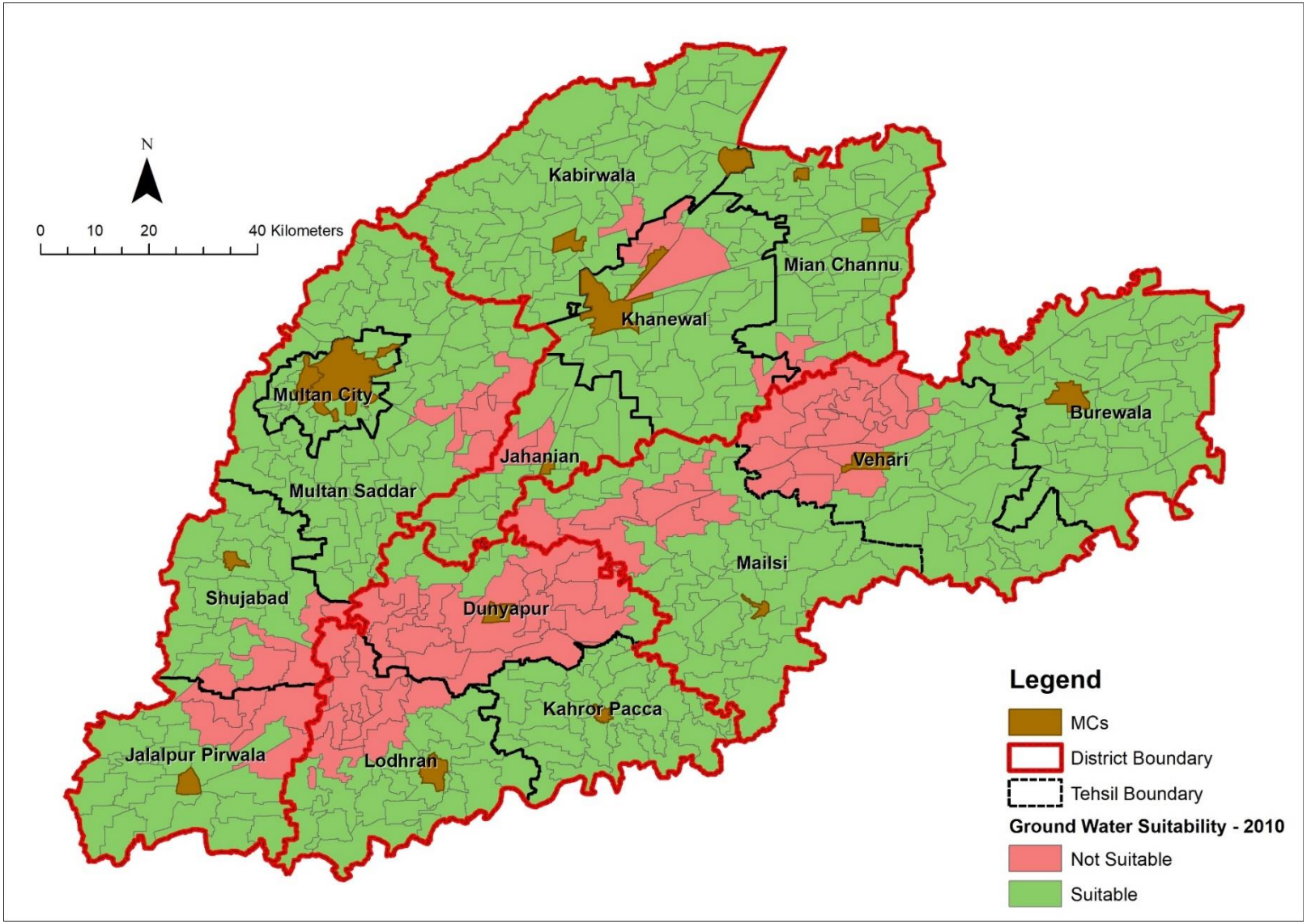
Districts	Groundwater suitability for crops in present time: 1-Yes, 2-No	Groundwater suitability (2010) for crops: 1-Yes, 2-No
Multan	55%	70%
Khanewal	60%	65%
Lodhran	40%	50%
Vehari	45%	65%
Total	50%	63%

Source: Urban Unit



Map 3: Groundwater Suitability in Present Time

Source: Urban Unit



Map 4: Groundwater Suitability in 2010

Source: Urban Unit

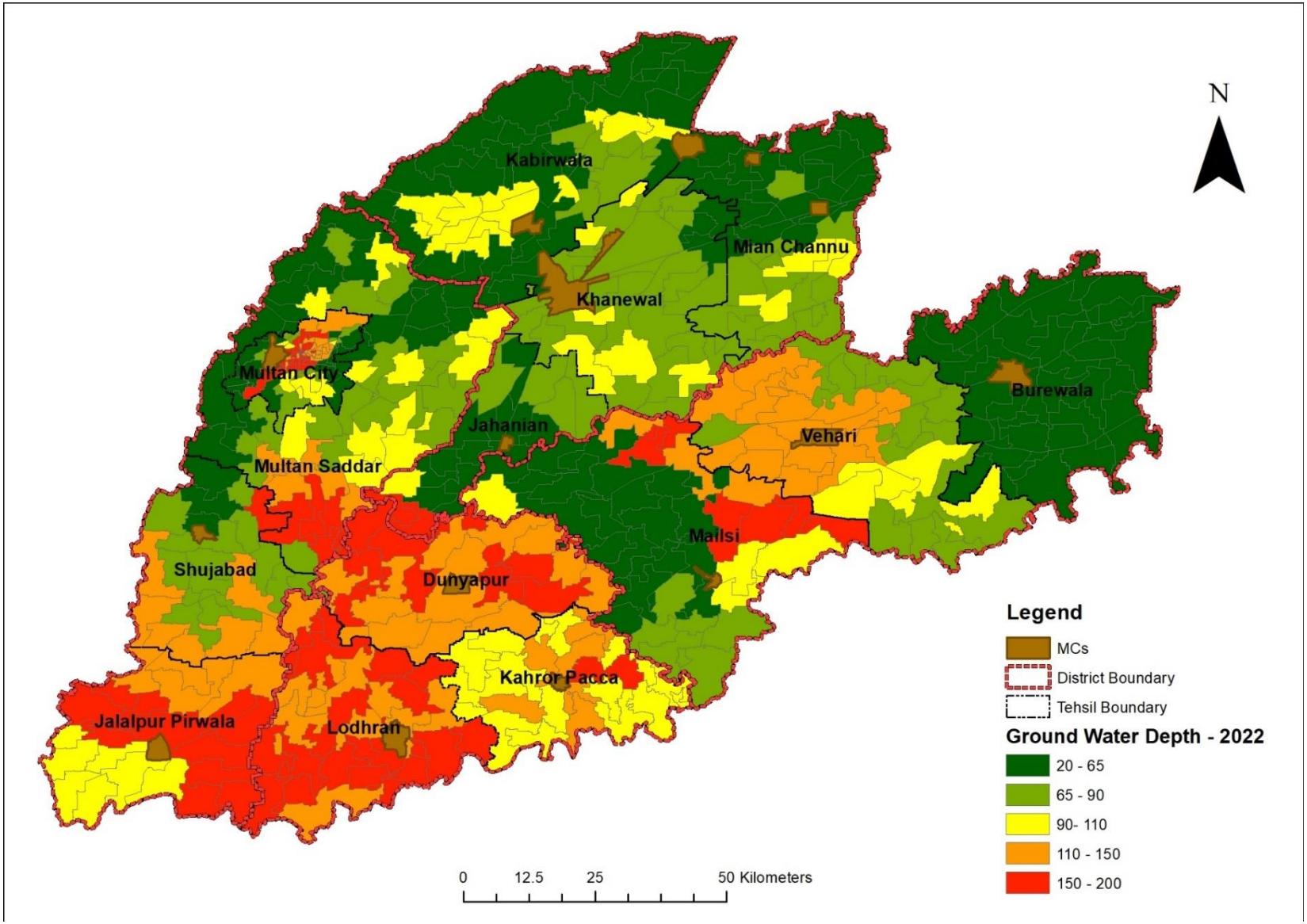
The groundwater depth in Multan Division reveals an overall decrease in water levels across the districts, with the current depths ranging from 145 to 235 feet. Based on this information, it is moderately concerning for agricultural use due to the rise in groundwater depth, indicating potential challenges for irrigation and water accessibility.

Table 3: District-wise Groundwater Depth Comparison

Districts	Ground Water dept (ft) in 2010	Ground Water dept (ft) in present time
Multan	120	150
Khanewal	70	90
Lodhran	190	235
Vehari	77	110
Total	115	145

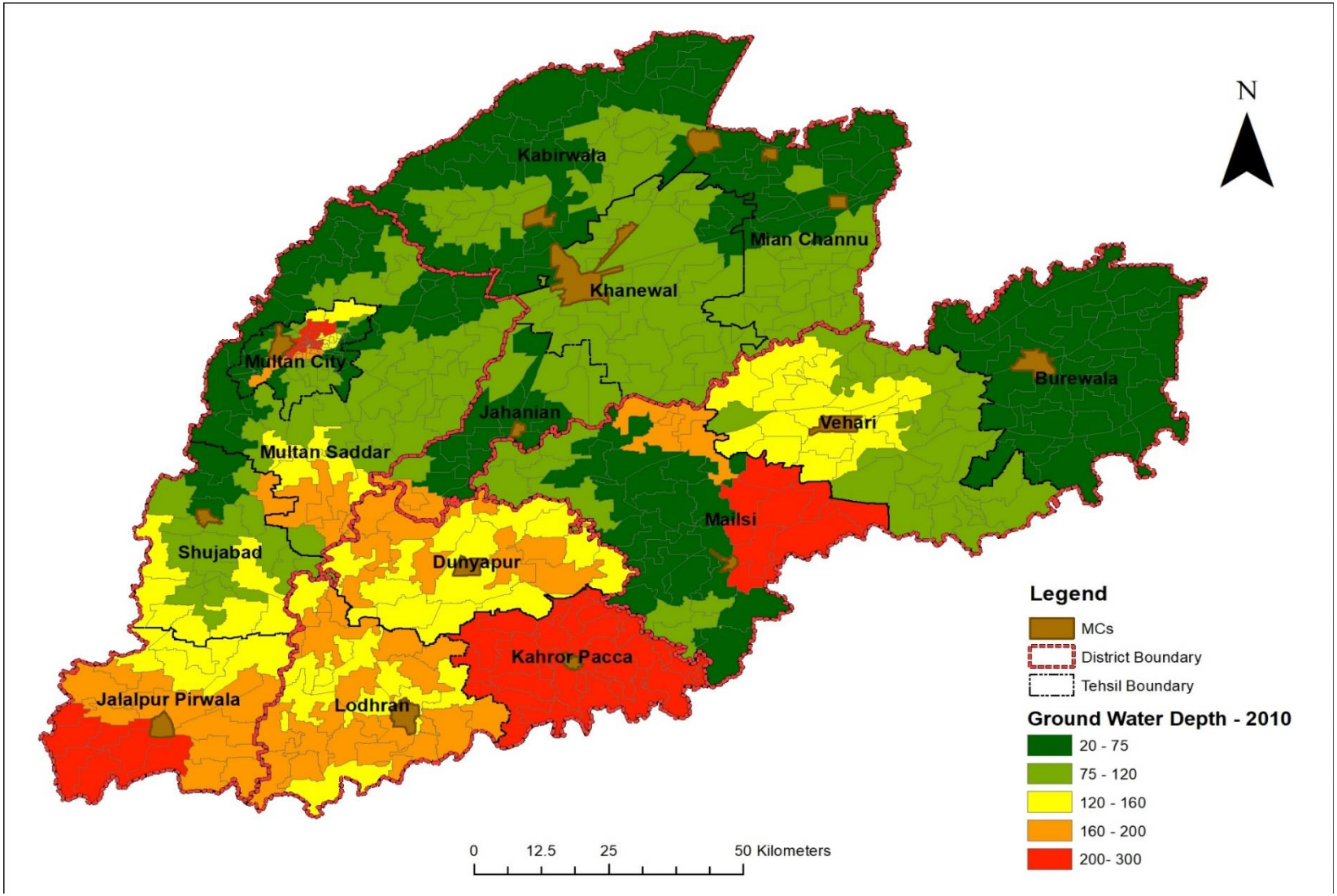
Source: Urban Unit

The maps presented illustrates the existing and 2010 levels of groundwater depths within the Multan division It can be seen, there has been a distressing deterioration in water depths, particularly in the Lodhran, Jalalpur Pirwala, Dunyapur, Kahror Pacca, Multan, and Mailsi tehsils. This concerning trend raises serious apprehensions about the state of the groundwater resources in the region.



Map 5: Groundwater Depth in Present Time

Source: Urban Unit



Map 6: Groundwater Depth in 2010

Source: **Urban Unit**

1.15.7. POOR FARM MECHANIZATION

The Multan division faces additional challenges in the realm of agricultural machinery. The availability of machinery tailored to meet the needs of traditional crops is quite limited, with a predominant reliance on older models that have been in use for years. This situation presents a hurdle for farmers as they strive to optimize their farming practices and improve productivity.

One specific concern is the lack of machinery specifically designed for crops such as cotton, mangoes, maize, vegetables, and fruits. These crops have unique requirements and demand specialized equipment for efficient cultivation and harvesting. Unfortunately, the absence of machinery tailored to these specific crops poses a significant obstacle for small farmers operating in these sectors.

To overcome this limitation, there arises a pressing need to develop and introduce machinery that is suitable for the requirements of small-scale farmers engaged in cultivating cotton, mangoes, maize, vegetables, and fruits. By designing and manufacturing machinery that aligns with the needs of these crops, farmers can enhance their productivity, streamline their operations, and ultimately improve their economic outcomes.

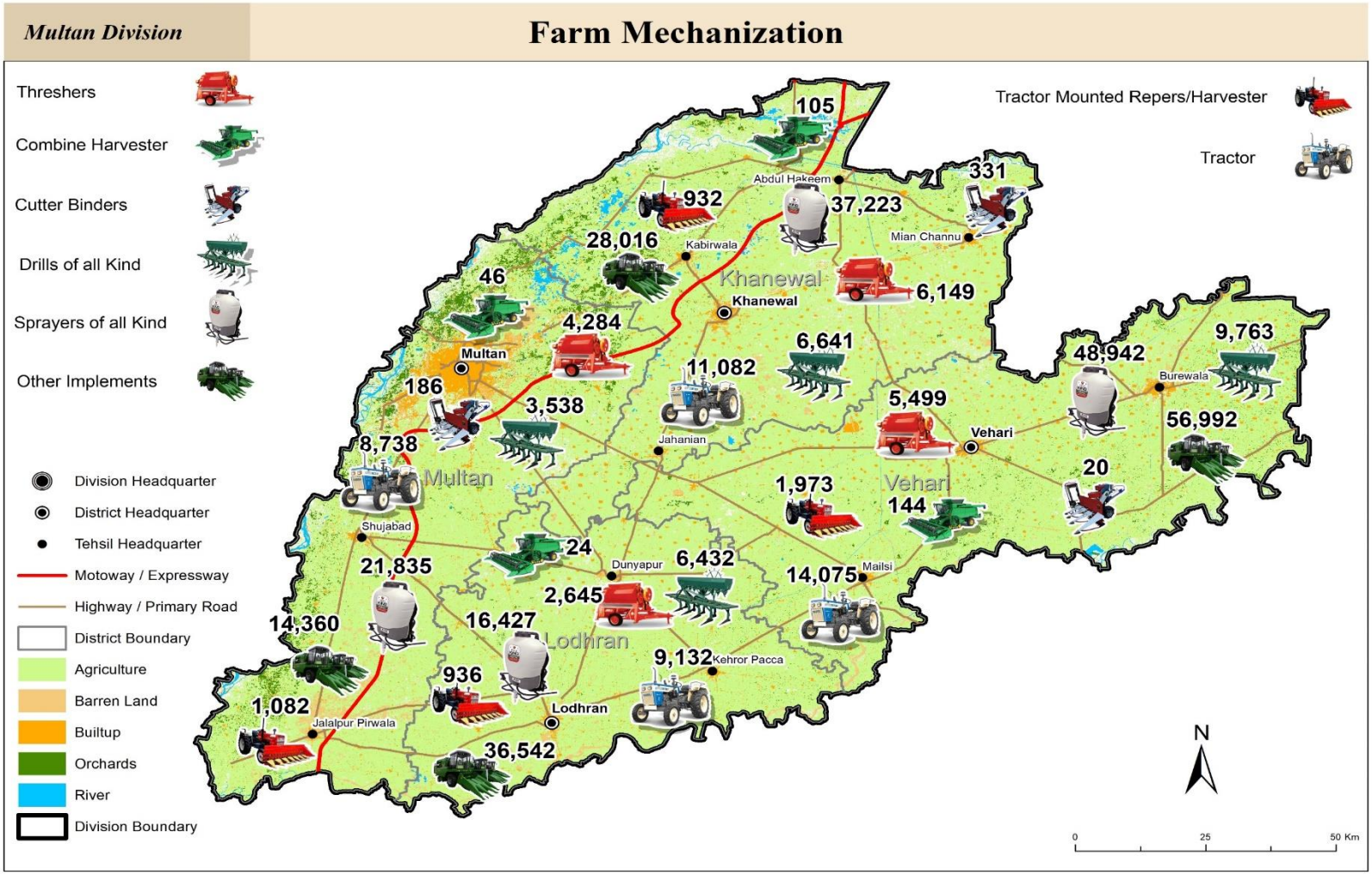
Investing in research and development efforts to create machinery that addresses the specific challenges faced by small farmers in the Multan division is of paramount importance. Collaborative initiatives involving agricultural experts, engineers, and farmers themselves can contribute to the development of innovative machinery solutions that cater to the diverse needs of these crops.

Moreover, it is essential to ensure that the newly developed machinery is not only efficient but also affordable for small farmers. Cost-effective solutions can empower farmers to adopt modern machinery and capitalize on its benefits, thus unlocking their full potential and fostering sustainable agricultural practices in the region.

Figure 15: Problems of Poor Farm Mechanization in The Multan Region

Source: Urban Unit

1.15.7.1. MAPPING OF AVAILABLE MECHANIZATION IN THE MULTAN DIVISON



Map 7: Poor Farm Mechanization

Source: Punjab Development Statistics (2019)/ Urban Uni

1.15.7.2. MECHANIZATION GAP IN PUNJAB

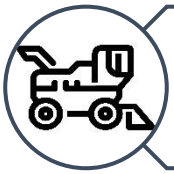
Table 1 describes in detail the mechanization gap in Punjab in comparison to Indian Punjab. According to the existing implements coverage, the chisel plough, rotavator, and disc harrow have a very low share in Punjab when compared to Indian Punjab. To close the mechanization gap in Punjab, smart tools and service centers must be deployed in each crop zone to promote mechanization. This also implies that extension services are inadequate and that many farmers are unaware of modern methods such as agrochemicals, crop varieties, and fertilizer use.

Table 4: Mechanization Gap in Punjab

Implement	Applicability	Punjab (Per 10,000 acres)	Indian Punjab (Per 10,000 acres)	Existing Coverage As % of Indian Punjab
Tractors	All Crops	***140***	***295***	***47%***
Chisel Plow	Cotton Sugarcane	***2***	***28***	***8%***
Cultivator	All Crops	***102***	***224***	***46%***
Disc Harrow	All Crops	***5***	***118***	***4%***
Rotavator	All Crops	***14***	***155***	***9%***
Seed Drill	Wheat	***21***	***124***	***17%***
Ridgercum Fertilizer	Sugarcane Cotton	***22***	***56***	***38%***

Source: Punjab Development Statistics (2019)

1.15.7.3. AVAILABILITY OF MACHINERY



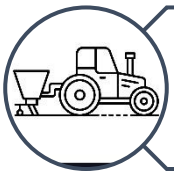
Threshers: There is a relatively low ratio of farmers to threshers, with 31 farmers sharing a single thresher. This indicates limited availability and potentially slower processing of harvested crops.

Self-Propelled Combine Harvester: The ratio of farmers to self-propelled combine harvesters is higher compared to threshers, with 2,702 farmers per machine. This suggests a relatively better availability of this advanced machinery for harvesting purposes.

Tractor Mounted Reapers/Harvester: The ratio of farmers to tractor-mounted reapers/harvesters is 103 farmers per machine. While the availability is better than threshers, it is still relatively limited, indicating potential challenges in harvesting efficiency.

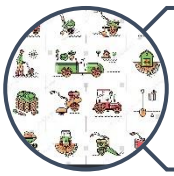
Cutter Binders: With a ratio of 3,252 farmers per machine, the availability of cutter binders seems to be higher compared to other machinery types. This indicates a relatively better provision of equipment for cutting and binding harvested crops.

Sprayers of all Kind: The ratio of farmers to sprayers is 12 farmers per machine. This suggests a relatively low availability of sprayers, which could impact the ability to effectively apply pesticides or fertilizers.



Drills of all Kind: The ratio of farmers to drills is 47 farmers per machine. While not as low as sprayers, the availability of drills for seeding or planting purposes appears to be limited.

Tractor: The ratio of farmers to tractors is 17 farmers per machine. While the availability seems better compared to some other machinery types, it still suggests that access to tractors might be limited for a significant portion of farmers.



Other Implements: The category of "Other Implements" has a ratio of 10 farmers per machine. It encompasses various agricultural implements, indicating a relatively limited availability across different types of equipment.

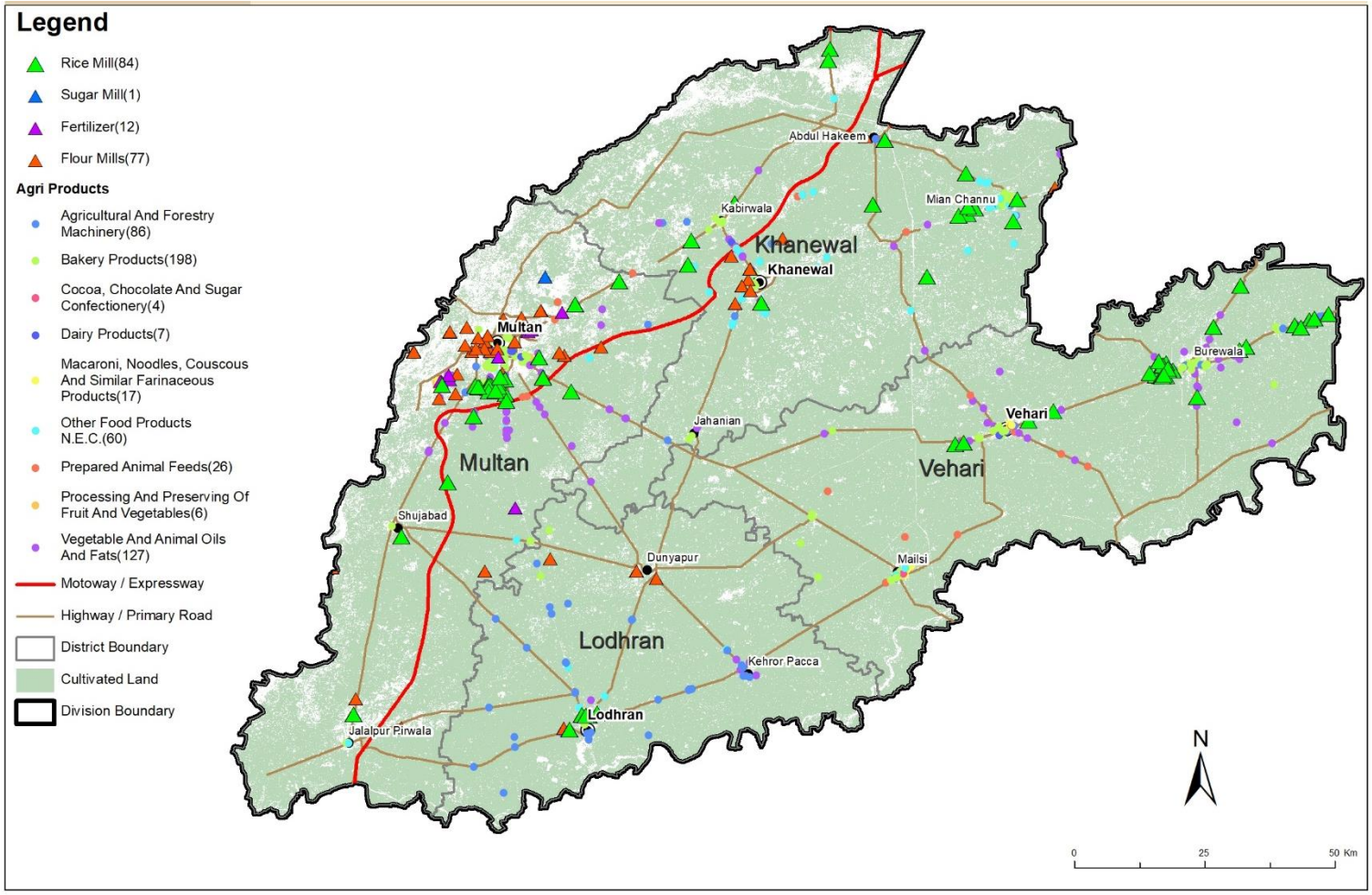
Table 5: Availability of Machinery in Multan Division

Agriculture Machinery	(Farmers/ Machine)	Acres / Machine
Threshers	***31***	***225***
Self-Propelled Combine Harvester	***2,702***	***19,531***
Tractor Mounted Reapers/Harvester	***103***	***748***
Cutter Binders	***3,252***	***23,509***
Sprayers of all Kind	***12***	***88***
Drills of all Kind	***47***	***339***
Other Implements	***10***	***69***
Tractor	***17***	***125***

Source: **Punjab Development Statistics (2019)**

1.15.8. LOW-VALUE ADDITION & EXISTENCE OF TRADITIONAL AGRO-BASED INDUSTRY

Map 3 shows the spatial distribution of rice, sugar, fertilizer, and flour mills in the Multan region. There exist certain challenges in the agricultural and food processing sectors in the Multan division. Firstly, there is a low-value addition in agricultural produce, especially in high-value crops. This indicates a need to enhance value-added activities and processes to increase the economic potential of the region's agricultural output. Additionally, the absence of agro-industrial units in potential crop zones hinders the development and growth of the agricultural sector. Moreover, the lack of processing industries for fruits and vegetables further exacerbates the limited value addition in these crops. This highlights the importance of establishing processing facilities to unlock the full potential of the region's agricultural resources and promote economic growth. In terms of food mills, there is a significant presence of rice mills, indicating the prominence of rice production in the region. However, there is a scarcity of sugar mills, with only one listed, and a moderate number of flour mills. On the basis of the above findings, these conclusions underscore the need for strategic investments and infrastructure development to strengthen the agro-industrial landscape and maximize the value and potential of agricultural production in the Multan division.. The availability of district-wise agro-based industries in the region is shown in the map below.



Map 8: Agro-Industry in Multan Division

Source: Urban Unit

1.15.9. PREVIEW OF AGRICULTURAL MARKETS

Map 4 reveals a discrepancy in market compatibility for fruits, vegetables, and grains in the Multan division. The availability of stockists for fruits and vegetables is relatively low, with only 8 stockists recorded. Additionally, there is a solitary stockist dedicated solely to vegetables. In contrast, the number of stockists for grain markets is higher, with 10 recorded. This mismatch indicates a need to enhance the variety of vegetables cultivated and marketed in the region. To address this issue, it is recommended to provide technical guidance and financial aid to individuals interested in establishing vegetable stockist enterprises. Moreover, proposing the development of model markets and state-of-the-art storage facilities would contribute to improving the overall agricultural infrastructure in the region. By addressing these gaps, the Multan division can foster a more balanced and diversified agricultural market.

Map 9: Markets in Multan Division

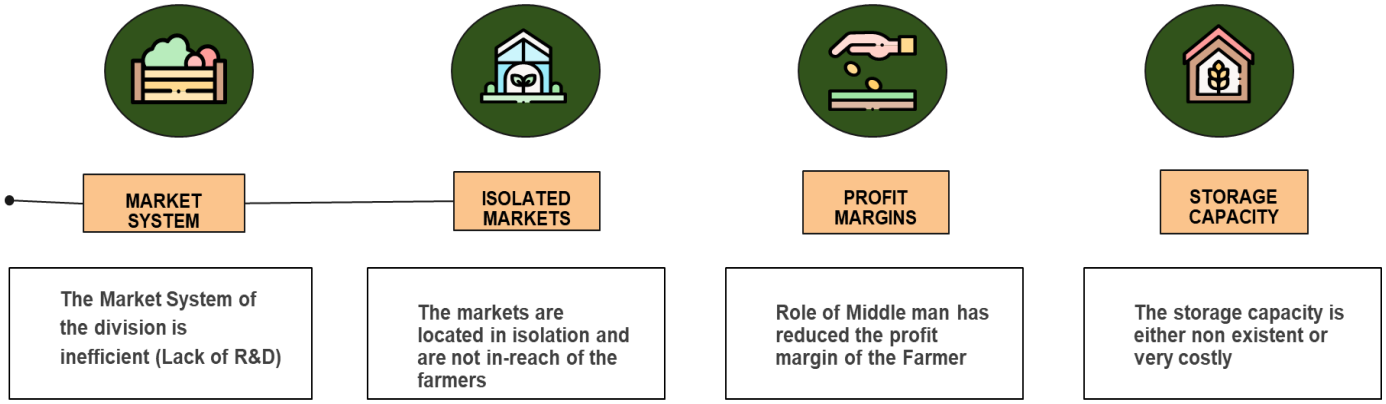
Source: Urban Unit

1.15.9.1. REASONS FOR INEFFICIENT AGRICULTURAL MARKETS

Table 3 shows that there is no proper storage capacity in markets and the existing storage capacity is costly. The onion crop prices are shown below as an example to show the inefficient market behavior in the Multan region. The markets are located in isolation and are not in-reach of the farmers. The Role of Middle man has reduced the profit margin of the Farmer, such as shown in the following table:

Table 6: Difference Between Farmgate, Retail & Wholesale Prices of Essential Food Commodities

Commodity	Farm gate price (PKR/kg)	Wholesale Market (PKR/kg)	Retail Price (PKR/kg)
Onion	15-25	50-80	70-130



The lack of adequate storage capacity in markets, particularly for perishable commodities, contributes to a prevailing inefficiency. The existing storage facilities are either insufficient or prohibitively expensive, posing significant challenges for preserving perishable goods.

1.15.10. THE AGRICULTURAL VULNERABILITY TO CLIMATE CHANGE

The article by Nadeem et al., (2022) examines the agricultural vulnerability to climate change across districts in Punjab province and identifies the significance of adaptive capacity in mediating district-level vulnerabilities. The findings highlight the need for policies that prioritize building adaptive capacity in vulnerable regions of Punjab and suggest that a one-size-fits-all adaptation policy that does not account for local variations in the causes of vulnerability is unlikely to be effective. The study employs a livelihoods approach and statistical associations to identify factors that shape adaptive capacity, such as human, financial, and social capital, and underscores the importance of effective government policies in supporting such factors. To inform top-down policy initiatives, there is a need to integrate climate change policies with general economic and social development policies in Punjab, with a focus on socio-economic aspects that account for place-based biophysical features and local-scale information.

1.15.10.1. VULNERABILITY INDEX OF AGRICULTURE IN THE MULTAN DIVISION

The assessment of the vulnerability of agriculture includes the following variables in the respective dimension in the Multan division:

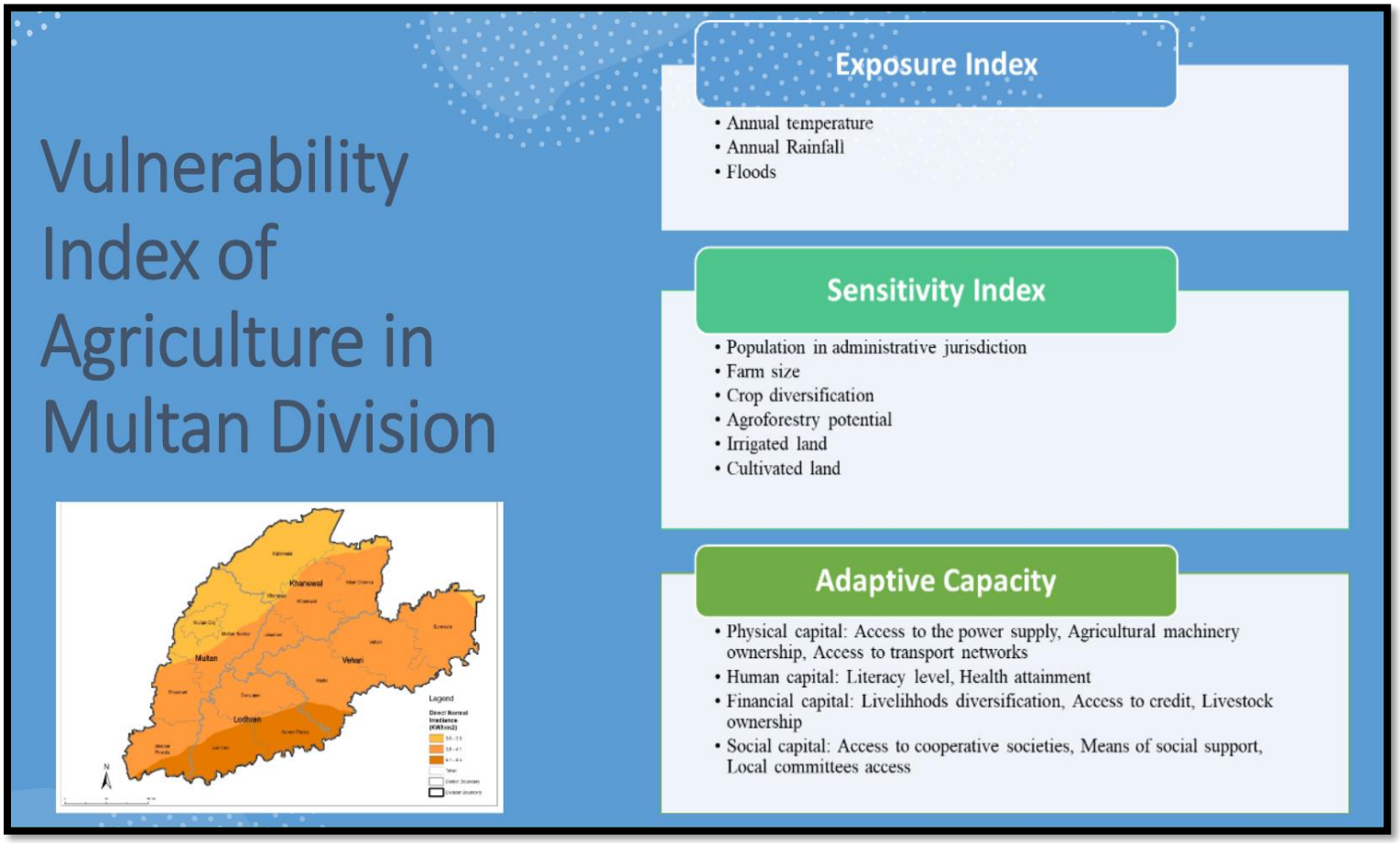


Table 7: Assessing the Vulnerability of Agriculture in Multan Division

Indicators	Multan	Lodhran	Khanewal	Vehari
Exposure Index	(0.40 - 0.59) Moderate Exposure	(0.60 - 0.79) High Exposure	(0.40 - 0.59) Moderate Exposure	(0.20 - 0.39) Low Exposure
Sensitivity Index	(0.40 - 0.59) Moderate Sensitivity	(0.20 - 0.39) Low Sensitivity	(0.40 - 0.59) Moderate Sensitivity	(0.40 - 0.59) Moderate Sensitivity
Adaptive Capacity Index	(0.20 - 0.39) Low adaptive capacity	(0.00 - 0.19) Very Low Adaptive capacity	(0.20 - 0.39) Low adaptive capacity	(0.20 - 0.39) Low adaptive capacity
Vulnerability index	(0.40 - 0.59) Moderate Vulnerability	(0.60 - 0.79) High vulnerability	(0.40 - 0.59) Moderate Vulnerability	(0.40 - 0.59) Moderate vulnerability

Source: (Nadeem et al., 2022)

1.15.10.2. Building Climate Resilience in Agriculture: Sustainable Practices and Technology Adoption in Multan Division

To mitigate the impacts of climate change in the Multan division, it will be important to adopt sustainable agricultural practices and promote the use of technologies that can help farmers to adapt to changing conditions. This may include implementing water-saving irrigation systems, using drought-tolerant crop varieties, and investing in soil conservation and management practices.

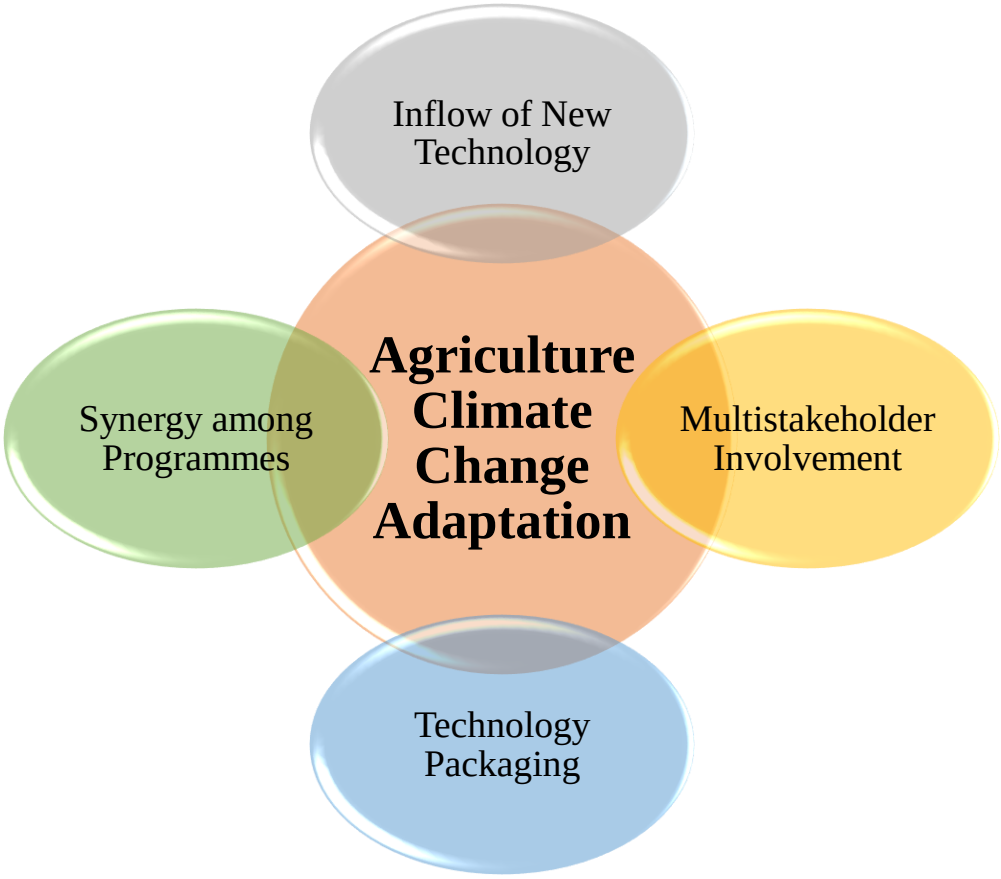


Figure 16: Key strategies essential for Climate change

Source: **(Rao et al., 2019)**

A systematic review paper on climate change adaptation in the agricultural sector in Pakistan identified four major themes of adaptation strategies: changing cropping practices, changing farm management techniques, advanced land use management measures, and non-agriculture livelihood options (Saddique et al., 2022). These themes were further broken down into 16 subthemes. The review found that factors influencing farmers' adaptation strategies in Pakistan include age, education, farming experience, landholding, access to climate information, access to credit facilities, and access to extension services. Several constraints were identified at the farm level that hindered the adaptive capacity of farm households, including a lack of access to information and knowledge, extension services, credit, and farm resources.

The objective of the Pakistan Punjab Irrigated Agriculture Productivity Improvement Program Project is to enhance the productivity of water use in irrigated agriculture, leading to increased agricultural production, employment, and incomes, as well as improved living standards and

positive environmental outcomes. By 2019, the project had installed high-efficiency irrigation systems covering 23,500 hectares, with a further 3,677 hectares in progress. It had also improved 11,916 watercourses with 1,220 more in progress, deployed 5,000 laser land-leveling units, and constructed 621 ponds. The project has directly benefited 500,000 farm families and improved water management on 5.7 million acres of farmland, creating more than 15,000 full-time jobs (Li & Ahmed, 2022).

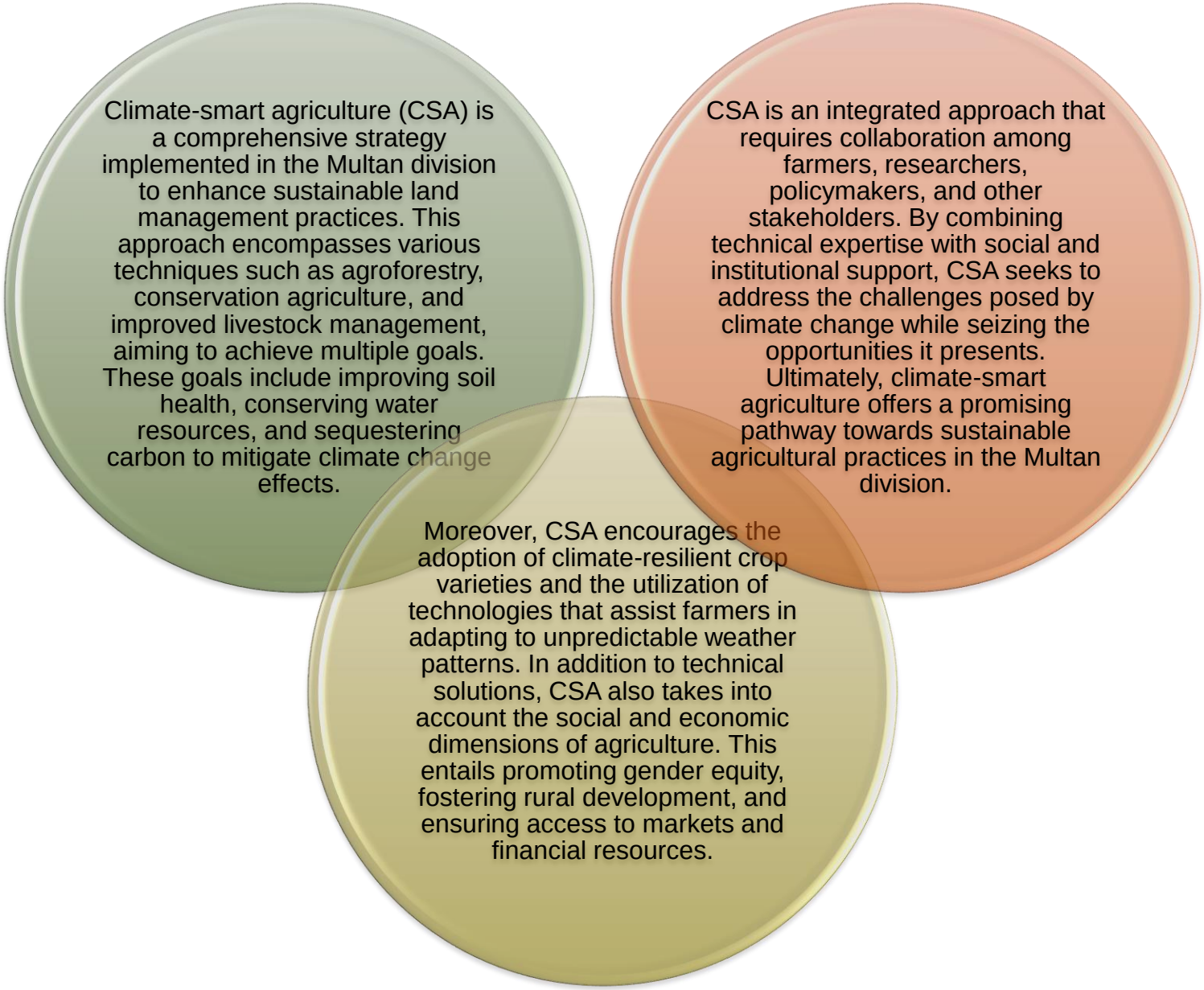
PxD is working to identify high-impact opportunities for climate change mitigation that leverage local knowledge in low- and middle-income countries, as well as their expertise in combining product development, behavioral science, and human-centered design with robust experimentation. They aim to explore climate financing mechanisms and MRV protocols that bridge the environmental efforts of smallholder farmers and global climate finance, with a focus on benefiting farmers working in the service of mitigation. They aim to partner with nonprofits and research institutions to develop robust mitigation programs and add new agrarian ladders out of poverty to those that have come in decades and centuries past (PAD-admin, 2022).

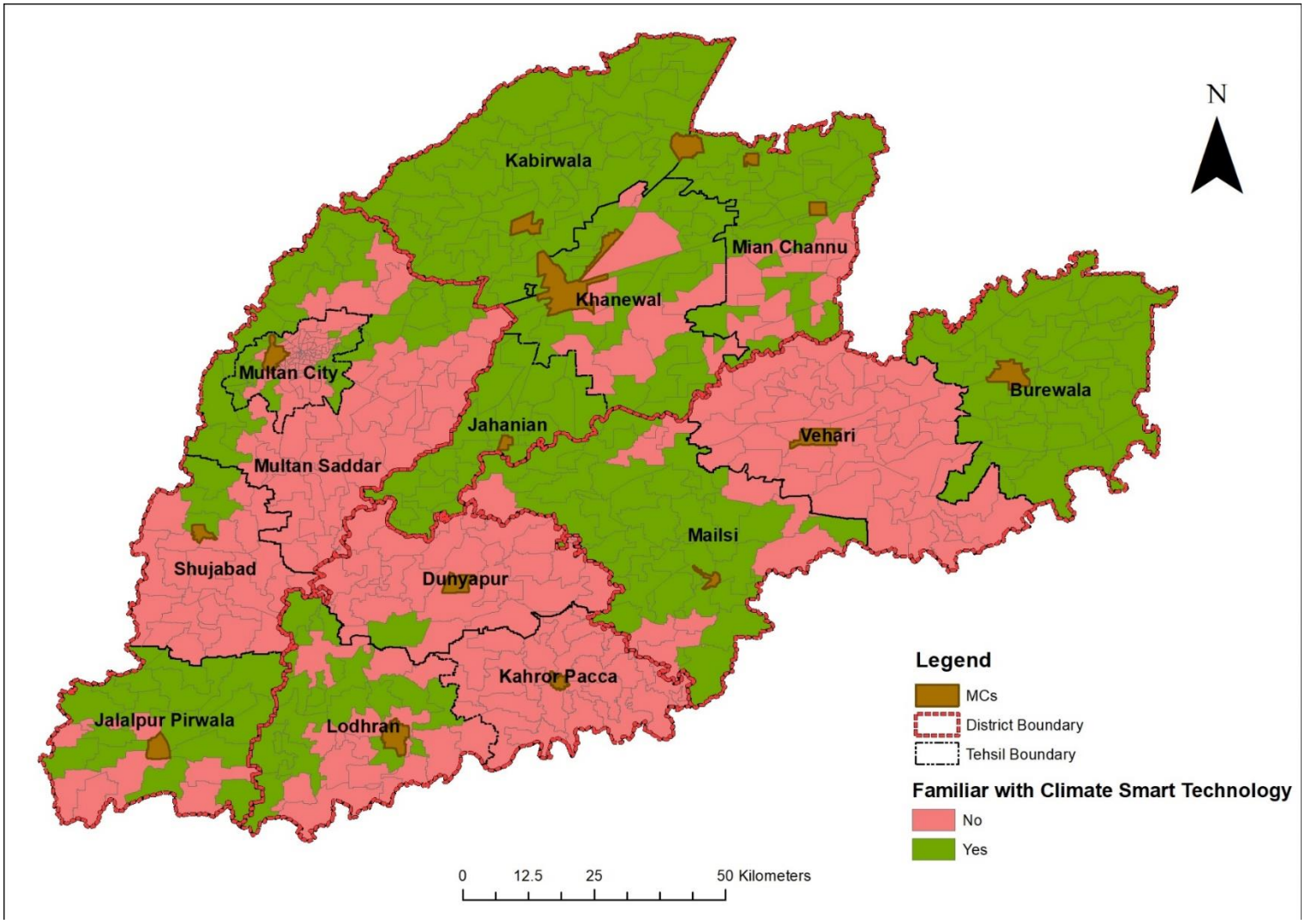
As a result, climate change is a complex and pressing issue that will require collective action and cooperation from multiple stakeholders to address effectively. It will be important to continue to monitor and understand the impacts of climate change on agriculture in the Multan division and to take proactive steps to mitigate these impacts and promote the sustainability of the agricultural sector in the region.

1.15.11. CLIMATE SMART AGRICULTURE

Climate-smart agriculture (CSA) is an approach to farming that seeks to address the interrelated challenges of food security, climate change, and sustainable agriculture. CSA aims to increase agricultural productivity and income, while also improving resilience to climate change and reducing greenhouse gas emissions. The data indicates that Khanewal and Vehari districts in the Multan division have shown awareness of Climate Smart Technology due to their cultivation of Maize and Rice. However, the actual availability of this technology is extremely limited. The areas highlighted in red signify a complete lack of knowledge among farmers regarding any climate smart-related technology. The Familiarity map for the Multan division, based on the Climate Smart Technology survey, illustrates implementation of Climate Smart Technologies across different districts.

Sustainability increases	Strengthen resilience	Reduces Agriculture's Contribution to Climate Change


Climate-smart agriculture (CSA) is a comprehensive strategy implemented in the Multan division to enhance sustainable land management practices. This approach encompasses various techniques such as agroforestry, conservation agriculture, and improved livestock management, aiming to achieve multiple goals. These goals include improving soil health, conserving water resources, and sequestering carbon to mitigate climate change effects.
CSA is an integrated approach that requires collaboration among farmers, researchers, policymakers, and other stakeholders. By combining technical expertise with social and institutional support, CSA seeks to address the challenges posed by climate change while seizing the opportunities it presents. Ultimately, climate-smart agriculture offers a promising pathway towards sustainable agricultural practices in the Multan division.
Moreover, CSA encourages the adoption of climate-resilient crop varieties and the utilization of technologies that assist farmers in adapting to unpredictable weather patterns. In addition to technical solutions, CSA also takes into account the social and economic dimensions of agriculture. This entails promoting gender equity, fostering rural development, and ensuring access to markets and financial resources.



Map 10: Familiarity of Climate Smart Technology

Source: Urban Unit Survey

1.15.11.1. REASONS FOR DECLINE IN MULTAN'S MANGO PRODUCTION DUE TO CLIMATE CHANGE

Effect of Heatwaves

- Heatwaves have become more frequent and intense, causing damage to the mango trees.
- The rise in temperature has led to early flowering and fruiting, affecting the fruit's size and quality.
- Pakistan's mango production fell by 50% in 2022 due to a heatwave and water shortage
- (Source: APP, Reuters)

Water Shortages

- Mango trees require a substantial amount of water for optimal growth and fruit production.
- Due to changing climatic patterns, water scarcity has become a significant issue, affecting the quality and quantity of the fruit produced.
- Farmers in Multan division have reported a decline in yield due to water shortage.
- (Source: APP, Reuters)

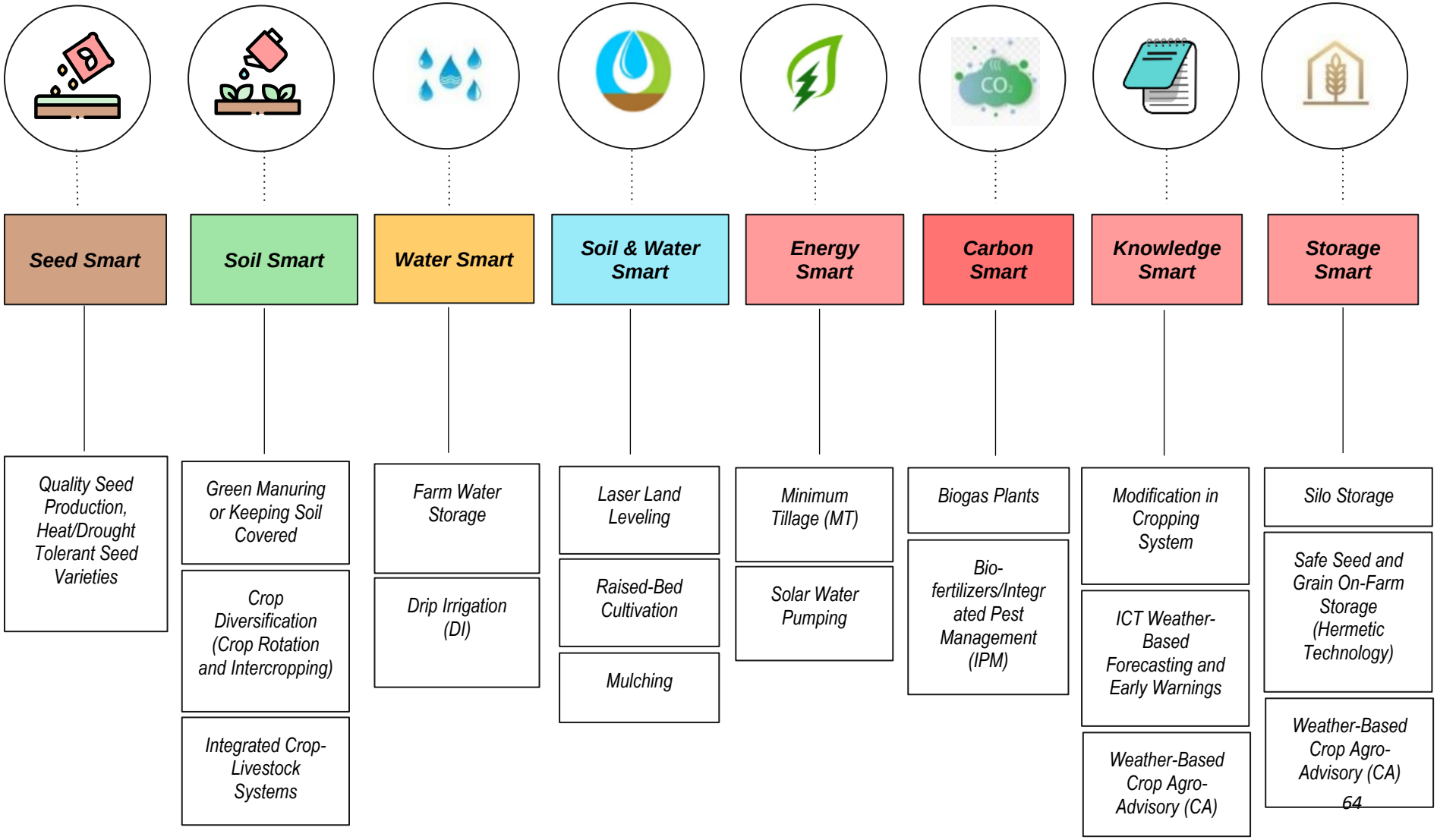
Pest & Diseases

- Climate change has led to the proliferation of pests and diseases in mango trees, causing a decline in production.
- Higher temperatures and changing rainfall patterns have created an environment that is conducive to pests and diseases.
- The increased use of pesticides to control these pests and diseases has led to environmental and health problems.
- (Source: Daily Times, Reuters)



1.15.11.2. IDENTIFIED TECHNOLOGIES AND PRACTICES FOR CSA

The diagram below highlights the identified technologies and practices for Climate-smart agricultural plan of Multan division.



1.15.12. AGRO-ECOLOGICAL CONDITIONS

Climate is a prime factor that exerts a major influence on vegetation, soil health, and water resources. Changing climate is likely to elevate the vulnerability of agricultural systems (Rosenzweig et al., 2013) by increasing temperature, changes in rainfall patterns, and more frequent extreme weather events in the world (IPCC, 2014). There is an explicit change in the weather patterns in Pakistan (Ahmad et al., 2015). Subsequently, climate change and variability have impacted crop production and could also be the reason for the shift in cropping systems in some districts of the Multan division.

Consequently, the urban unit has identified different Agro-ecological zones in the Multan division based on Agro-climatic and Edaphic variables through which crop zoning has been identified;

- Identified suitability of crops in AEZs for sustainability.
- Assessment of Agro-economic performance in delineated agro-ecological zones.

Multan division, located in the Punjab province of Pakistan, is known for its fertile soil, which is primarily composed of clay, loam, and sand. The exact soil texture in the region can vary depending on the specific location, as well as the type of crop being grown.

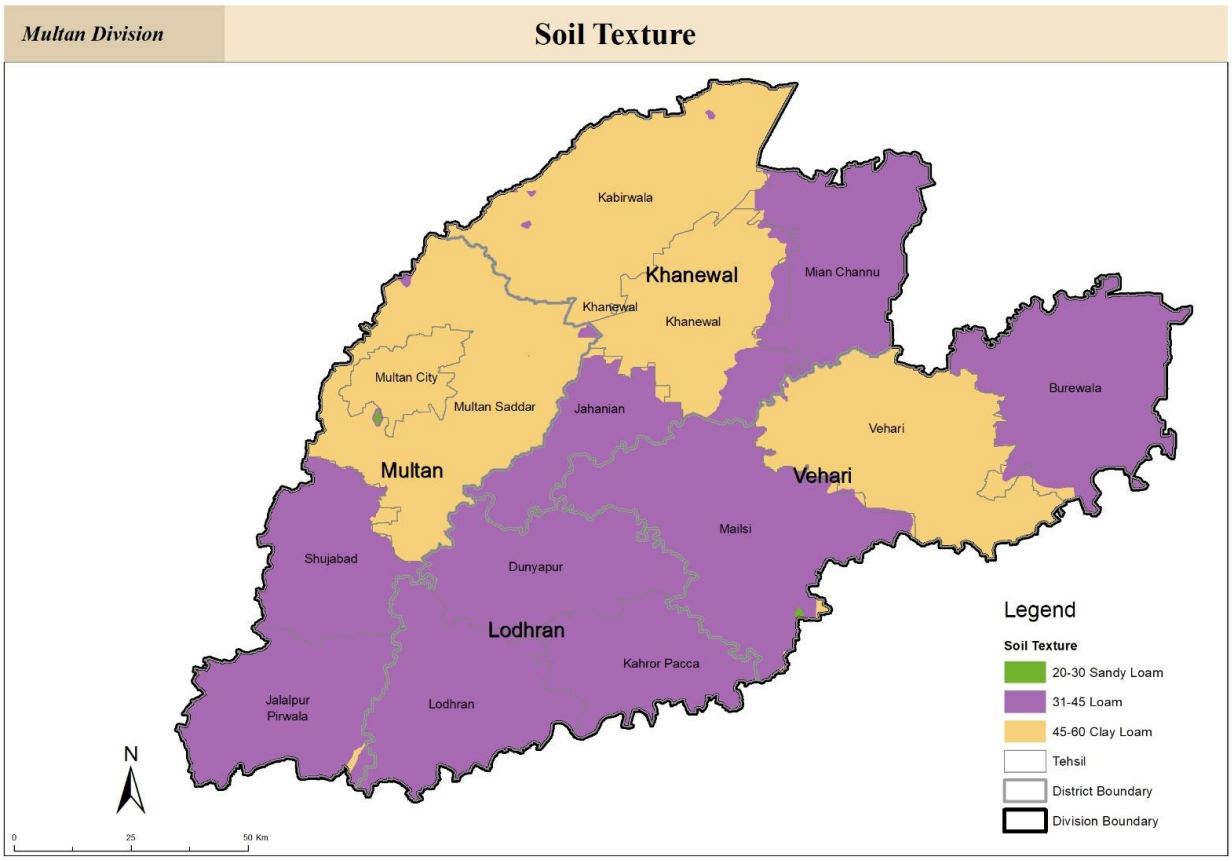
Clay soils are characterized by high levels of nutrient retention and are good for crops that require a lot of moisture, such as rice. Loam soils are a mixture of sand, silt, and clay, and are considered ideal for growing a variety of crops due to their ability to hold moisture and nutrients. Sandy soils are well-drained and warm up quickly in the sun, which is beneficial for crops that require good drainage and warm temperatures, such as certain vegetables.

It's important to note that the specific soil characteristics of the Multan division will also be influenced by factors such as soil pH, soil fertility, and soil structure, which can vary depending on the specific location within the region. A comprehensive soil analysis can provide information on the specific soil characteristics and fertility of a particular piece of land, which can be useful in determining the best crops to grow and the most effective methods of cultivation.

The soil is a key element of agriculture, without which we could not grow plants. Each type of soil is not suitable for each crop due to the effect of different crop growth factors. Soil conditions and

characteristics are one of the key factors that directly drive crop growth potential and thus, a soil data set is key information when developing agro-ecological zones.

The texture is the most important parameter of soil. There are four different soil textures reflected in map 5 below i.e. Sandy Loam, Loam, and Clay loam. Redefining AEZs was based on the moisture index calculated by using ET0 with an overlay of analysis of soil texture. Loam and Clay loam are mostly dominated in the region.

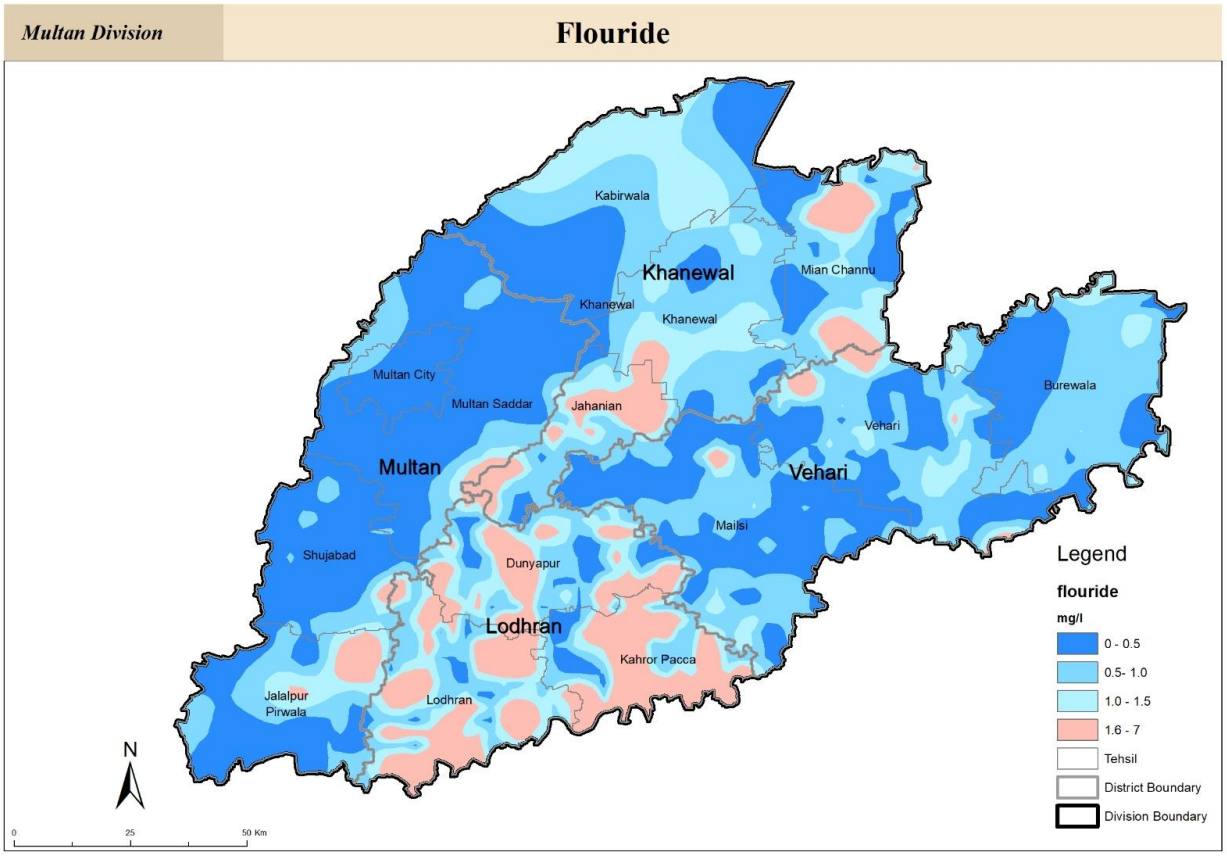


Map 11: Soil Texture of Multan Division

Source: Urban Unit

Fluoride is a naturally occurring element that can be present in varying concentrations in groundwater, and high levels of fluoride in drinking water can have negative health effects. The concentration of fluoride in groundwater in the Multan division of Pakistan can vary depending on the specific location and geological conditions.

Under the arid climatic conditions of large parts of Pakistan, high fluoride concentrations in the groundwater are to be expected at least in some areas. Excessive fluoride concentrations are a problem in parts of Punjab, Sindh, and Baluchistan (Tariq, 1981). Fluoride appears not to be a national problem but is a regional problem of sufficient magnitude to merit consideration in water-testing and supply programs. In some areas, high levels of fluoride in groundwater can be a concern, particularly in communities that rely on groundwater as their primary source of drinking water. Ingesting high levels of fluoride over a long period of time can lead to a condition known as fluorosis, which can cause damage to teeth and bones. The fluoride in the Multan division shows varying concentrations in all districts.



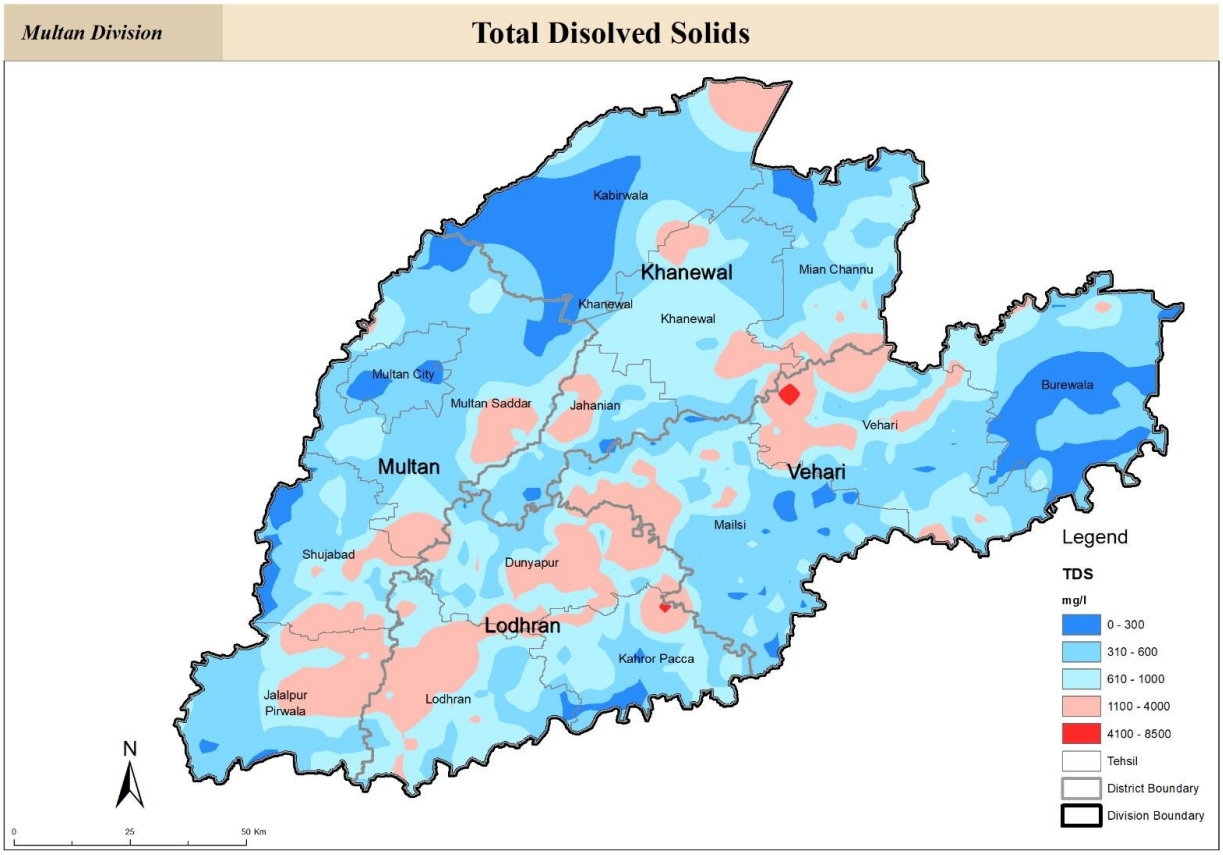
Map 12: Total Water Availability

Source: The Urban Unit

Groundwater in the Multan division of Pakistan can contain varying levels of Total Dissolved Solids (TDS), which is a measure of the amount of inorganic and organic substances present in water. High levels of TDS in groundwater can have negative effects on the quality and suitability of the water for various uses, such as drinking, irrigation, and industrial processes.

The TDS levels in groundwater in the Multan division can be influenced by a variety of factors, including the geology of the area, land use practices, and anthropogenic activities. In some areas, high levels of TDS may indicate the presence of pollutants, such as salts, chemicals, and minerals, that can negatively impact the quality of the water.

Groundwater not only supplies additional water to fulfill irrigation deficits but also provides flexibility to match crop water requirements. The groundwater of acceptable quality has the potential to provide the flexibility of water supply in canal commanded areas and to extend irrigation to rain-fed areas. It is estimated that up to 95% of all surface and groundwater is utilized for irrigation. Access to groundwater would assist farmers in dealing with the inconsistencies of surface supplies, diversifying cropping patterns, and converting uncertain crop yields into more sustained crop production. Since groundwater quality plays a crucial role in successful crop production, therefore groundwater quality map given below shows that most of the areas in the division are suitable for crops in all the districts of Multan division except for fewer areas in the Vehari and Kahror Pacca tehsils.

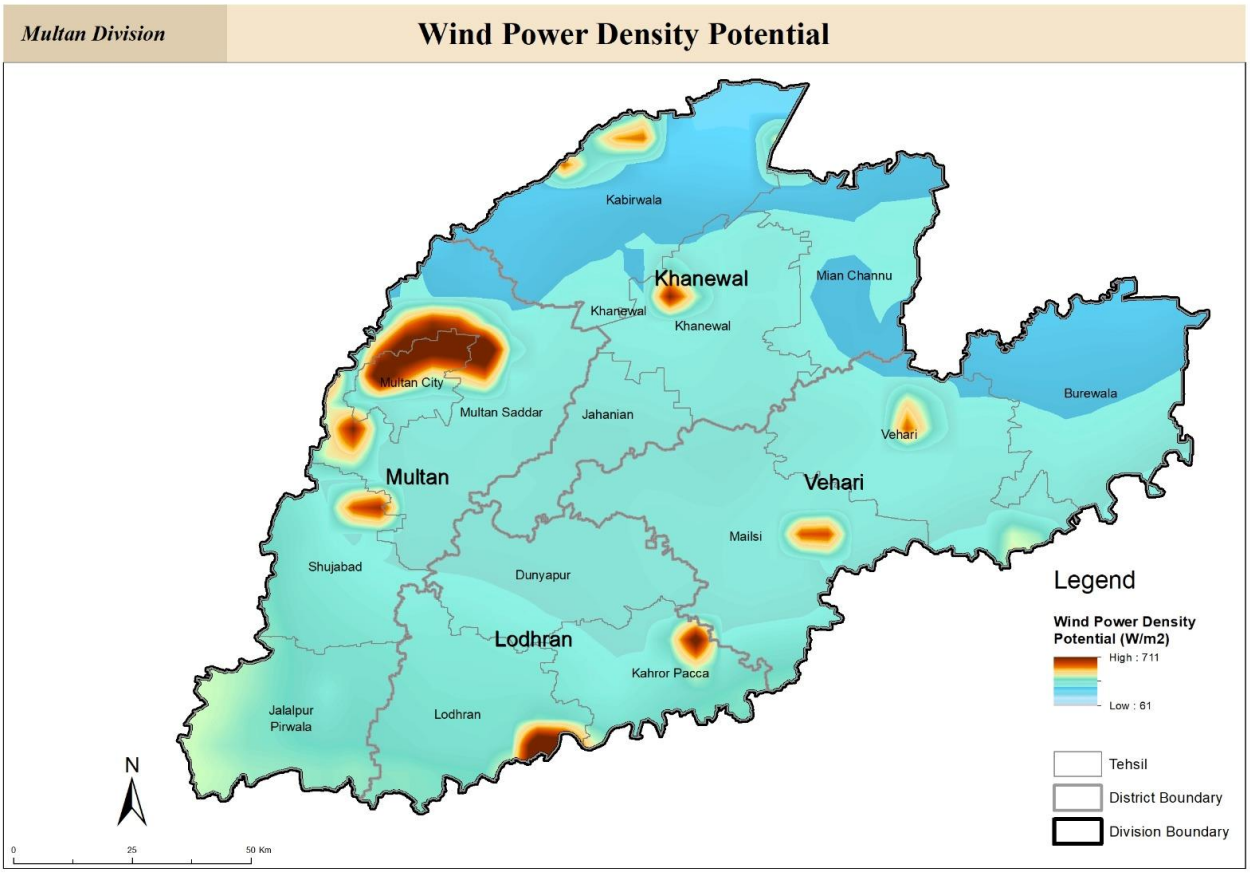


Map 13: Groundwater (TDS)

Source: Urban Unit

The spatial distribution of weather station data points is used in the regional plan. The weather stations used for the collection of weather data include wind power, average yearly temperature, and solar irradiance.

Map 8 shows the wind power density potential (W/m2) observed for the Multan region ranging from high 711 to low 61 density potential. A smaller portion of all districts of the Multan region falls under the high-density wind power areas and a major portion of the Multan city falls under higher density potential.



Map 14: Wind Power

Source: The Urban Unit

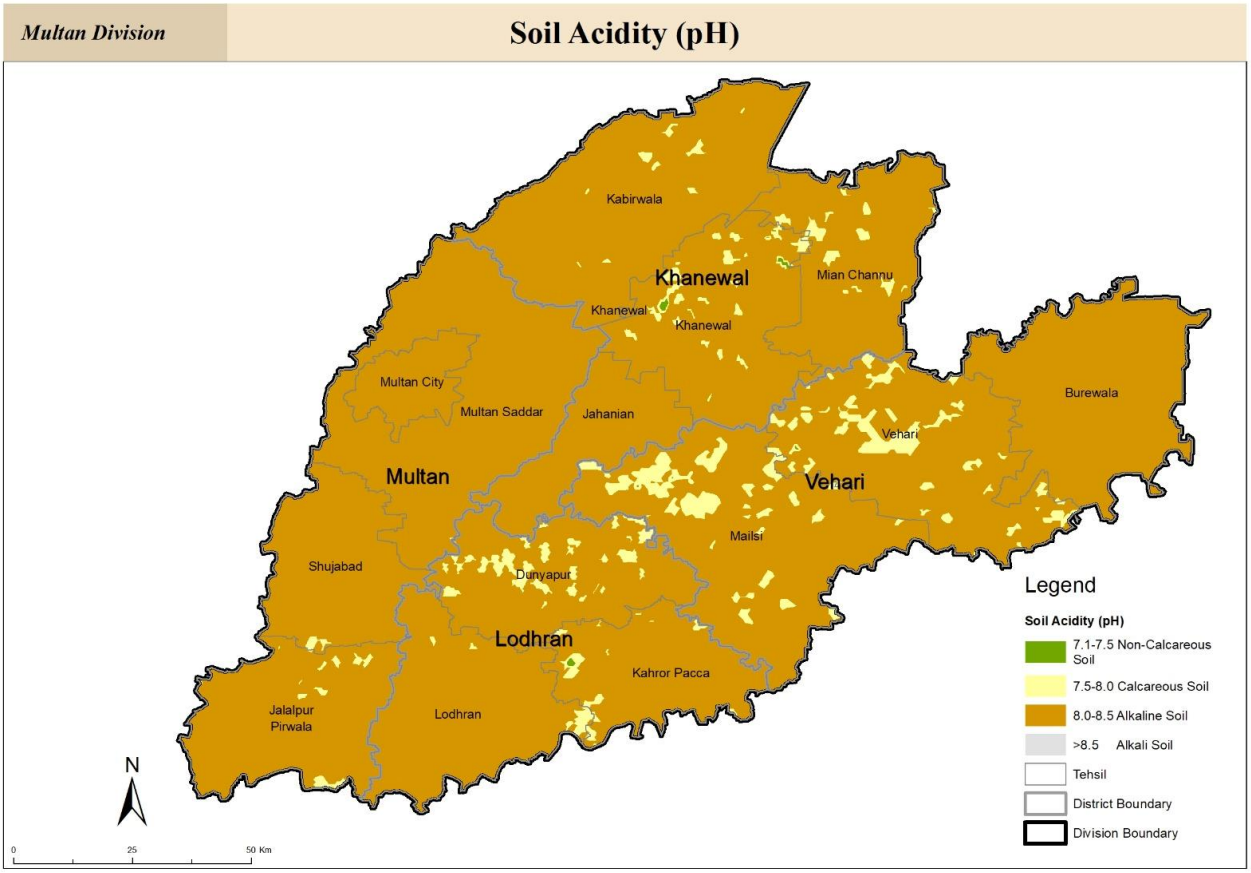
Soil pH is an important factor that can impact the growth and health of crops in the Multan division of Pakistan. The pH of soil refers to its acidity or alkalinity, and it is expressed on a scale of 0 to 14, with 7 being neutral. Soil pH can influence the availability of essential nutrients for plant growth, as well as the presence of certain chemicals in the soil that can be harmful to crops.

In general, most crops grow best in soils with a pH between 6.0 and 7.5. However, the optimal pH range for a specific crop can vary depending on the type of crop and the specific growing conditions.

Soil pH can be influenced by a variety of factors, including the geology of the area, the type of soil, and land use practices, such as the application of fertilizers and liming materials. A comprehensive soil analysis can provide information on the specific soil pH of a particular piece

of land, which can be useful in determining the best crops to grow and the most effective methods of cultivation.

The Soil parameters like Soil pH have been observed in the Multan region as shown below. The Alkaline soil pH in the Multan division ranged between 8.0 – 8.5. In addition to it, Calcareous soil ranging from 7.5-8.0 pH has been observed in all districts of the Multan division. The pH value of 5.5 to 6.0 (acidic) is considered to be an optimum for citrus cultivation; as the lower level tends to increase the leaching of lime and magnesium whereas the higher level is conducive to reducing the availability of trace elements. It is recommended that before planting the trees, it is desirable to determine the suitability of soil for crops and if necessary appropriate reclamation measures should be taken. It is also advised that the soil pH should be assessed once a year.

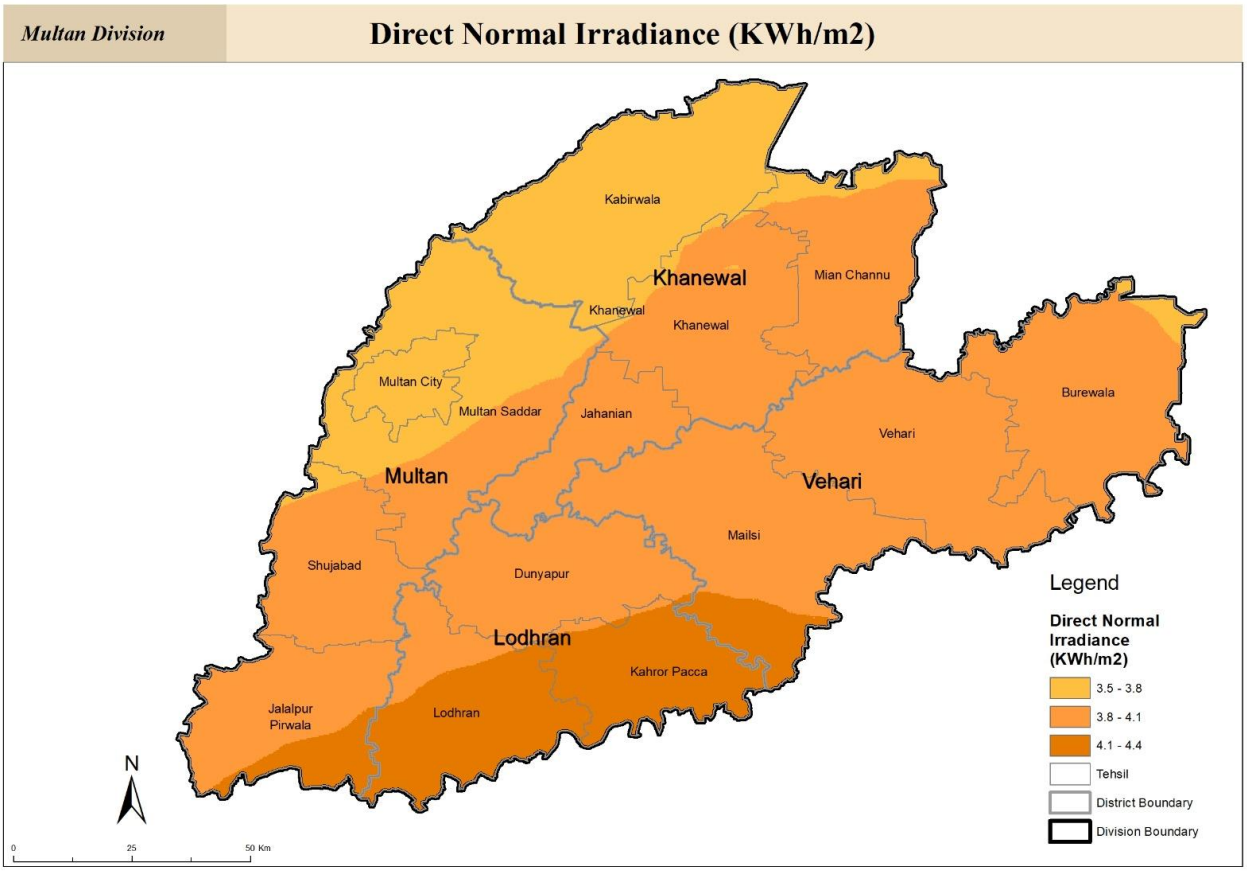


Map 15: Soil pH
Source: Urban Unit

Direct solar normal irradiance refers to the amount of solar radiation that is received on a surface perpendicular to the sun's rays. This type of irradiance is important for many applications, including photovoltaic power generation, solar water heating, and the cultivation of crops. The strength received from the Sun in the form of electromagnetic waves as evaluated in the range of wavelength of the measurement device is referred to as solar irradiance.

The amount of direct solar normal irradiance received in the Multan division of Pakistan can vary depending on several factors, including the time of year, the latitude of the area, and the weather conditions. The latitude for the Multan division of Pakistan is approximately 30.2° N. Multan is located slightly south of Faisalabad, which is situated at a latitude of 31.41° N. Multan is also close to the Tropic of Cancer, experiencing similar climatic conditions with hot and dry summers and relatively cool and wet winters.

Direct Normal Irradiance (KWh/m2) is calculated for the Multan region, with the highest solar irradiance observed in Jalal Pirwala tehsil of Multan, Lodhran district tehsil including Lodhran and Kahror Pacca, and Vehari tehsil including Mailsi. Accurate measurement of direct solar normal irradiance in the Multan division is crucial for various applications, including solar energy system design and optimization, as well as selecting and cultivating crops suitable for the local climate. However, actual irradiance levels are influenced by local weather conditions, such as cloud cover, atmospheric stability, air pollution, and the orientation and tilt of receiving surfaces.



Map 16: Solar Irradiance

Source: Urban Unit

Hence, based on the above agro-ecological conditions, the Multan division is summarized on the following agro-climatic factors:

Table 8: Agro-Climatic Factors

Avg, rabi max temp (^{0}C)	Avg, rabi min temp (^{0}C)	Avg, Kharif max temp (^{0}C)	Avg, Kharif min temp (^{0}C)	Rainfall (mm)	ETo (mm)	Soil type	EC
28.09	12.31	39.28	27.31	230	3.20	Most Sandy	0.07-27
29.20	12.45	40.41	27.59	234	3.10	Loam, sandy loam (9%)	0.07-27
27.59	12.38	38.94	27.22	412	2.88	Loam, sandy loam (20%), clay loam (8%)	1-27

Source: Fao Agroecological Condition

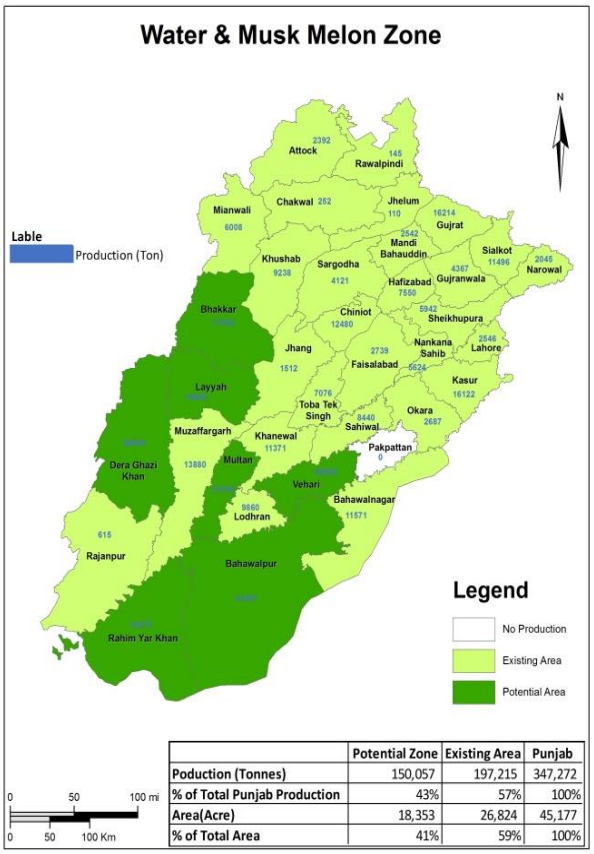
Based on the above-described conditions, the following crops have been identified as suitable for the Multan division; Chilies, Citrus, Cotton, Garlic, Guava, Bitter Gourd, Cucumber, Falsa, Lady Finger, Mango, Onion, Tomato, Water Melon, Sunflower, and Canola. In this regard, production, yield & value, and logistics analysis of the Multan division are discussed below.

1.15.13. PRODUCTION ANALYSIS

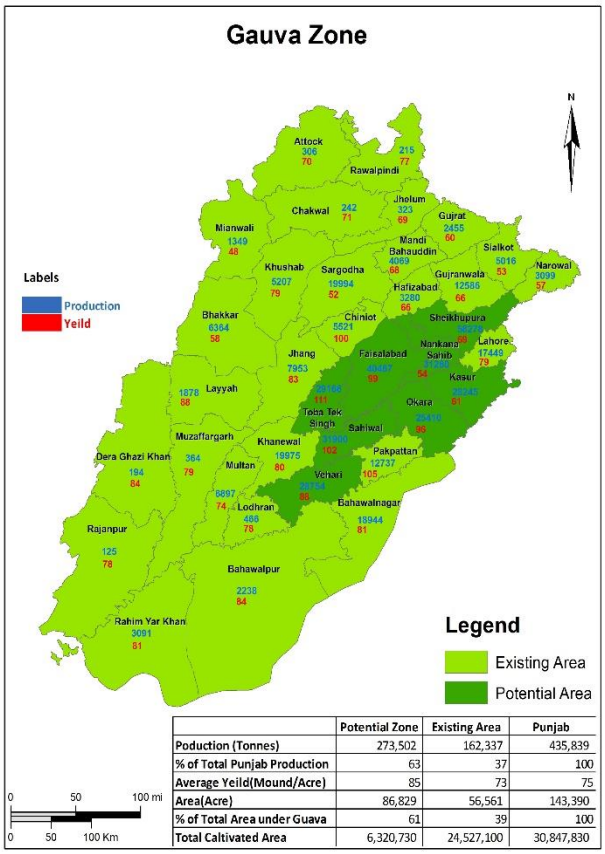
The potential crops zone based on these agroecological conditions is shown on the map (figure 18). These zones are identified based on comparative advantages in yield, production, and agroecological conditions.

For example, Mango is chosen for the Multan, Shujabad and Kabirwala tehsils, Chilies for all four districts of the region. Likewise, we have identified specific high-yielding locations for each crop as shown in the map along with potential clusters for each crop clearly showing the current cultivated areas vs. the increased area that needs to be cultivated for certain crop/cluster where a specialized support system is to be provided.

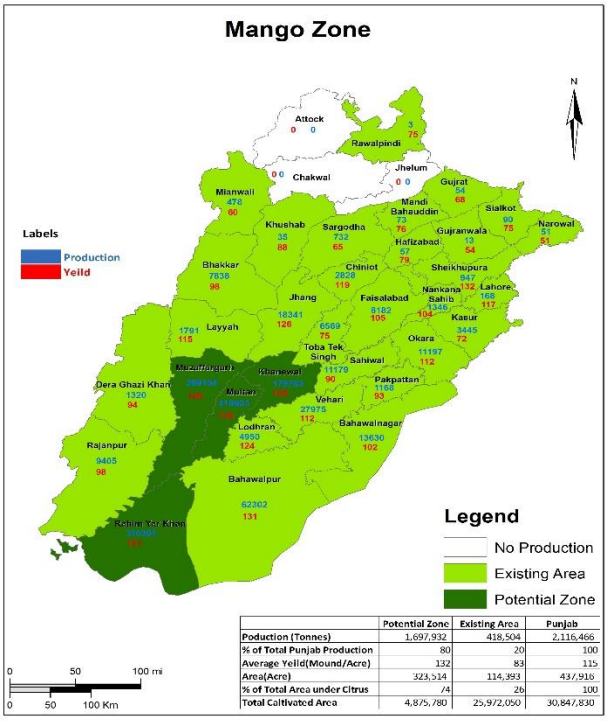
1.15.13.1. PRODUCTION AREA MAPPING



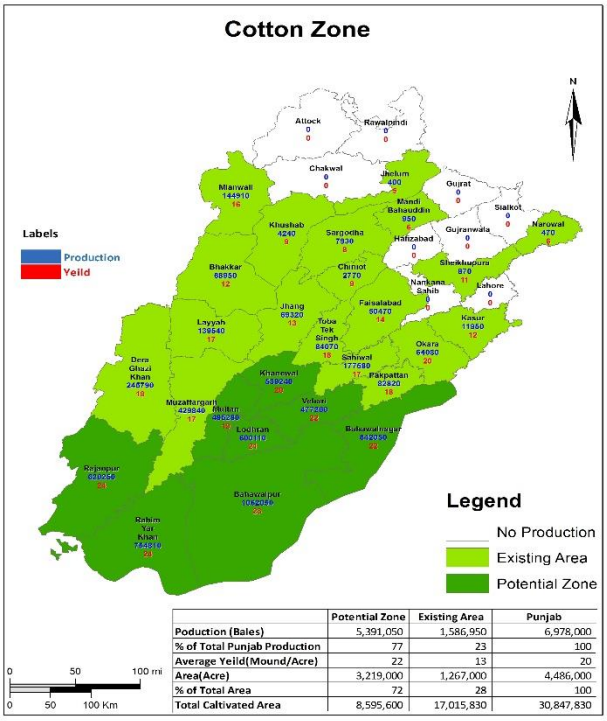
	Potential Zone	Existing Area	Punjab
Poduction (Tonnes)	150,057	197,215	347,272
% of Total Punjab Production	43%	57%	100%
Area(Acre)	18,353	26,824	45,177
% of Total Area	41%	59%	100%



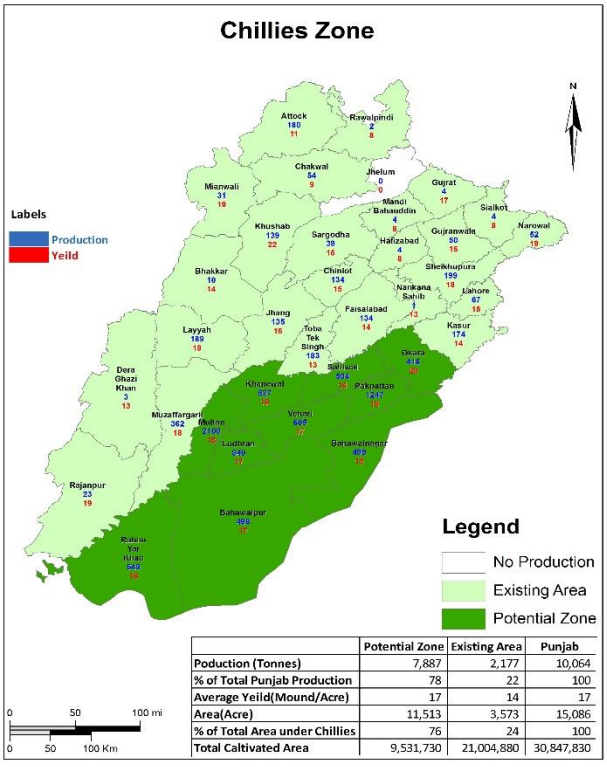
	Potential Zone	Existing Area	Punjab
Poduction (Tonnes)	273,502	162,337	435,839
% of Total Punjab Production	63	37	100
Average Yeild(Mound/Acre)	85	73	75
Area(Acre)	86,829	56,561	143,390
% of Total Area under Guava	61	39	100
Total Caltivated Area	6,320,730	24,527,100	30,847,830



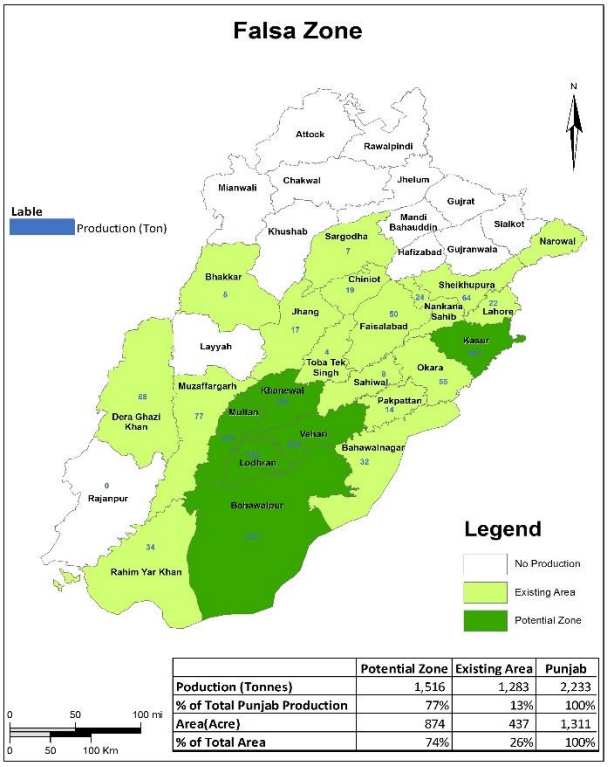
	Potential Zone	Existing Area	Punjab
Poduction (Tonnes)	1,697,932	418,504	2,116,466
% of Total Punjab Production	80	20	100
Average Yeild(Mound/Acre)	132	83	115
Area(Acre)	323,514	114,393	437,916
% of Total Area under Citrus	74	26	100
Total Caltivated Area	4,875,780	25,972,050	30,847,830



	Potential Zone	Existing Area	Punjab
Poduction (Bales)	5,391,050	1,586,950	6,978,000
% of Total Punjab Production	77	23	100
Average Yeild(Mound/Acre)	22	13	20
Area(Acre)	3,219,000	1,267,000	4,486,000
% of Total Area	72	28	100
Total Caltivated Area	8,595,600	17,015,830	30,847,830



	Potential Zone	Existing Area	Punjab
Poduction (Tonnes)	7,887	2,177	10,064
% of Total Punjab Production	78	22	100
Average Yeild(Mound/Acre)	17	14	17
Area(Acre)	11,513	3,573	15,086
% of Total Area under Chillies	76	24	100
Total Caltivated Area	9,531,730	21,004,880	30,847,830



	Potential Zone	Existing Area	Punjab
Poduction (Tonnes)	1,516	1,283	2,233
% of Total Punjab Production	77%	13%	100%
Area(Acre)	874	437	1,311
% of Total Area	74%	26%	100%

Figure 17: Production Area Mapping

Source: Urban Unit

1.14 **WAY FORWARD**

The agriculture sector plays a crucial role in ensuring food security and promoting the growth of other sectors in the economy. The present situation of the Multan region needs a high priority for the growth of the agriculture sector on a sustainable basis and requires the implementation of the most appropriate interventions to achieve the desired outcome. The Multan Rabi/Kharif patterns for the growth of agriculture will further need improvement in its output and capacity-building training to trickle down to farmers. The emphasis is on the use of the better quality seed, and modern technologies to ameliorate agriculture outlook and food security.

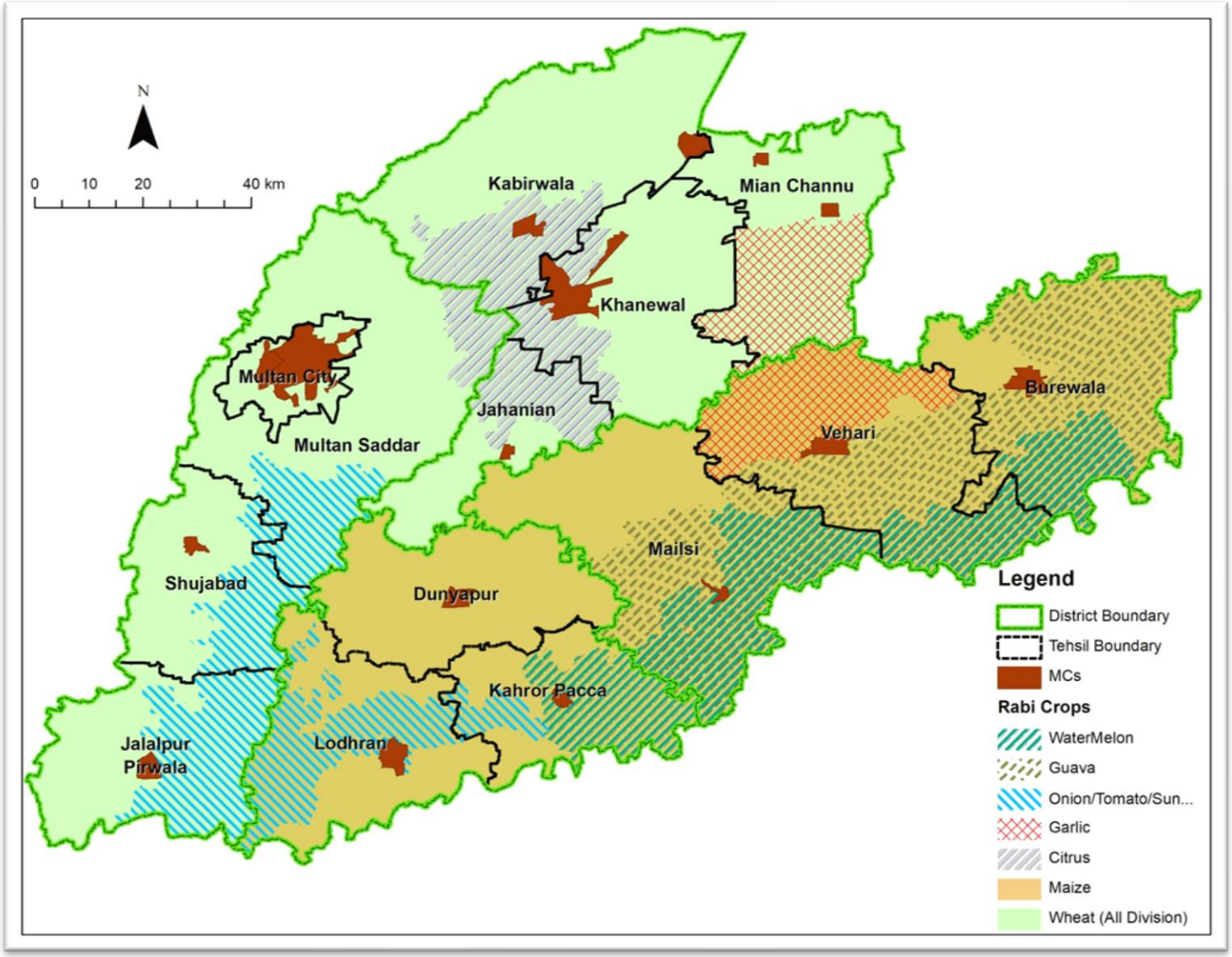
The overall goal of the livestock sector strategy for the Multan region is to contribute toward poverty alleviation and economic development of the province of Punjab through the provision of an enabling environment and support services for enhancing value addition, and value chain development, enhancing exports, and profitability of the livestock sector.

Livestock is an integral part of the agricultural system in Pakistan. However, with innovative approaches, livestock financial instruments need to be developed to route the finances of milk producers via the middlemen. In addition, agroforestry can also be included in future research studies and reports.

1.15 **PROPOSED CROPPING PATTERN**

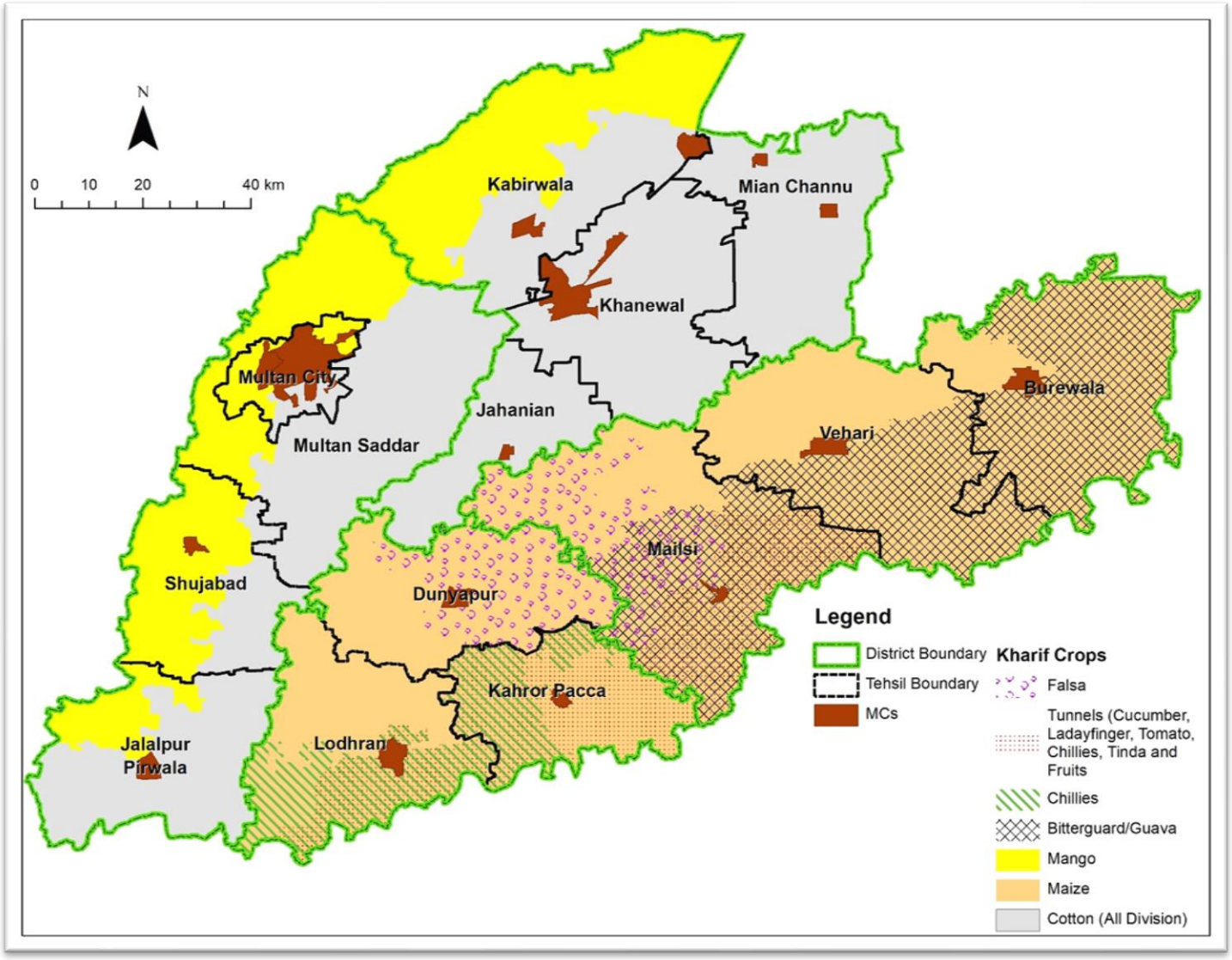
Based on agro-ecological conditions, production, yield & value, and logistics analysis mentioned above, 16 crops are recommended for this region. Following value chains of the recommended crops in this region are proposed that are discussed below.

Figure 13 & 14 shows the spatial location of Rabi and Kharif crops for the Multan division. For Rabi season Wheat, Fodder, Maize, Onion, Citrus, Rapeseed, Guava, Water Melon, Tomato, Garlic whereas Cotton, Fodder, Maize, Rice, Mango, Chilies, Lady Finger, Guava, Bitter gourd, and Phalsa are proposed for Kharif season. Specific clusters for each crop are identified as shown on the map. There is a need to increase the area of each crop in the specified cluster as calculated in the map and provide a specialized support system from seed to the international market in each cluster. It will ensure efficient use of resources and increase each crop yield & water efficiency and adoption of good agriculture practices as per international standards.



Map 17: Proposed Cropping Pattern of Rabi Crops

Source: The Urban Unit



Map 18: Proposed Cropping Pattern of Kharif Crops

Source: **The Urban Unit**

1.17.1. IMPACT OF PROPOSED CROPPING PATTERN

The impact of the proposed cropping pattern discusses that the main focus of this plan is on the value chain development through crop zoning.

Considering the analysis highlighted above, the main target is to increase the crop yield of division at least up to the level of progressive farmers, to gain surplus, increase exports and create sustainable value addition.

Below table 10 demonstrates the potential of various proposed crops. Thus, if we achieve a yield of the progressive farmer, better quality, and proper market strategy then we can increase the Multan agriculture GDP from Rs. 541 Billion to Rs. 1048 Billion.

However, more efforts are required to increase the yield of pulses and grams. Whereas, high-value crops like citrus, dates, and vegetables have the potential. Therefore, sincere interventions are needed to increase their area, and a provision of specialized support systems is also necessary to develop the value chain of these proposed crops.

Table 9: Impact of Proposed Cropping Pattern

Crops (R&K)	Current Area	Proposed Area	Current Yield Mnd/acre	Potential Yield Mnd/acre	Potential Output	Potential Value (PKR)	Current value (PKR)
Onion	36,816	60,000	123	222	13,320,000	10,656,000,000	3,636,180,000
Garlic	1,552	1,552	101	170	263,840	633,216,000	376,800,000
Water Melon	3,677	10,000	523	415	4,150,000	1,867,500,000	864,618,750
Canola	1,586	5,000	18	27	135,000	216,000,000	45,880,000
Tomato	2,847	7,000	200	700	4,900,000	3,351,600,000	390,358,800
Guava (R&K)	7,357	12,000	113	462	5,544,000	6,652,800,000	994,050,000
Citrus	28,106	45,000	168	400	18,000,000	21,600,000,000	5,661,030,000
Cotton (Bales Pro)	1,057,000	1,057,000	31	50	52,850,000	317,100,000,000	195,508,500,000
Rice	387,000	387,000	22	22	8,452,500	15,214,500,000	15,214,500,000
Sugarcane	76,000	76,000	700	1,200	91,200,000	21,523,200,000	12,555,672,000
Lady Finger	7,467	10,000	169	225	2,250,000	3,510,000,000	1,970,241,000
Bitter Gourd	1,198	2,000	131	400	800,000	1,600,000,000	313,400,000
Chillies (Red)	10,455	25,000	25	150	3,750,000	7,500,000,000	531,100,000
Mango	121,412	150,000	142	250	37,500,000	75,000,000,000	34,545,300,000
Phalsa	1,206	3,000	35	170	510,000	612,000,000	50,010,000
Other Crops						**561,156,424,914**	**247,075,981,194**
Total						**1,048,193,240,914**	**519,733,621,744**

Source: Crop Reporting Service/ Urban Unit

1.17.2. VALUE CHAIN ANALYSIS

Agri-food Value Chains are designed to increase competitive advantage through collaboration in a venture that links producers, processors, marketers, food service companies, retailers, and supporting groups such as shippers, research groups, and suppliers.

The stages involved in the process of value-chain are: The first is input supply, then production, collection, processing, and then retailing. The intermediaries are the actors in the chain that are involved at each stage that belongs to local and inter-provisional commissions. In some cases, the same actor may be involved in more than one stage. The diagram also represents the institutions that help support the actors in the value chain.

Based on the value chain framework, various value-chains are devised for each crop which helps in explaining the analysis, strategy development, planning, and implementation and also presents a bird's eye view of the analytical stage of the proposed value chain projects. Following value chains of the recommended crops in this region are proposed are discussed below.

1.17.3. MANGO VALUE CHAIN

1.17.3.1. DISTRICT WISE ANALYSIS OF MANGO AREA AND PRODUCTION

The chart presents data on mango cultivation areas in the Multan Division of Pakistan for two periods: 2016-17 and 2020-21. The cultivation areas are reported for four specific regions within the Multan Division: Multan, Lodhran, Khanewal, and Vehari.

In 2016-17, the total mango cultivation area in the Multan Division was 119,120 hectares, with Multan having the largest area of 77,000 hectares. Lodhran had the smallest area at 1,000 hectares, followed by Khanewal with 34,900 hectares, and Vehari with 6,220 hectares.

By 2020-21, the overall mango cultivation area in the Multan Division slightly increased to 121,412 hectares. Multan experienced a slight decrease in cultivation area to 76,646 hectares. Lodhran witnessed a significant increase to 3,057 hectares, while Khanewal and Vehari showed minor changes to 37,268 hectares and 4,441 hectares, respectively.

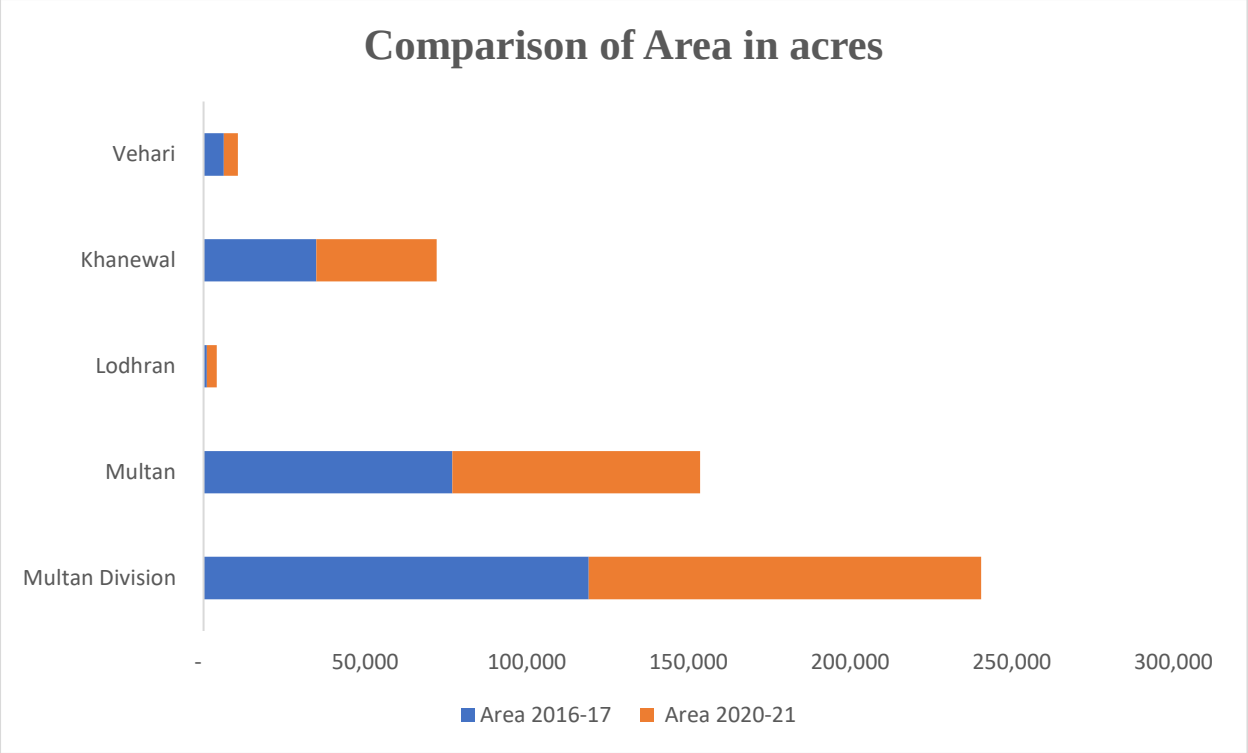


Figure 18: District-wise comparison of Area in acres

Source: PDS 2021

The chart provides data on mango production in the Multan Division of Pakistan for two different periods: 2016-17 and 2020-21. In 2016-17, the overall mango production in the Multan Division was 632,291, with the highest contribution coming from Multan itself, accounting for 419,603 units. Lodhran had the lowest production at 4,950, followed by Khanewal with 179,763, and Vehari with 27,975.

By 2020-21, there was an increase in mango production across the Multan Division. The overall production rose to 690,906. Multan continued to be the major contributor, with a production of 446,846. Lodhran experienced significant growth, increasing its production to 16,691. Khanewal also saw an increase to 201,247, while Vehari witnessed a slight decrease to 26,122.

Therefore, it can be observed that overall mango production in the Multan Division has increased between the two periods, with variations in production levels across the different regions. Multan remains the primary mango-producing region, while Lodhran shows significant growth in mango production.

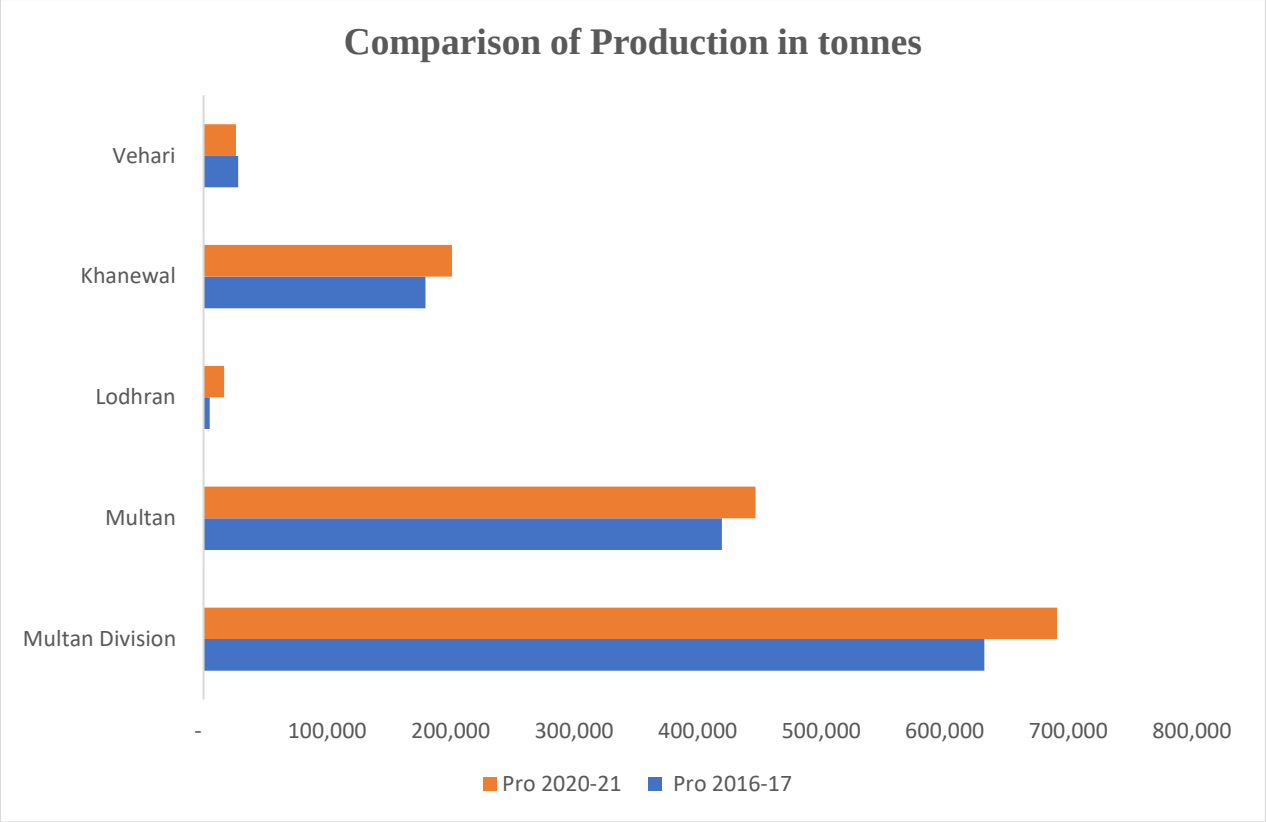


Figure 19: District-wise comparison of production in tonnes

Source: PDS 2021

1.17.3.2. PROVINCE WISE COMPARISON OF MANGO CONTRIBUTION (AREA & PRODUCTION)

The province of Punjab is prominently leading in both the cultivation and production of mangoes, with Sindh following closely behind. This indicates that Punjab is at the forefront when it comes to mango-related activities, such as growing mango trees and yielding a significant harvest. In comparison, Sindh is not far behind and also plays a substantial role in mango production. Baluchistan and Khyber Pakhtunkhwa (KP) also produce mangoes, but these provinces have little share in the total production due to incompatible weather conditions.

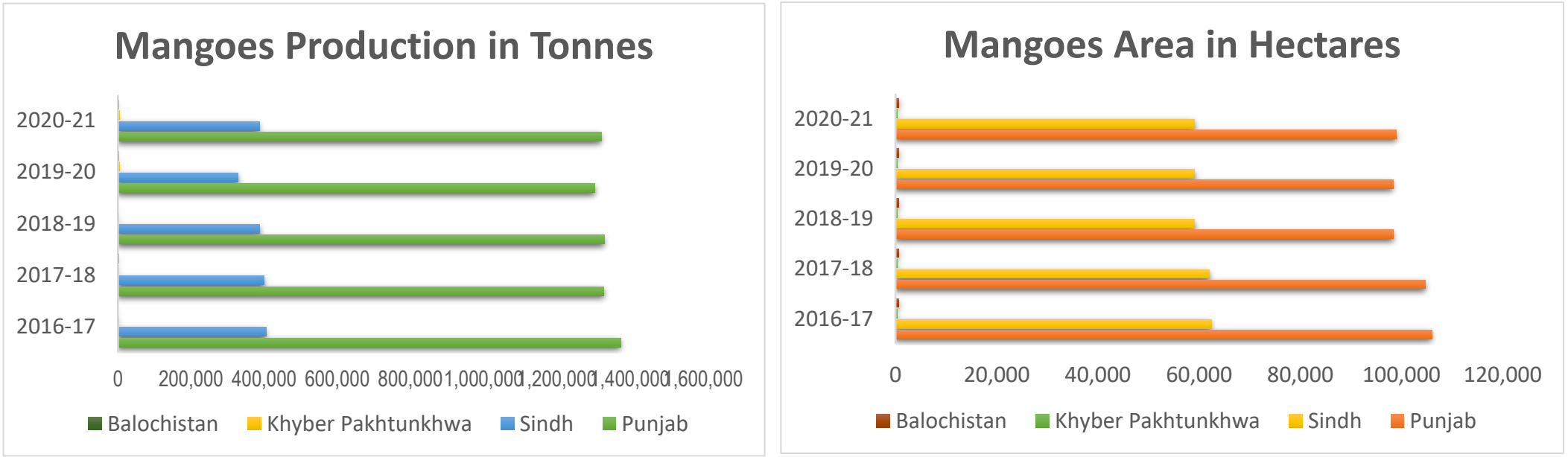


Figure 20: Province-wise Area & Production of Mangoes
Source: Ministry of National Food Security and Research (2019)

1.17.3.3. STATUS OF MANGOES EXPORT POTENTIAL AND WHOLESALE PRICE ANALYSIS IN PUNJAB PAKISTAN

- *Export volume of mangoes from Punjab increased from **62,824 metric tons in 2015 to 108,404 metric tons in 2019***
- *Export earnings from mangoes increased from **$40.4 million in 2015 to $70.6 million in 2019***
- *Wholesale prices fluctuated throughout the years, with the highest prices seen in 2016 and the lowest in 2018*
- *Average wholesale price of mangoes per kilogram increased from **Rs. 70 in 2015 to Rs. 90 in 2019***
- *Increasing trend in export volume and earnings indicates growing demand for Pakistani mangoes in international markets*
- *Fluctuation in wholesale prices may indicate challenges in supply and demand management*

1.17.3.4. STRATEGIES TO STRENGTHEN MANGO PRODUCTION AND VALUE ADDITION

1.17.3.5. DRIED MANGO EXPORT STATUS

Dried mango is a significant value-added product that is produced through the dehydration process of mango slices or mango pulp. Dehydration involves removing the water content from the mango, resulting in a preserved and concentrated form of the fruit. This process not only extends the shelf life of the mango but also enhances its flavor and nutritional value.

Pakistan's mango export market is highly concentrated in the Middle East (Government of Pakistan, 2015). The total mango export was to UAE followed by Saudi Arabia, Kuwait, and Afghanistan.

The market for mangoes worldwide is substantial and experiencing rapid growth. The rise in global export can be attributed to the expanding middle class in India and China, as well as the growing preference for exotic fruits with their unique nutritional and taste qualities in Western markets. Moreover, there is a rising demand for value-added products such as juices, condiments, and more, which further contributes to the overall increase in mango consumption.

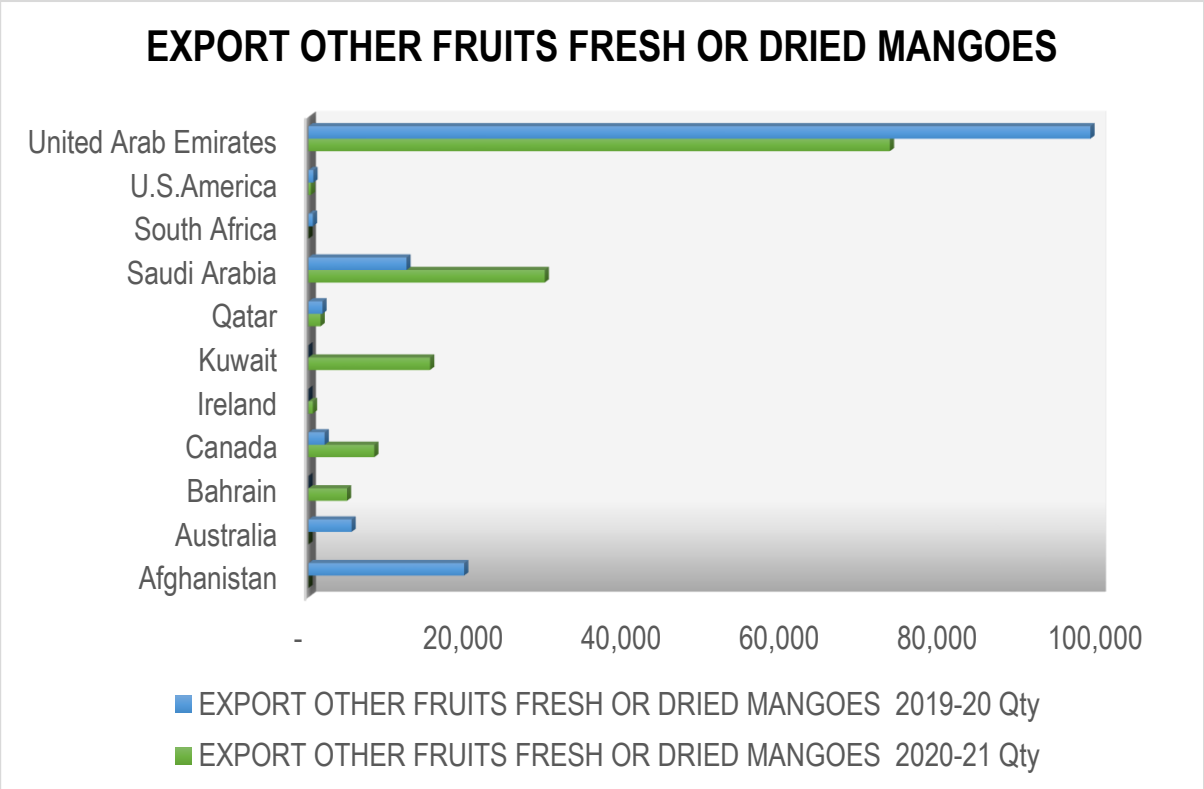


Figure 21: Pakistan Export Status of other fresh or Dried Mangoes

Source: Ministry of National Food Security and Research (2021)

Except for Pakistan, all major mango-growing countries recognize the significance of dried mango as a valuable product. In Pakistan, however, there is only one small-scale facility located in Tando Allahyar, Sindh, which dehydrates mangoes and supplies them in limited quantities to local and export markets. The Sindhri mango variety, known for its distinctive taste, holds great potential for being transformed into dried mango. The project required for establishing such facilities is not capital-intensive and can be afforded by medium-level farmers and contractors. Another variation of dried mango involves drying the mango pulp instead of mango slices, resulting in a product known as mango leather. This variation allows for the incorporation of various additives into the pulp, creating different flavors for the mango leather product.

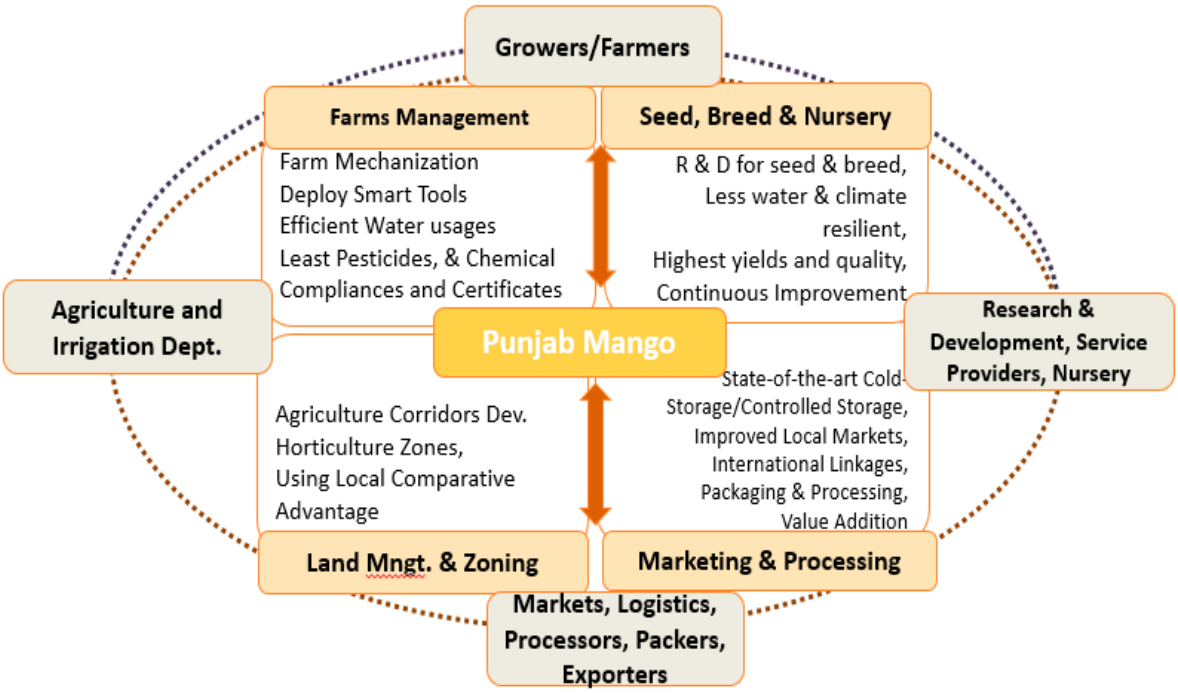
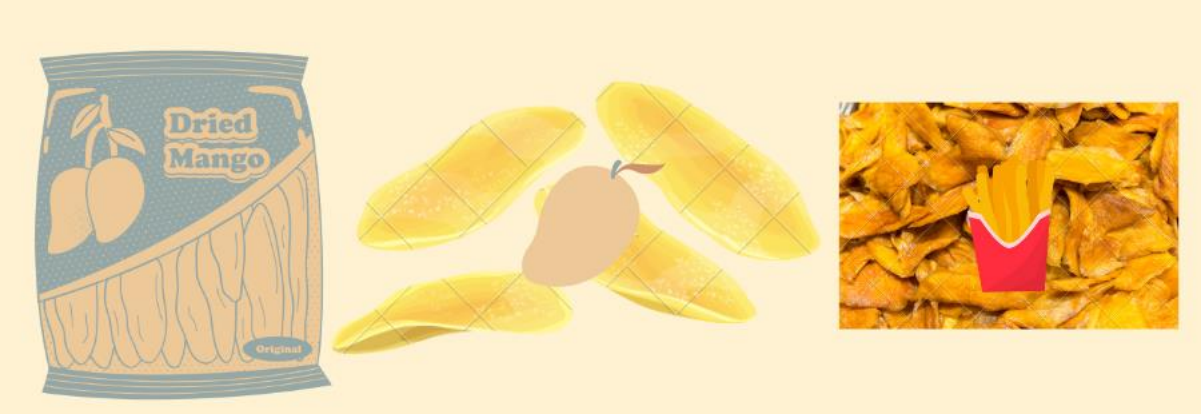


Figure 22: Proposed Punjab Mango Value Chain

Source: Ayub Agricultural Research Institute (AARI) Faisalabad/ Urban Unit

1.17.3.6. DRIED MANGO INTERVENTIONS



Stage	Interventions
Pre-Harvest	Provide technical assistance and training to farmers on pre-treatment and drying techniques
Harvesting	Provide training on proper harvesting techniques to minimize damage to the fruit
Post-Harvest	Develop and disseminate quality standards for dried mangoes
Processing	Provide technical assistance and training to processors on proper drying, packaging, and labeling techniques
Packaging and Labeling	Develop and disseminate standards for packaging and labeling of dried mangoes
Market Linkages	Establish market linkages with potential buyers and exporters, both domestically and internationally
Financing	Provide access to finance for farmers and processors to invest in the necessary equipment and infrastructure for drying mangoes
Quality Control and Certification	Establish a system for quality control and certification of dried mangoes, including testing for food safety and adherence to international standards
Infrastructure Development	Invest in the necessary infrastructure for drying mangoes, including solar dryers, storage facilities, and transportation systems
Policy and Regulatory Environment	Advocate for policies and regulations that support the development of the dried mango value chain

1.17.3.7. CHALLENGES AND ISSUES

Inputs	Production	Harvest	Markets & Logistics
Non-availability of appropriate quality fertilizer and micronutrients	Lack of extension Services and technical assistant	Lack of modern technology	Lack of farmers' connection with markets.
Declining organic matter in soils	Poor pest/disease management	Access to finance problem	Poor marketing infrastructure
Limited availability of certified, quality, and pure variety seed/seedlings	Lack of capacity to address the emerging issues in such as high-density gardens, IPM, etc.	Low automation	Lack of marketing campaign for local consumption
Water quality and availability	Intercropping with Mango orchards	Lacking infrastructure for quality maintenance	Lack of market research/ market identification
Low-quality inputs in the market	Flooding irrigation wastes water and deteriorates Mango quality	Lack of capacity and resources for small scale stakeholders to get involved in processing	No contract farming with defined quantities and quality parameter
	Inefficient use of pesticide	Few farmers adopt the latest technologies such as de-sapping to lower the mango temperature after harvesting and hot-water treatment to disinfest diseases	Little credit availability from formal institutes for any actor of cluster
	Imbalance uses of Nutrition		Low and inadequate quality of existing storage facilities
	Imbalance and sub-optimal use of fertilizer		The transportation supply chain needs to be made efficient
	Prolonged winter and sudden temperature rise affect flowering and Mango settings	Improper harvesting procedure	Improper stacking during transportation

1.17.3.8. RECOMMENDATIONS

Inputs	Farms Management & Zoning	Marketing & Access to Finance
Availability of inputs (fertilizers, herbicides, electricity, diesel, etc.)	Availability of skilled and trained labor	Mapping of countries and markets for the target mango production should be carried out.
Development of certified seed/Nursery system (Development and introduction of local marketable varieties)	Farm Mechanization Training program on plant protection, Harvesting, Packing, and processing of mango	Specific compliance, customs regulations, packaging requirements, and other related prerequisites of exports to these markets shall be identified.
Linkages with academia and international researchers for R&D	Promotion of High-Density Plantation. Development of Cluster and Site-Specific Appropriate Management Practices.	Logistics viz-a-viz cost of mango should be determined. Keeping in view potential international markets and compliance requirements thereof, a detailed marketing strategy with an overall aim to enhance exports to potential high-value export markets must be designed.
Timely availability of water and other inputs	Developing Integrated Pest Management (IPM) Strategies	
Provision of integrated/specialized extension services	Capacity Building of farmers Cultivation of Mango on High-density Planting under Drip Irrigation in new areas.	Strengthening of R&D Institutes
On-going varietal development based on market research		Social Mobilization & Networking
Promotion of Certified Nurseries		Ease of financial access and insurance bundle services.
		Establish/ update Cold Storage/Controlled atmosphere facilities for local and international market/Mandi to increase shelf life

1.17.4. DEVELOPING THE VEGETABLE CLUSTER IN DHANOTE: OPPORTUNITIES AND INTERVENTIONS

Introduction

During a discussion with a Progressive Farmer in the Tehsil Council of Kehror Pakka, the largest area for growing vegetables in the region was identified as Dhanote. This section explores the various interventions recommended by Arian Farms' Progressive Farmer, Kashif, who specializes in commercial crop cultivation. It highlights the importance of perplexity and burstiness in writing, as well as the need for diverse sentence structures.

To develop the vegetable cluster in Dhanote, a range of interventions is necessary. These include the development of seed varieties, improvements to infrastructure, the establishment of cold stores and packing houses, and exploration of value-added opportunities. By supporting the growth of the vegetable cluster, local farmers can increase their income, new jobs can be created, and the overall economic growth of the region can be enhanced.

Declining Expertise in Greenhouse Open Vegetable Concept

Dhanote has witnessed a decline in expertise concerning the greenhouse open vegetable concept. However, since 2002, tunnel farming has gained popularity and offers significant potential. Farmers from mandis, including Quetta, Peshawar, and Karachi, come to Dhanote to obtain materials for cultivation outside the border.

Collaboration and Training for Farmers

Imported hybrid seeds are prevalent in Pakistan, and universities like Muhammad Nawaz Sharif University of Agriculture, Multan and University of Agriculture Faisalabad, along with other research institutes, should collaborate to train farmers. While Mansoba is actively involved in training farmers, universities should be encouraged to train farmers in seed breeding to facilitate local production of hybrid vegetable seeds.

Cotton Belt Transformation and the Potential of Maize

Although the Multan-Lodhran area was historically considered the cotton belt, the poor quality of cotton seeds has diminished its success and potential. However, maize cultivation now holds enormous promise due to the availability of high-quality seeds.

Need for Packing Houses and Export-oriented Approach

Despite being the largest area for growing offseason vegetables, Dhanote lacks packing houses. Establishing a packing house in Dhanote for the vegetable cartel would be beneficial, especially if an export-oriented approach is desired. Moreover, growing exotic vegetables like cherry tomatoes, asparagus, iceberg lettuce, and broccoli can enhance exports. Sweet corn, if exported, has the potential to generate substantial revenue.

Infrastructure and Farm-to-Market Linkages

The vegetable growers' belt lacks proper infrastructure, with roads from Kehror Pakka to Mailsi, Vehari, Arif Wala, Burewala, and Chichi Watni being notably absent. This region, which is essential for vegetable production and also grows strawberries, requires farm-to-market linkages to optimize its potential.

Importance of Cold Stores and Drip Irrigation

Multan airport lacks cold storage facilities, which restricts the export potential of mangoes and vegetables. Drip irrigation systems are also uncommon in the district, especially in the fields. The government should provide financial assistance to farmers to maintain the supply chain effectively. Constructing cold stores, including one in Dhanote for the vegetable cluster, would allow growers to store multiple crops, such as cucumber, grapes, melon, watermelon, squash, and red chili.

Value Addition and Seed Variety Development

Value addition plays a crucial role in the global economy. Therefore, it is essential to shift from the concept of fresh vegetables to value-added products. Investment in pulping units for strawberries and tomatoes could yield favorable returns. Furthermore, given the rising dollar price, emphasis should be placed on developing a wide range of seed varieties.

Certification and Sustainable Plant Practices

Grape pruning techniques and methods to extend shelf life require further exploration, as does the certification of nurseries. Certifying all plants and ensuring rootstock identification are crucial for sustainable plant practices. Commercially grown crops in Dhanote include cucumber, grapes, strawberries, bitter gourd, onion, and melon.

1.17.4.1. PROPOSED INTERVENTIONS TO IMPROVE FRUITS & VEGETABLE MARKETS

Promote the establishment of more Fruit & Vegetable stockists:

Increase the number of Fruit & Vegetable stockists to support the growth of this sector and improve access to fresh produce for consumers.

Encourage the expansion of the vegetable stockist sector:

Provide technical assistance and financial support to individuals interested in starting a vegetable stockist business, to diversify the range of vegetables grown and sold in the region.

Support the development of value-added products from fruits & vegs:

Encourage the creation of value-added products, such as jams, pickles, and sauces, to create new market opportunities for farmers.

Improve the infrastructure for storing and transporting produce:

Improve the infrastructure for storing and transporting perishable goods, such as refrigerated trucks and warehouses, to reduce post-harvest losses and ensure quality produce.

Promote small and medium-sized food processing enterprises:

Encourage the development of small and medium-sized food processing enterprises, which can create jobs and add value to locally grown products.

Encourage sustainable farming practices:

Promote sustainable farming practices, such as conservation tillage and integrated pest management, to improve productivity and minimize the environmental impact of agriculture.

Provide training and extension services to farmers:

Provide training to enhance farmers knowledge of best practices in agriculture, including pest management, soil fertility, and new technologies.

Strengthen market linkages and improve information systems:

Improve market information systems and strengthen market linkages to ensure that farmers can access better prices and market opportunities for their produce.

Invest in research and development:

Invest in agricultural research and development to develop new crop varieties better adapted to local climate and soil conditions.

Encourage climate-smart agriculture practices:

Encourage the adoption of climate-smart agriculture practices, such as rainwater harvesting and efficient irrigation systems, to help farmers adapt to climate change and reduce greenhouse gas emissions from the sector.

1.17.5. COTTON VALUE CHAIN

Cotton is grown almost all over the world from times immemorial with probable earliest documentation of cotton usage being from the time when Peruvian mummies were clothed in it. At present cotton is grown all over the world, i.e. in India, the USA, Russia, China, Brazil, Egypt, Pakistan, Turkey, Mexico, and Sudan are leading cotton-growing countries. Cotton is the most important fibre crop which plays an important role in the economic and social affairs of people. Cotton is grown chiefly for its fibre and also for several other purposes such as for making threads for mixing with other fibres and for extraction of oil from cottonseed and leftover can also be used as animal feed in the livestock sector. All these uses give a high industrial value to this crop.

1.17.5.1. GLOBAL COTTON PRODUCTION

Cotton is grown in subtropical and seasonally dry tropical areas in both the northern and southern hemispheres, although most of the world's production takes place north of the equator. The main producing countries are India, China, the United States, Brazil, and Pakistan. Together, these countries account for more than three-quarters of global production.

This graph shows the world's leading cotton-producing countries in the crop year 2020/2021. In that year, cotton production in China amounted to around 6.42 million metric tons whereas Pakistan is producing 980 million metric tons and is at fifth position in terms of global production.

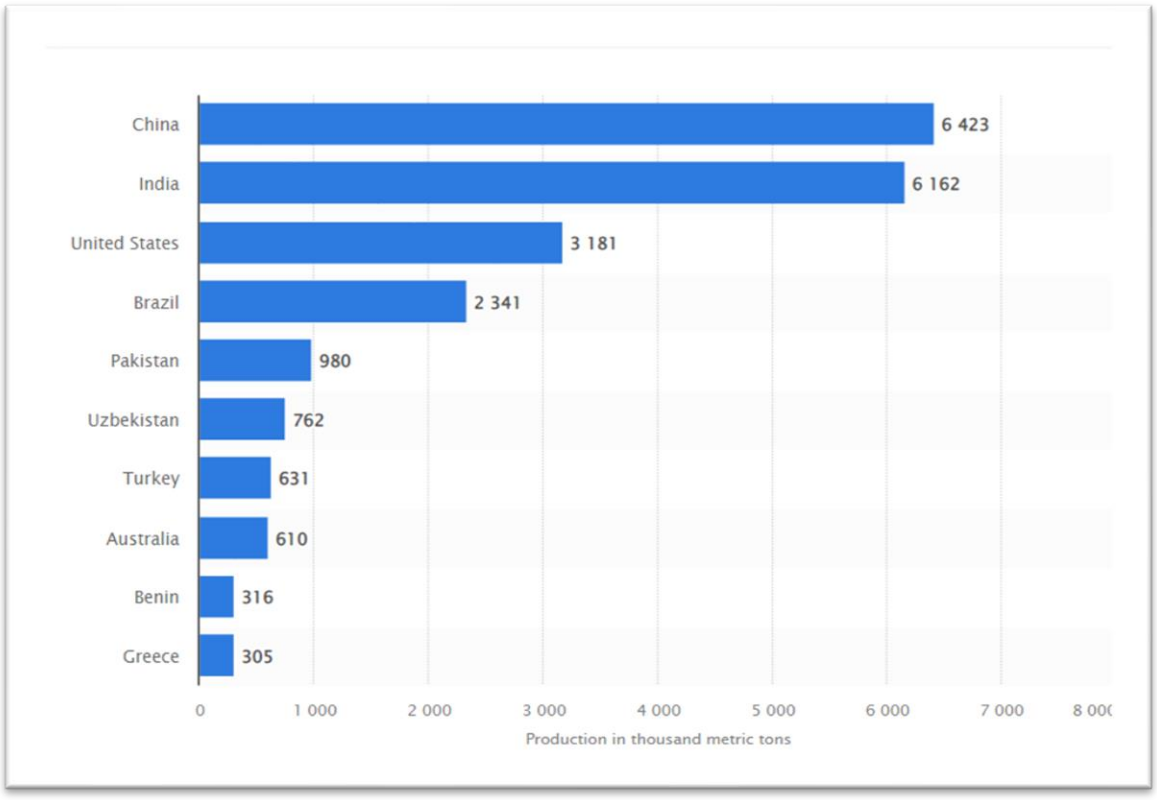


Figure 23: Global Cotton Production

Source: Statista

Pakistan Exports of cotton were US$3 million during 2019. For the year 2020, Worldwide Cotton Market was US$ 47 Billion. Pakistan stands at the 6th position globally producing US$ 2 million during the year 2020.

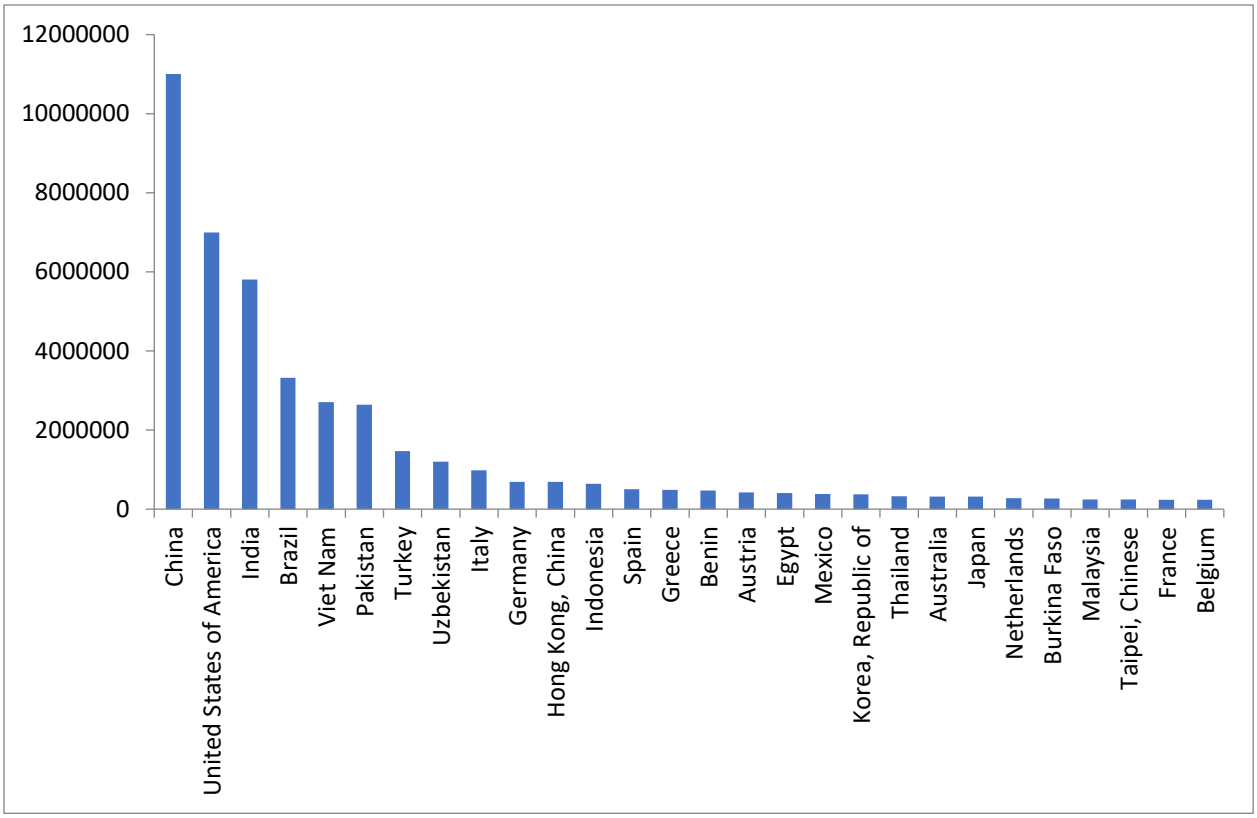


Figure 24: Cotton Exports

Source: Trade Map

1.17.5.2. VALUE CHAIN

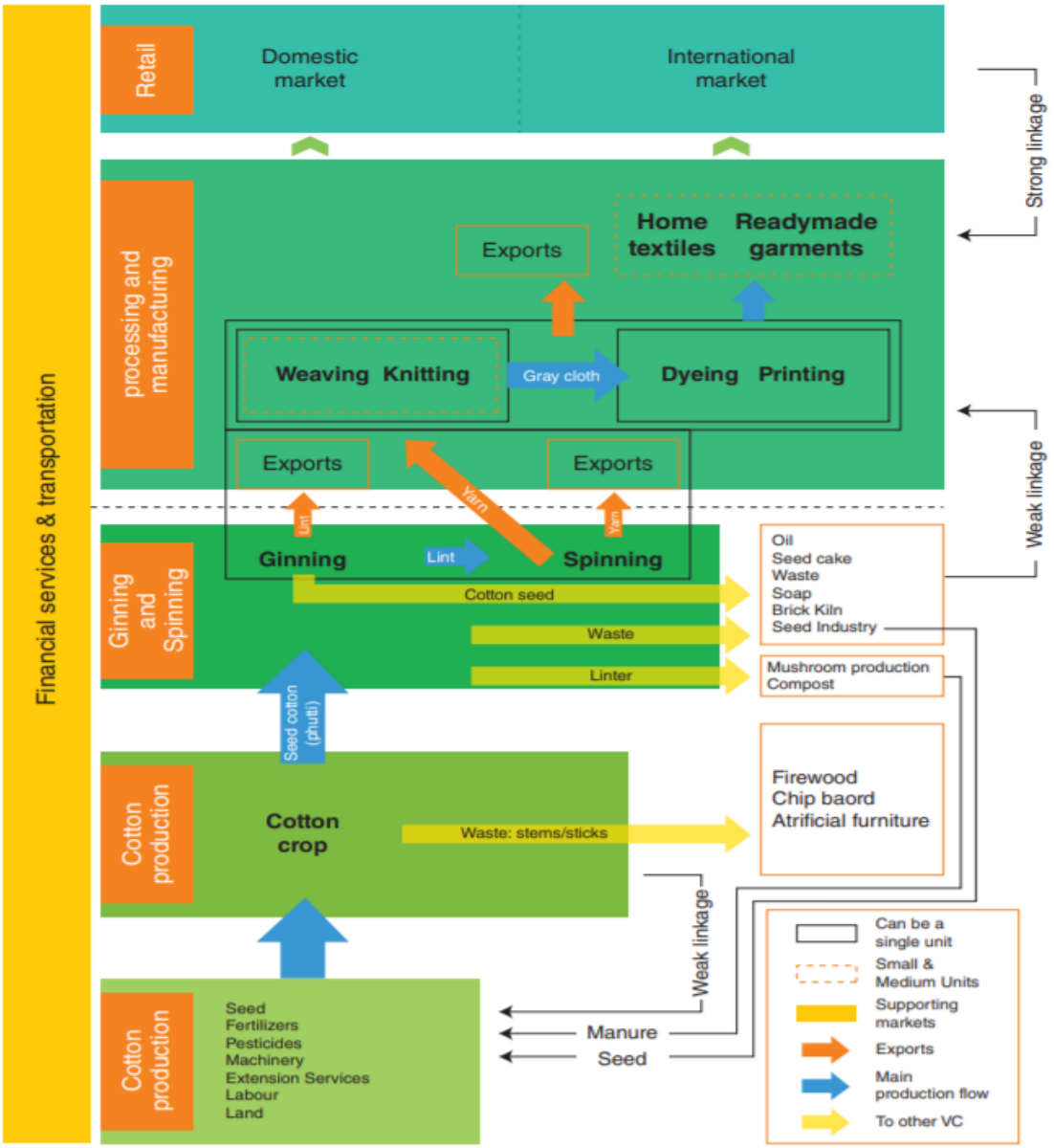


Figure 25: Cotton Value Chain

1.17.5.3. CHALLENGES AND ISSUES

Inputs	Production	Logistics & Process	Markets
Low Seed Quality Provision of uncertified seed The high moisture content at the time of ginning and storage of seed Slow approval of cotton varieties. Lack of proper infrastructure of private seed companies. High pest populations like pink bollworm, red cotton bug, and the dusky bug can deteriorate seed quality. Picking of undeveloped and immature bolls ultimately results in low germination. Low provision of Fertilizers, Pesticides Lack of Extension Services	Lack of proper seed production system Floods pose an imminent threat to cotton production in Pakistan Awareness and capacity building of farmers and pickers Rising temperature is gradually affecting the growth of the cotton plant. Inefficient Irrigation systems No disease-free zones were identified for new plantation Lack of extension Services and technical assistant Poor pest/disease management Change in rainfall patterns also affects the quality of cotton crop Specialized farmer training and cotton clinics Lower Yield per Hectare Inadequate Fertilizers Use	Technically sound and mobile extension agents Awareness about and integration with BCI international volunteer standards Unavailability of ease of credit Lack of availability of Machinery	Lack of regulation Poor marketing infrastructure Lack of marketing campaign for local consumption

1.17.5.4. RECOMMENDATIONS

Inputs	Farms Management & Zoning	Marketing & Access to Finance
Production of early generation seed i.e. breeders' nucleus seed (BNS) and Pre Basic Seed (PBS). Improving the infrastructure of Punjab Seed Corporation and private seed companies. Strict implementation of Cotton Control Ordinance, 1966 Clean picking- Reduction in trash from 8% to 3%. Penalizing Breeders/Institutional Heads for non-maintenance of registered varieties. Certification is strictly restricted to seed crops produced from certified pre-basic or certified basic seed, as the case may be. Open auction of pre-basic seed at higher rates with a 25% share of the breeder(s). Up-gradation of Seed grading and processing facilities Breeding for high seed index varieties	Up-gradation of ginning industry: A roller ginning machine may be introduced to increase staple length and fiber strength. Expediting variety approval system Nutrition Management of Cotton Pink Bollworm Management Development of climate-resilient varieties Establishment of an autonomous excellence centre for cotton research and development at Multan-market Germplasm enhancement Biological control through the establishment of Biocontrol Labs Launching of integrated pest management (IPM). The active role of Monitoring Teams is to check environmentally un-approved transgenic crop varieties.	Latest GMO technology acquisition from foreign countries Announcement of minimum support price for cotton Fixing of cotton window (Sowing window may be re-standardized) Crop zoning Exploring new potential pockets in all four provinces Encourage use of certified seed Support and encourage Mechanical picking Ban on cotton import from September to March Promotion of improvement of soil health Improvement of spraying techniques Ensure incentives for progressive cotton farmers for quality seed production

1.17.6. ONION VALUE CHAIN

Onion is a significant seasoning widely utilized in households throughout the year, across various socioeconomic groups. Its green leaves, as well as immature and mature bulbs, are consumed raw or used in vegetable preparations. However, the availability of onions falls short during December-January, leading to a significant increase in prices, often reaching more than five times the normal season. The demand for onions exhibits a high income elasticity, meaning that as the population, economy, and urbanization grow, the demand for onions also increases (Fateh, 2009).

In Pakistan, the yield of onion crops is relatively low compared to the global market. Onion cultivation spans an area of 136 thousand hectares, with a production of 1.74 million tons across all provinces and regions, each with varying harvesting periods, resulting in a dispersed availability of fresh onions. Price fluctuations for onions follow a seasonal pattern, with prices dropping during the post-harvest period and soaring during the off-season. Consequently, farmers are unable to fetch reasonable prices for their produce, while consumers are burdened with high prices during the off-season. To mitigate this situation, the government is compelled to import onions during the off-season to augment the supply in the market.

There is significant potential to increase both the area and production of onions in the Multan & Lodhran district by adopting new technologies and utilizing high-yielding onion seed varieties. This would help address the issue of high prices during the off-season, benefiting both farmers and consumers.

1.17.6.1. CHALLENGES AND ISSUES

Inputs	Production	Harvest	Markets and Logistics
Onions crops are mixed with other crops like wheat, mustard, Sugarcane and other vegetables that causes disease infection. Low uptake and usage of fertilizers and pesticides. Limited availability of certified, quality, and pure variety seed/seedlings. Non-availability of appropriate quality fertilizer and micronutrients in local input market. Unhealthy and diseased seed plantation	Heavy rainfall cause reduction in seed and bulb yield. Sometimes monsoon rainfall causing serious damage to onion nursery. Unhealthy and diseased seed plantation. Traditional crop management practices are faulty. Pre-harvest losses due to lack of skills and infrastructure.	High post-harvest loss Unavailability of processors and modern processing plants. Poor post-harvest management practices. Lack of technologies, and equipment for canning. Poor post Handling.	Most farmers have no storage facility and they sell the produce at field level. Majority of farmers and traders do not follow the commodity handling precautions and protocols. High fuel cost especially diesel used in transportation and high freight cost. Farmers are disconnected from high value markets. No cold chains or cold storage are available Producers have little information about the quality requirements in national and international Markets

1.17.6.2. RECOMMENDATIONS

Inputs	Farms Management and zoning	Marketing & Access to Finance
Investment in R&D and processing and quality infrastructure. Training of Farmers and contractors to adopt production and harvesting practices which can maintain the quality of onion.	Increase in income for farmers, middlemen, and traders. Crop management practices followed by the growers need to be further strengthened with new technologies and knowledge. Mechanized harvesting by the onion harvesting machines. Improved Extension Services.	Availability of modern processing plants, technologies, and equipment for canning and processing. Adaptation of international quality standards at each segment of the value chain to promote exports. Replace the onion varieties with high yielding modern varieties and supply their seedlings through certified nurseries.

1.17.7. TOMATO VALUE CHAIN

Tomato is a globally significant vegetable and serves as a cash and industrial crop in many regions. In Pakistan, tomatoes are widely used in cooking as vegetables, condiments, and salads, making them a common and essential kitchen ingredient. The demand for tomatoes exhibits a high income elasticity, meaning that as population, economic growth, and urbanization increase, the demand for this vegetable also rises.

In terms of acreage, production, yield, commercial use, and consumption, tomatoes hold a prominent position among vegetables. They are consumed on a daily basis and form a crucial component of the Pakistani diet. In Pakistan, tomato cultivation covers an area of 150 thousand hectares, with a production of 57,094 tons. Sindh is the leading province in tomato production, cultivating tomatoes on 67.46 thousand hectares, followed by Balochistan with 31.38 thousand hectares and Punjab with 18.29 thousand hectares.

Improving productivity is a key focus for all economies as it leads to increased trade. Productivity, innovation, and exports are closely linked. Developed countries achieve high productivity per hectare through advanced technology adoption, while developing countries strive for productivity enhancement. Pakistan, being a developing country with a large population, heavily relies on agriculture, with 67% of the population engaged in the sector. Horticulture contributes 11% to the total value added in agriculture. In Pakistan, the yield of various crops remains mostly stagnant, but tomatoes hold a significant position among horticultural crops. The potential areas for tomato cultivation in the Multan Division encompass the districts of Multan, Lodhran, and Vehari.

1.17.7.1. CHALLENGES AND ISSUES

Inputs	Production	Harvest	Markets & Logistics
Expensive seeds Seed efficiency is 80 % No locally Produced Cheap seed available in the market Lack of institutional support to provide database and inventorying of certified, disease-free seed plants. Unreliable supply of certified plants. Lack of registered nurseries Poor nursery management practices	Shortage of Skilled Labor. Most of the Production is in the Peri-Urban area due to the labor supply. Fail to meet Demand annually because of limited capacity. Inadequate supply of plants required for new zones. No disease-free zones were identified for new plantation Low quality of pesticide. Low Price in the local market Lack of extension Services and technical assistant Poor pest/disease management Imbalance uses of Nutrition	Post-Harvest Losses up to 20% Incorporate modern harvesting technologies Inadequate and scarcity of existing facilities for Grading, Polishing, and sizing for local market demands. Quality assurance mechanisms and standardized certifications for export are missing. Lack of modern technology Access to finance problem Perishable goods and no storage capacities No Pulping unit nearby.	Role of the middle man. Lack of regulation Poor marketing infrastructure Lack of marketing campaign for local consumption Lack of market research/ market identification Poor access to the high-end market Lack of presence at international exhibitions/ trade shows Lack of support from trade counselors posted abroad in opening new markets/relationship management in existing markets

1.17.7.2. RECOMMENDATIONS

Inputs	Farms Management & Zoning	Marketing & Access to Finance
Availability of Cheap and HYV seeds in the market	Increasing cropping area and Declaring peri-urban area to be Tomato zones.	Developing state-of-the-art Cold-Storage
Develop new seed varieties	Availability of skilled and trained labor	Improved local markets, & international linkages
DNA & all other required testing are for mother plant and scion varieties	Provide Farm Mechanization	Provide an incentive for setting up new industries
Identify protocol for export of tomatoes to the various markets.	Availability of cheap and efferent Pesticides	Providing Pulping Units
Upgradation and capacity building of their staff	Awareness and training of farmers on standardized Tomato farming management and improved irrigation practices	Availability of alternative Value addition Products of Tomatoes.
Linkages with academia and international researchers for R&D	Training of labor on Grading, Sorting, Packaging, usage of processing equipment	Develop packaging manufacturing industry for fresh fruit
Timely availability of water and other inputs	Provision of extension services	Develop local manufacturing industry to manufacture Grading/Sorting/Packing lines
		Develop zoning-based state-of-the-art trading market. Identification of demand in the international and local market

1.17.8. GUAVA VALUE CHAIN

Guava is a widely recognized fruit with substantial importance in many regions. In Pakistan, guavas are highly valued and consumed for their culinary versatility, including fresh consumption, processing, and various culinary applications. The demand for guavas exhibits sensitivity to income, meaning that as population, economic growth, and urbanization increase, the demand for this fruit also rises.

In terms of cultivation area, production, yield, commercial utilization, and consumption, guavas hold a notable position among fruits. They are consumed regularly and form a significant component of the Pakistani diet. In the Multan Division of Pakistan, guava cultivation is feasible in areas such as Tehsil Mian Channu of Khanewal district and Vehari, Burewala and Mailsi of Vehari district.

Efforts to enhance productivity are vital for economic growth and trade expansion. Productivity, innovation, and exports are interrelated factors. Developed countries achieve high productivity

per unit area through advanced technological practices, while developing countries focus on improving productivity. Although crop yield remains relatively stagnant for various crops, guavas continue to hold a significant position within the horticultural sector.

1.17.8.1. CHALLENGES AND ISSUES

Inputs	Production	Harvest	Markets & Logistics
Expensive seeds Lack of locally produced cheap seeds Insufficient institutional support: Unreliable supply of certified plants Lack of registered nurseries Poor nursery management practices: Inadequate management practices in guava nurseries hinder the production of healthy plants.	There is a scarcity of skilled labor, which affects guava production. Guava production is mainly limited to peri-urban areas due to labor availability, resulting in insufficient production to meet demand. The supply of guava plants for expansion into new cultivation zones is inadequate. The identification of disease-free zones for new guava plantations is lacking. Inadequate management practices for pests and diseases adversely impact guava production. Improper use of fertilizers and nutrients affects guava crop growth and productivity.	Inadequate post-harvest management practices. The adoption of modern harvesting technologies is needed to minimize losses and maintain fruit quality. Insufficient infrastructure for grading, polishing, and sizing guavas hinders meeting local market demands. The absence of quality assurance mechanisms and certifications poses challenges for exporting guavas. Limited access to modern technology impedes efficient guava harvesting and post-harvest practices. Limited access to finance: Perishable goods and lack of storage capacities: The lack of pulping units in proximity adds challenges for processing guavas.	Middlemen play a significant role in guava marketing, affecting farmers' profitability. Insufficient regulatory measures contribute to market challenges and unfair practices. Poor marketing infrastructure: Limited marketing campaigns hinder the promotion of guavas for local consumption. Insufficient market research and identification impede targeted marketing strategies. Difficulties in accessing high-end markets restrict opportunities for premium guava sales. The absence of guava representation at international events limits exposure and market opportunities. Lack of support from trade counselors

1.17.8.2. RECOMMENDATIONS

Inputs	Farms Management & Zoning	Marketing & Access to Finance
Ensure the availability of affordable and high-yielding variety (HYV) guava seeds in the market. Invest in research and development to develop new guava seed varieties. Conduct DNA and other required tests for mother plant and scion varieties to ensure quality and disease resistance. Establish protocols for the export of guavas to different markets. Enhance the capacity and skills of staff involved in guava farming through training and upgradation. Foster linkages with academia and international researchers for research and development initiatives. Ensure timely availability of water and other necessary inputs for guava cultivation	Encourage the expansion of guava cultivation areas and designate peri-urban areas as guava zones. Improve access to skilled and trained labor for guava farms. Promote farm mechanization to enhance efficiency and productivity. Provide affordable and effective pesticides for guava pest management. Conduct awareness programs and training for farmers on standardized guava farming practices and improved irrigation techniques. Train labor in grading, sorting, packaging, and the usage of processing equipment. Strengthen extension services to disseminate knowledge and best practices to guava farmers.	Establish state-of-the-art cold storage facilities to maintain guava quality and extend shelf life. Develop local and international markets for guava, including improved marketing channels and linkages. Provide incentives for setting up new guava processing industries. Facilitate the establishment of pulping units for value-added guava products. Explore alternative value addition products from guavas. Support the development of packaging manufacturing industries for fresh guava fruit. Promote the establishment of local manufacturing industries for grading, sorting, and packing lines. Identify demand in local and international markets and align guava production accordingly.

1.17.9. WATER MELON VALUE CHAIN

Watermelon is a widely recognized fruit with significant importance in many regions. In Pakistan, watermelons are highly valued and consumed for their refreshing taste and nutritional benefits. The demand for watermelons is influenced by income levels, population growth, economic development, and urbanization.

Watermelons hold a prominent position in terms of cultivation area, production, yield, commercial utilization, and consumption among fruits in Pakistan. They are consumed regularly and contribute significantly to the Pakistani diet. In the Multan Division of Pakistan, suitable areas for watermelon cultivation include Tehsil Kahror Pacca of Lodhran district and Burewala, and Mailsi of Vehari district.

The export status of watermelons in Pakistan, specifically in Multan, has witnessed remarkable growth in recent years. According to published articles, Pakistan exported approximately 150,000 metric tons of watermelons in the last fiscal year. This marks a significant increase from previous years, reflecting the growing demand for Pakistani watermelons in international markets.

In 2022, Multan alone exported around 70,000 metric tons of watermelons, contributing significantly to the country's agricultural economy. However, it is worth noting that challenges exist in the export process. Quality control and packaging standards are crucial factors that exporters need to address to maintain international market competitiveness. Efforts are being made to enhance these aspects to meet the expectations and requirements of global buyers.

Additionally, logistical issues, such as transportation and storage, have also been identified as areas that require attention. Improving infrastructure and establishing efficient supply chains will help streamline the export process and reduce costs, making Pakistani watermelons more competitive in the international market.

Despite these challenges, the future prospects for watermelon exports from Multan look promising. The unique taste, quality, and size of Pakistani watermelons continue to attract buyers from various countries. With a focused approach on quality control, packaging, and logistical improvements, Multan's watermelon exports are poised to thrive further and contribute significantly to Pakistan's economy in the coming years.

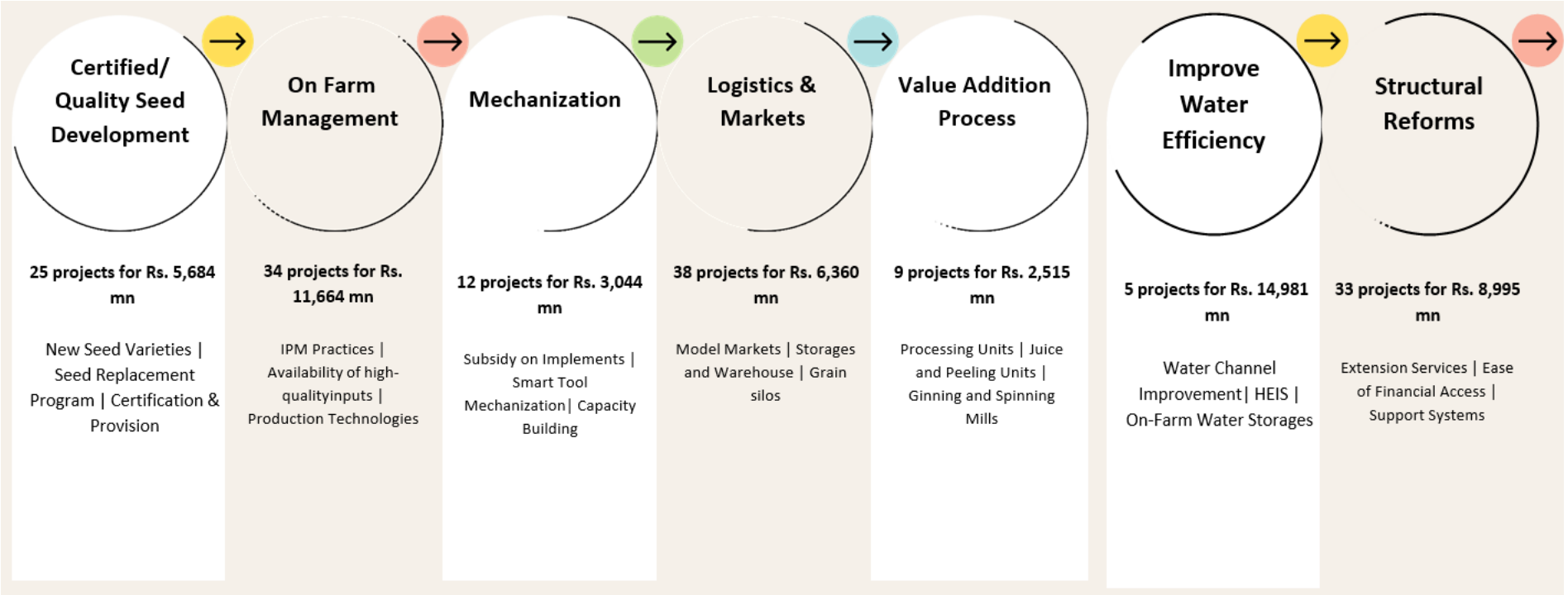
1.17.9.1. CHALLENGES AND ISSUES

Inputs	Production	Harvest	Markets & Logistics
Expensive seeds and lack of locally produced cheap seeds. Insufficient institutional support and unreliable supply of certified plants. Lack of registered nurseries and poor nursery management practices hinder the production of healthy watermelon plants.	Scarcity of skilled labor affecting watermelon production. Limitation of watermelon production to peri-urban areas due to labor availability. Inadequate supply of watermelon plants for expansion into new cultivation zones. Lack of identification of disease-free zones for new watermelon plantations. Inadequate management practices for pests and diseases. Improper use of fertilizers and nutrients impacting watermelon crop growth and productivity.	Inadequate post-harvest management practices. Need for adoption of modern harvesting technologies to minimize losses and maintain fruit quality. Insufficient infrastructure for grading, and polishing watermelons. Lack of quality assurance mechanisms and certifications for exporting watermelons. Limited access to modern technology for efficient harvesting and post-harvest practices.	Limited access to finance for watermelon farmers. Lack of pulping units in proximity adds challenges for processing watermelons. Insufficient regulatory measures contribute to market challenges and unfair practices. Poor marketing infrastructure for watermelons. Limited marketing campaigns hinder the promotion of watermelons for local consumption. Insufficient market research and identification impede targeted marketing strategies. Difficulties in accessing high-end markets restrict opportunities for premium watermelon sales.

1.17.9.2. RECOMMENDATIONS

Inputs	Farms Management & Zoning	Marketing & Access to Finance
Ensure availability of affordable and high-yielding watermelon seeds in the market. Invest in research and development to develop new seed varieties for improved watermelon production. Conduct DNA and other necessary testing for mother plants and scion varieties to ensure quality and disease resistance.	Increase cropping area for watermelon and designate peri-urban areas as specific watermelon zones. Provide training and capacity building programs for farmers to enhance their management skills. Foster linkages with academia and international researchers for research and development in watermelon cultivation. Ensure timely availability of water and other essential inputs for watermelon farming. Ensure the availability of skilled and trained labor for watermelon farming and post-harvest activities.	Develop state-of-the-art cold storage facilities to maintain watermelon quality and prolong shelf life. Improve local markets and establish international linkages for watermelon trade. Provide incentives for setting up new industries related to watermelon processing, such as pulping units. Promote value addition by exploring alternative products derived from watermelons. Support the development of a packaging manufacturing industry for fresh watermelon products. Establish local manufacturing facilities for grading, sorting, and packaging lines. Develop zoning-based trading markets with advanced infrastructure to meet domestic and international demand for watermelons. Identify export protocols and market requirements for watermelon to facilitate international trade.

1.16 SUMMARY INTERVENTIONS



TOTAL: 53,243 mn

1.17 **KEY INTERVENTIONS**

The urban unit recognizes that some important interventions need to be addressed on short, medium, and long-term project scales.

Crops	Phase	Interventions	Cost (Tentative) in Million Pkr
Cotton	Short-term	Acquire germplasm and technology, maintain high-quality inbred lines, and produce sufficient high-quality breeder seed.	650
	Short-term	Introduction of IPM practices for effective insect/pest control in the area.	200
	Short-term	Ease of financial access and insurance bundle services along with fin-tech services for the provision of credit	300
	Short-term	Provision of fertilizer and pesticide on subsidy through Kissan card	982
	Short-term	Provide well-resourced and staffed public research systems at the provincial level with collaboration of international research institutes	900
	Short-term	Improve water storage capacity to ensure sufficient supply during the cotton-growing season.	450
	Short-term	Upgrade ginning equipment to improve lint quality.	450
	Short-term	Implement the seed act and make revisions to discourage the informal sector through quality control inspector	250
	Short-term	Train and support farmers in using quality inputs, preventive management, and mechanization services.	200
	Short-term	Conduct market surveys to identify demand in international and local markets.	100
	Medium-term	Introduction of production technologies and implements keeping in view the climate change.	360
	Medium-term	Up-gradation of Seed grading and processing facilities.	300
	Medium-term	Use public-private partnerships (PPPs) to access advanced seed technology with international partners	600
	Medium-term	Enhance capacity for extension services through PPPs, including agri-graduate field engagement programs and ICT-led extension and advisory services.	500
	Medium-term	Develop strategies to address labor shortages, such as training and incentivizing local labor.	450
	Medium-term	Build capacity of ginners with revised standards to ensure quality assurance at each stage.	300
	Medium-term	Establishment of Foundation seed cell to strengthen the seed production facilities	890
	Long-term	Introduction of high-yielding cotton varieties compatible with local conditions.	250
	Long-term	Development of Ginning cotton industry & Spinning cotton industry to meet international standard	1000

	Long-term	Implement structural reforms by establishing an independent governing authority (Cotton Council) that works across all stakeholders in the value chain.	150
	Long-term	Announce intervention prices, ensuring a margin for farmers, and consider adopting a minimum ensured price (MEP) system, as seen in India.	150
Total			9,432
Crops	**Phase**	**Interventions**	**Cost (Tentative) in Million Pkr**
Mango	Short-term	Training program on plant protection, Harvesting, packing, and processing of mango	250
	Short-term	Provide training and education to farmers on modern farming practices like good agricultural practices (GAP) and high-density plantation	60
	Short-term	Provide training and education to farmers and value chain actors on post-harvest management practices to reduce losses and maintain quality	40
	Medium-term	Cultivation of Mango on High-density Planting under Drip Irrigation in new areas.	975
	Medium-term	Establish/ update Cold Storage/Controlled atmosphere facilities for local and international market/ mandi to increase shelf life.	600
	Medium-term	Develop new varietal characteristics in terms of shelf life, robustness in handling, and ability to withstand phytosanitary treatments (HWT, VHT, or irradiation) to target high-end markets.	450
	Medium-term	Strengthning of Mango Research Station	1100
	Medium-term	Extend the mango area by strengthening the production of mangoes especially in Rahim Yar Khan (RYK)	80
	Medium-term	Develop and enforce quality compliance measures to improve the quality of mangoes in both domestic and international markets	40
	Long-term	Improve profitability across the value chain stakeholders through fair pricing and support to small farmers by developing blockchain	45
	Long-term	Develop climate-smart agricultural practices to adapt to climate change	70
	Long-term	Strengthen market linkages and improve market information systems to ensure that farmers and processors can access better prices and market opportunities for their products.	35
	Long-term	Promote the export of the most in-demand mango varieties, such as Chenab Gold, to increase profitability.	110
	Long-term	Develop mango byproducts, such as mango toffee etc, to increase profitability & Increase value addition by building more pulping units to produce pulp according to international standards for export purposes.	225
	Long-term	Upgrade research and development, and build research labs for dried mangoes to develop new mango byproducts.	45
	Long-term	Standardize and establish modern nurseries to improve the quality of mangoes and develop a monitoring and evaluation system to maintain quality.	55
Dried Mango	Short-term	Provide technical assistance and training to farmers on pre-treatment and drying techniques	50

	Short-term	Provide training on proper harvesting techniques to minimize damage to the fruit	50
	Short-term	Provide technical assistance and training to processors on proper drying, packaging, and labeling techniques	70
	Medium-term	Develop and disseminate quality standards for dried mangoes	45
	Medium-term	Develop and disseminate standards for packaging and labeling of dried mangoes	60
	Medium-term	Establish market linkages with potential buyers and exporters, both domestically and internationally	50
	Long-term	Provide access to finance for farmers and processors to invest in the necessary equipment and infrastructure for drying mangoes	200
	Long-term	Establish a system for quality control and certification of dried mangoes, including testing for food safety and adherence to international standards	80
	Long-term	Invest in the necessary infrastructure for drying mangoes, including solar dryers, storage facilities, and transportation systems	200
	Long-term	Advocate for policies and regulations that support the development of the dried mango value chain	65
Total			**5,050**

Crops	Phase	Interventions	Cost (Tentative) in Million Pkr
Lady Finger	Short-term	Seed replacement program; through multiplication of pre-basic and basic quality seed developed by VRI by introducing private seed companies to reduce import bill	314
		Provision of inputs (Fertilizer, Pesticides and Implements) on subsidy to develop ladyfinger cluster	171
	Medium-term	Organizing labor training programs with the help of VRI to ensure skill labor availability in the Crop Cluster	150
		Establishment of market in the crop cluster with storage, packing and grading facilities to ensure quality	200
		Establishment of value-added production unit by incentivizing private sector	60
	Long-term	Development of Certified Seed Varieties (Pre basic, basic and multiplication)	200
Total			**1,095**
Canola	Short-term	Provision of High-Quality seed; through multiplication of pre-basic and basic quality seed developed by Oilseed Research Institute by introducing private seed companies to reduce import bill	250
		Introducing policy for the provision of Support price till market development.	150
		Organizing competitions for the appreciation of best growers on provincial and district level.	150
		Arrange seminars at district level in core oilseed districts to create awareness about best management practices/production technology for selected crops during Rabi and Kharif season.	150

		Provision of inputs (Fertilizer, Pesticides and Implements) on subsidy to develop crop clusters.	533
	Medium-term	**Promote mechanization for oilseed crops in order to minimize post-harvest losses and get good yields.**	300
		Ensure Hybrid Seed Availability through National and Multinational Seed Companies.	300
		Incentivizing private sector by credit through banks for the establishment of Oil extraction units in clusters.	600
	Long-term	**Establishment of state-of-the-art oilseed market with storage, packing and grading facilities to ensure quality.**	160
Total			**2,593**
Water Melon	**Short-term**	**Good Agricultural Practices (GAP) and Food Safety Management System (FSMS)**	170
	Medium-term	**Provision of High-Quality seed; through multiplication of pre-basic and basic quality seed developed by Research Institute by introducing private seed companies to reduce import bill**	180
		Introducing Watermelon climate smart agronomic practices with the help of HRI	110
		Integrated soil and water management practices for Watermelon production	
		Incentivize and subsidize farmers for Watermelon harvesting and post- harvest management	130
		Incentivizing private sector by credit through banks for to introduce Watermelon value addition	200
	Long-term	**Incentivize and subsidize farmers for Mechanization of watermelon production activities**	250
		Development of Certified Seed (Pre basic, basic and multiplication) to the Farmer of peas.	200
Total			**1,240**
Crops	**Phase**	**Interventions**	**Cost (Tentative) in Million Pkr**
Guava	**Short-term**	**Incentivize and subsidize farmers for Development of best agronomic practices**	140
		Provision of inputs (Fertilizer, Pesticides and Implements) on subsidy to develop gram cluster	150
	Medium-term	**Capacity building of the institutes to Improve access to extension & technology**	180
		Experimenting with GAP as a strategy to open Guava markets	190
	Long-term	**Development of Certified Seed (Pre basic, basic and multiplication)**	170
Total			**830**
Bitter gourd	**Short-term**	**Local seed varieties replacement program; through multiplication of pre-basic and basic quality seed developed by Research Institute by introducing private seed companies to reduce import bill**	265

		Provision of inputs (Fertilizer, Pesticides and Implements) on subsidy to develop Bitter gourd cluster	131
	Medium-term	**Organizing labor training programs with the help of VRI to ensure skill labor availability in the Crop Cluster**	120
		Establishment of markets of Bitter gourd cluster with storage, packing and grading facilities to ensure quality.	100
		Incentivizing private sector by credit through banks for to introduce Establishment of Value-Added products	35
	Long-term	**Development of Certified Seed Varieties (Pre basic, basic and multiplication)**	130
Total			**781**
Garlic	**Short-term**	**Local seed varieties replacement program; through multiplication of pre-basic and basic quality seed developed by Research Institute by introducing private seed companies to reduce import bill**	141
		Provision of inputs (Fertilizer, Pesticides and Implements) on subsidy to develop garlic cluster.	130
	Medium-term	**Organizing labor training programs with the help of VRI to ensure skill labor availability in the Crop Cluster**	90
		Establishment of garlic market in garlic cluster with storage, packing and grading facilities to ensure quality.	110
		Incentivizing private sector by credit through banks for Establishment of Garlic powder and paste production unit	70
		Strengthen and capacity building programs for the provision of specialized extension services.	80
	Long-term	**Development of Certified Seed (Pre basic, basic and multiplication) to the Farmer of Garlic.**	245
		Incentivize and subsidize farmers for Mechanization of Garlic production activities	220
Total			**1,086**

Crops	**Phase**	**Interventions**	**Cost (Tentative) in Million Pkr**
Onion	**Short-term**	**Local onion seed varieties replacement program**	314
		Provision of inputs (Fertilizer, Pesticides and Implements) on subsidy to develop onion cluster	171
	Medium-term	**Capacity building of labor for onion harvesting**	150
		Establishment of onion market in onion cluster	200
		Establishment of onion powder and other Value Addition	60
	Long-term	**Development of Certified Seed Varieties (Pre basic, basic and multiplication)**	200
Total			**1,095**

Tomatoes	Short-term	Provision of inputs (Fertilizer, Pesticides and Implements) on subsidy to develop tomato cluster.	696
		Local tomato seed varieties replacement program.	300
	Medium-term	Establishment of Tomato paste production unit	200
		Establishment of CA (Control Atmosphere) storage	180
		Establishment of tomato market in tomato cluster.	200
	Long-term	Development of Certified Seed (Pre basic, basic and multiplication) to the Farmer of Tomato.	300
Total			**1,876**
Crops	**Phase**	**Interventions**	**Cost (Tentative) in Million Pkr**
Chillies	Short-term	Training of farmers in cultivation, harvesting, packing, and storage of these crops.	150
	Short-term	Provision of inputs (Fertilizer, Pesticides, and Implements) on subsidy to develop chilies cluster.	196
	Medium-term	Establishment of chilies market in its cluster.	200
	Medium-term	Establishment of the chilies processing unit (dry chili, hot sauce & chili powder).	50
	Long-term	Development of hybrid chilies varieties and cultivation under controlled environment.	300
Total			**896**
Citrus	Short-term	Conduct market survey to identify demand in international and local market for Kinnow and other varieties and identifying protocol for export of citrus to the various markets & conduct survey of registered nurseries. All nurseries to be given targets to produce 20 million plants & monitor them.	200
	Short-term	Incentivize and subsidize farmers for Integrated Orchard Management to minimize disease spread and crop damage	4000
	Medium-term	Incentivizing private sector by credit through banks for the establishment of Citrus processing unit within the crop clusters	320
	Medium-term	Incentivizing private sector by credit through banks for the establishment of Citrus juice processing unit within the crop clusters	200
	Medium-term	Incentivizing private sector by credit through banks for the establishment of Cold storage within the crop clusters	600
	Long-term	Development of Certified Seed Varieties (Pre basic, basic and multiplication) according to the international market demand	350
Total			**5,670**
Crops	**Phase**	**Interventions**	**Cost (Tentative) in Million Pkr**

Fruits & Vegetables	**Short-term**	**Improve the infrastructure for storing and transporting produce: Improve the infrastructure for storing and transporting perishable goods, such as refrigerated trucks and warehouses, to reduce post-harvest losses and ensure quality produce.**	200
	Short-term	**Provide training and extension services to farmers and stockists: Provide training to enhance farmers and stockists' knowledge of best practices in agriculture, including pest management, soil fertility, and new technologies.**	150
	Short-term	**Strengthen market linkages and improve information systems: Improve market information systems and strengthen market linkages to ensure that farmers and stockists can access better prices and market opportunities for their produce.**	100
	Medium-term	**Encourage the expansion of the vegetable stockist sector: Provide technical assistance and financial support to individuals interested in starting a vegetable stockist business, to diversify the range of vegetables grown and sold in the region.**	100
	Medium-term	**Support the development of value-added products from fruits & vegs: Encourage the creation of value-added products, such as jams, pickles, and sauces, to create new market opportunities for farmers and stockists.**	200
	Medium-term	**Promote small and medium-sized food processing enterprises: Encourage the development of small and medium-sized food processing enterprises, which can create jobs and add value to locally grown products.**	100
	Long-term	**Promote the establishment of more Fruit & Vegetable stockists: Increase the number of Fruit & Vegetable stockists to support the growth of this sector and improve access to Lfresh produce for consumers**	90
	Long-term	**Encourage sustainable farming practices: Promote sustainable farming practices, such as conservation tillage and integrated pest management, to improve productivity and minimize the environmental impact of agriculture.**	125
	Long-term	**Invest in research and development: Invest in agricultural research and development to develop new crop varieties better adapted to local climate and soil conditions.**	250
	Long-term	**Encourage climate-smart agriculture practices: Encourage the adoption of climate-smart agriculture practices, such as rainwater harvesting and efficient irrigation systems, to help farmers adapt to climate change and reduce greenhouse gas emissions from the sector.**	180
Total			**1,495**
Tunnel Farming of: Cucumber, Grapes, Strawberries, Bitter-Gourd, Onion, and Melon	**Short-term**	**Conduct research to locally produce hybrid seeds of vegetables &Train farmers on seed breeding techniques to locally produce hybrid seeds of vegetables.**	25
	Short-term	**Establish a packing house in Dhanote for the vegetable cartel.**	70
	Short-term	**Grade vegetables to have an export-oriented approach.**	30
	Short-term	**Explore value-added opportunities, such as the production of pulps for strawberries and tomatoes.**	80
	Short-term	**Promote growing exotic vegetables like cherry tomatoes, asparagus, iceberg, and broccoli.**	150
	Short-term	**Establish cold stores at Multan airport to support the export of mangoes and vegetables & for vegetable growers in Dhanote to store their crops.**	100
	Short-term	**Improve the road infrastructure (Farm to Market) from Kehror Pakka to Mailsi to Vehari to Arif Wala to Burewala till Chichi Watni.**	200

	Medium-term	**Provide financial assistance to farmers to maintain the supply chain.**	15
	Medium-term	**Develop seed varieties with universities and research institutes.**	150
	Medium-term	**Train farmers on grape pruning techniques and how to increase its shelf life.**	10
	Medium-term	**Certify nurseries to ensure plant sustainability.**	30
	Long-term	**Encourage tunnel farming in the region.**	5
	Long-term	**Establish a farm-to-market linkage.**	15
	Long-term	**Develop a drip irrigation system in the region.**	25
	Long-term	**Develop a comprehensive survey analysis on the vegetable growers in the region.**	15
	Long-term	**Establish more Opa-like units to process and sell frozen vegetables.**	120
	Long-term	**Increase the cultivation of sweet corn and explore its export potential.**	70
Total			**1,110**
GRAND TOTAL OF CROPS			**34,249**
WATER EFFICIENCY			
	Short-term	Climate Smart Water Management and Information Services	**304**
		•Development of a Water Accounting System	
		•Development of an Evapotranspiration-based Water Management System	
		•Development of an Early Warning System	
		•Provision of Information and Data to Facilitate Climate Change Adaptation	
		Building on-Farm Resilience to Climate Change	**348**
		•Development of practices for climate change resilient	
		•Training of extension workers and farmer facilitators	
		Establishment of Technology Transfer Centers (TTCs) in Sargodha Division for the demonstration to enhance water use efficiency through;	**655**
		•Farm layout planning/ designing, precision / LASER land leveling and water budgeting & accounting.	
		•Provision of rapid soil testing kits to the farmers at TTCs for application of balanced fertilizer.	

		•Fixation of pipe nakkas according to soil type and water flow for channelized stream flows.	
		•Installation of flow measurement devices for open channels and tubewells for measuring the discharge of water for water accounting.	
		•Installation of soil moisture monitoring gadgets.	
		•Application of Alternate Wetting & Drying (AWD) and Direct Seeding Rice (DSR) water saving techniques in rice fields to increase the water productivity.	
		Support farmers for installation of tunnels for off-season vegetable production.	**210**
		Provision of 400 LASER land levelers to the farmers/ service providers for strengthening LASER land leveling services in the private sector.	**400**
	Medium-term	Construction of on-farm water storage ponds in irrigated areas for storing excess canal/ rainwater for supplemental irrigation.	**6,825**
		Install solar systems for operating high efficiency irrigation systems.	**630**
	Long-term	Improvement of unimproved & additional lining of watercpourse improvement	**6,000**
		Promote high efficiency irrigation systems on Drip and Sprinkle Irrigation System on fruit and vegetables farms.	**871**
		Deliver soil moisture to the farmers/ service providers.	
TOTAL			**16,243**
COMMON STRUCTURAL PROJECTS			
Common Structural Projects	**Medium-term**	Provision of specialized extension services for vegetable crops.	**300**
		Provision of specialized extension services for fruits.	**300**
		Ease of financial access and insurance services to farmers.	**300**
		Up gradation and establishment of agriculture markets.	**500**
		Establishment of feed mills.	**300**
		Integrated Pest diagnosed, warning, and control management for all crops	**200**
		Set up of support system for the farmers in case of crop failure and price fluctuation for vegetables and fruit crops.	**500**
	Long-term	Establishment of state of the art warehouse and grain silos.	**300**
		Promoting research for enhancement of mash and lentil production to reduce pulse import bill	**51**
		Improving an organizations overall performance and efficiency by improving the members (individuals and groups) performances, commitment, and flexibility. (HR)	**.**

TOTAL	**2,751**
GRAND TOTAL	**53,243**