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# Mapping and Temporal Analysis of Wheat Crop Using Remote Sensing Imageries Burewala, Pakistan

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**Abstract:** Research is proposed to study the monitoring and detection of the wheat crop using remote sensing Imagery of Burewala Pakistan.The objectives of the study are to map agriculture land using Landsat-9 (USGS) Imageries and On-field visit of the crops. The image processing techniques such as Normalized Difference Vegetation Index (NDVI), Masking, were used to map the land cover changes. Further, the changes in land cover are correlated with reference to agricultural land.The proposed methodology and scientific approach are simple and effective and could be utilized for better management for the development of crops in the region. The aim of this research is related to wheat crops in Burewala using state of the art , remote sensing imageries and field data. We have deferment the socioeconomic impacts of wheat crop declining . The results would help to conclude the socioeconomic aspects related to the wheat crop productivity.

**Keywords:** Remote Sensing ;Temporal Analysis ; GIS Satellites ; Mapping Analysis

## 1. Introduction

More than 180 million people of Pakistan is directly or indirectly based on the agriculture sector [3] with wheat as an important necessary food.[4]. 43.7% the manpower of the Pakistan is holding down a job in the cultivation sector [5]and Pakistan is the eighth largest wheat fabricator globally.[4] Wheat is the most important cultivated crop for 80% of farmers and amount to nearly 40% of the country's total agricultural land.[4] However, the annual national wheat production of approximately 21 million tones (MT) does not cover the total demand of 24.0 MT [4, 6]. To meet gaps in demand and supply, Pakistan imports wheat on variable scales each year. Wheat is grown during the winter season or Rabi, which begins in October to December and ends in April to May. Recurring droughts and changing weather patterns strongly influence crop yields in Pakistan with climate change a suspected factor in recent production variations.[7-9] The country's extensive irrigated cropland system, one of the largest contiguous networks in the world.[10] Depends on sustained water flows in the Indus River basin. However, water flows in the Indus River have not been consistent in recent decades.[11] Flood and drought cycles have been more common and are affecting crop production [8, 9] Accurate estimation of cultivated wheat area and associated production is important for the country to address changes occurring from climate change impacts and water dynamics. Remote sensing is a powerful tool for mapping and monitoring agricultural crops, and can provide valuable information to farmers, policymakers, and researchers. The agricultural sector plays a crucial role in our economy, yet regular practices often contribute to environmental humiliation and operational inability due to a heavy reliance on non-renewable energy sources[12].

Wheat is one of the major crops in Pakistan, and Burewala is an important wheat-growing region located in the Punjab province. The use of Landsat-9 imagery will enable us to capture high-quality data with improved spatial and spectral resolution, allowing us to identify subtle changes in the crop's growth

and health. We will use a combination of supervised and unsupervised classification techniques to map the wheat crops. The results of this study will provide valuable insights into the dynamics of wheat crops study area in Burewala and can be used by farmers to optimize their crop management practices, by policymakers to make informed decisions regarding crop production and food security, and by researchers to further study the dynamics of wheat crops in the region. Water is one of the most essential part of soil, especially for plant growth, and crop and well-being. Water content, often known as soil moisture, may be used to determine how much water is accessible in the soil[13].The use of remote sensing technologies in agriculture has revolutionized the way we study and manage crops. In this study, we aim to analyze the wheat crop in Burewala, Pakistan using remote sensing imageries. This study, we aim to use Landsat-9 imagery to map and analyze the temporal changes in wheat crops in Burewala, Pakistan. Landsat-9 is a new generation of remote sensing satellite with the crop's temporal changes and assessing the crop's health using remote sensing data. The study will focus on identifying and mapping the different stages of wheat growth, monitoring resources available for crop monitoring, it is challenging to assess crop health and growth status using traditional methods. Remote sensing provides a cost-effective and efficient way to monitor crops over large areas. We will be using temporal analysis techniques to study the growth patterns of wheat crops in Burewala area. The study will involve collecting and analysing satellite images of the region taken at different intervals during the crop growth cycle. The data will be analyzed using various indices such as the normalized difference vegetation index (NDVI) to assess the crop health and growth status. In mapping land cover changes, image processing techniques play a crucial role. The Normalized Difference Vegetation Index (NDVI) is employed to quantify and visualize vegetation health. High NDVI values indicate healthy vegetation, aiding in identifying areas with flourishing crops.This information can be used to make informed decisions regarding crop management and resource allocation in the region. Ultimately, the results of this study can contribute to improving the overall productivity and sustainability of agriculture in Burewala, Pakistan. Remote Sensing (RS) is the process of collecting information or data about the Earth's surface and atmosphere using various sensors and instruments from a distance, typically from aircraft or satellites. The collected data can include information about the properties of the Earth's surface, such as its temperature, moisture content, vegetation cover, land use, and topography. The phrase "remote sensing" refers to a group of techniques for detecting the chemical or physical qualities of physical objects at any distance by recording, measuring, and translating images and digital representations of energy patterns generated by non-contact sensor systems. The collected data can be analyzed to gain insights into a range of topics, including environmental monitoring, natural resource management, urban planning, and disaster response. And Principal Component Analysis (PCA) approaches popular technique for analysing large datasets containing a high number of dimensions/features per observation, increasing the interpretability of data while preserving the maximum amount of information, and enabling the visualization multidimensional data. The study will use high resolution satellite images to detect the diseases and analyze the temporal changes in the crop.

The study will also analyze the impact of the diseases on the crop. The study will use remote sensing imagery to detect the diseases and analyze the temporal changes in the crop. The study will also analyze the impact of the diseases on the crop yield and the environment. The study will also provide recommendations on how to reduce the impact of the diseases on the crop yield and the environment. The study will also provide a comprehensive understanding of the diseases and their impact on the crop yield and the environment. The study will also provide a platform for further research and development in the field of remote sensing and crop diseases. Problem statement also shows in (fig 1). Especially plants provide us the food and oxygen. In fact, every plant has its own characteristics for example economics value, habits, and other morphology. For that reason, farmers have large range of diversity for selecting various suitable crops and finding the suitable pesticides for wheat crop. Wheat is a kind of plant grown throughout the world for its majorly nutritious and usable grain. It is one of the topmost produced crops in the world, along with rice and corn.[14] Cultivation of wheat over 6,000 years and likely originates in the fertile field, along with other stable crops. Disease on wheat leads to the important reduction in the quality and quantity of the product of agricultural in wheat most common disease is stem rust, yellow rust, and Powderly. To effectively understand the disease of plant leaf experiments, prefer visually observable arrangements of wheat plant disease.[15] Crop disease diagnosis is of great importance to prevent the spread of diseases and maintain the sustainable development of agricultural economy. In general, the crop disease diagnosis

is performed manually by visual observation or microscope techniques, which are proven to be time-consuming and have the risk of error due to subjective perspective. In this context, various spectroscopic and imaging techniques have been studied for recognizing crop disease symptom.[16] [17]Wheat (Tritium aestival) is one of the most important staple crops that contribute extensively to global food security.[18-20] It provides 20% of human food calories world-wide.These food calories are frequently found in wheat products such as bread, cereal, rusks, biscuits, pasta, cookies, noodles, and others. [20]Wheat is planted in more than 120 countries across Asia, Europe, America, Africa and Australia/Oceania.[20, 21] The approximated planted area of wheat was 220.83 million hectares (HA) worldwide in 2020/21, which makes it the most widely expended crop, compared to 199.11 million ha of maize and 165.22 million (HA) of rice. Recent reports show that annual global wheat production is around 775.71 million metric (MT) tons for 2020–2021, this is an increase of around 12.34 million metric tons (MT) from the 2019– 2020 records.[20] The biggest helpers to global wheat production include Asia, Europe, America, India, and Russia; minor contributors include Africa and Australia .[15, 22]

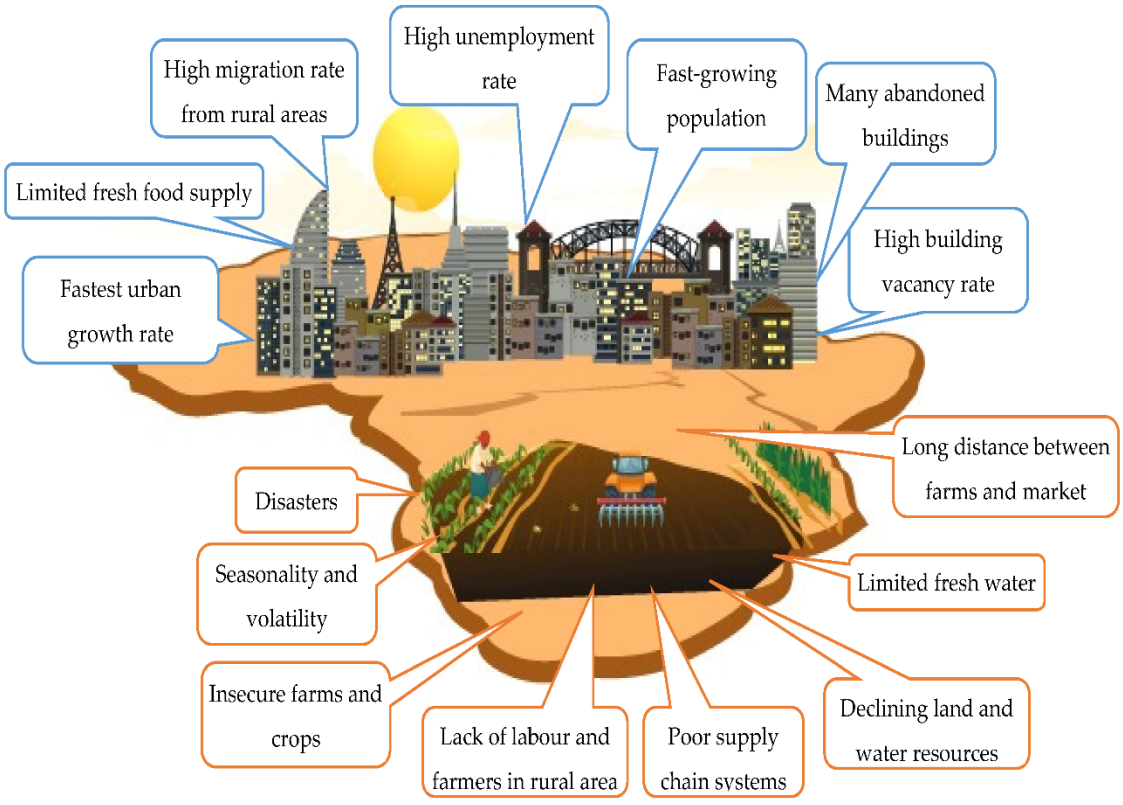


**Figure 1.** Urban area increasing and the agricultural area decreasing[2]

## 2. Literature Review

The study is highlighting the effect of climate change on the agricultural crops in Punjab.[23] This is the first study of its nature to study the impact of meaningful knowledge on the stages of progress of each crop in order to assess the impact of climate change on each stage of the crops.[23] The study shows a robust approach for early wheat area estimation providing information related to decision support systems worrying food production and trade.[24] This study explained a satellite-based methodology for early season wheat production forecasting. Wheat area is derived from a MODIS satellite image time series.[25] Wheat is the major winter crop in Pakistan during the winter (Rabi) season and an important food essential.[25] This study finds that the output of wheat, rice and cotton has a positive and meaningful connection with the agricultural GDP of Pakistan, while the output of sugarcane has a negative and Non-meaning full relationship with the agricultural GDP of Pakistan[26]. The study uses the Vector Auto Regression (VAR) model to evaluate the impact of global climate change on the production of wheat in Pakistan. The study regarded annual data from 1960 to 2009. On the basis of this historical data, the study captures trends for

the impact of climate change on wheat production for the period 2010-2060.[27] fast-growing population can result in unmanageable urbanization, leading to a burden on fresh and clean water systems and a risk to individuals' food security thus efacting most African cities that are struggling to identify their future economic drivers.[2]The modeling analysis of non-living stresses under which the farmers' crops were grown revealed that nitrogen (N) deficiency was the main driver for the large yield spaces at both sites, for both crops, with low surface soil carbon (0.19% Narowal; 0.49% Gujranwala).[28] This study was designed to compare farmers' perceptions with actual climatic trends and to identify key socio-economic factors associated with farmers' perceptions of climate change.[29] This article is based on Pakistan's empirical data to analyze the profitability of major and the objective of the study was to analyze the productivity of the major crops by comparing.[30]This article presents the results of a field study undertaken in the province of Baluchistan, Pakistan, to understand the experience and impact of an ongoing program of transitioning from karez (an ancient mode of tapping groundwater) to tube well irrigation on social equity, livelihoods, community cohesion and environmental quality.[31]There are immense gaps between the obtained and actual output of produce, which suffers due to a lack of suitable technology, use of inputs at impropriate times, inaccessibility of water and land use and insufficient education about insect pest control, which not only negatively affects the produce but also significantly decreases the amount of produce showed that impact of variation in temperature during growing stage is highly significant and contributes in lowering the wheat yield risk, while increase in precipitation during growing and blooming stages poses high risk to wheat crop[26]. Interaction terms of climatic variables showed non-significant risk-decreasing impact during all the three growth stages of the crop.[32]2This paper discusses the changing use of, and attitude toward, land in the rural areas of Pakistani Punjab in the context of rural urbanization.[33]The agriculture sector is also the biggest user (more than 90%) of water in Pakistan. The water availability in Pakistan is already below the scarcity level of 1000 m3/person and climatic changes in the region may further worsen the situation.[34]

**Table 1.** Literature review of previous studies

| Study | Publication year | Approaches /Technology Inculcated | Goals |
|---|---|---|---|
| [23] | 2012 | No sensor/ Fixed Effect Model (FEM) are used on the base of the balanced data design. | Iinvestigate the impact of climate (through changes in temperature and precipitation) |
| [24] | 2016 | Satellite imagery at a medium spatial resolution. | Robust approach for early wheat area estimation |
| [28] | 2019 | APSIM model was parameterized for local soils and climate, and then calibrated for rice and wheat growth, | To increased soil carbon levels, and shorter season high-yielding rice |
| [29] | 2020 | Using multistage sampling technique, field-tested questionnaire about their perceptions of climate change at farm. | study was to examine the degree of agreement between farmers' perception and actual climate trends in three irrigated districts of Punjab province in Pakistan |
| [2] | 2022 | Questionnaires', survey structural equation modelling (SEM), Robust statistical method that fits networks of constructs to data | Relationship between the perceived advantage and challenges of USF and the desire of local African communities to actively participate in USF projects as a potential mechanism to improve local economy and food production |

| | | | |
|---|---|---|---|
| [35] | 2023 | remote sensing images from Sentinel-2 and Landsat-8 with Machine Learning (ML) methods, namely a Decision Tree Classifier (DTC) and a Random Forest (RF) algorithm | identifying specific crop types, cropland, and cropping patterns using space-based observations |

The existing literature on mapping and temporal analysis of wheat crops using remote sensing imagery in Burewala, Pakistan, lacks a comprehensive exploration of the impact of varying environmental conditions on crop dynamics, hindering a nuanced understanding of the factors influencing wheat Production over time.

**3. Materials and Methods**

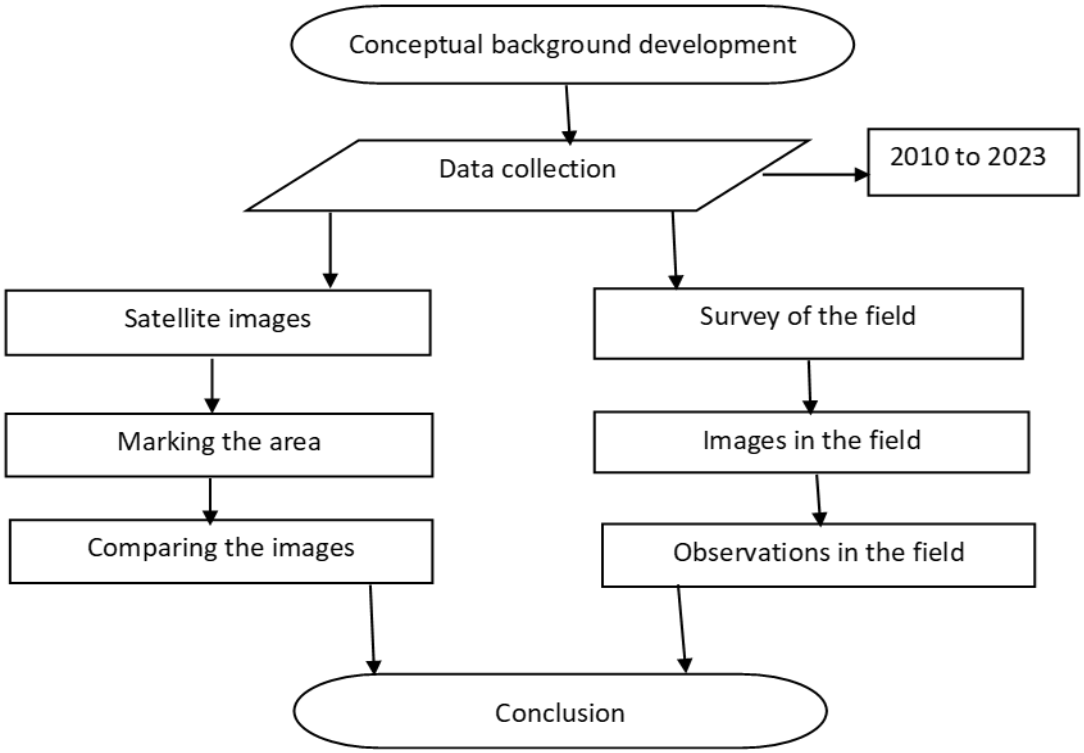


**Figure 2.** Methodology

Methodology for mapping and temporal analysis of wheat crops usually involves using remote sensing data, such as satellite imagery, to monitor changes in vegetation over time. This would help in assessing crop health, growth stages, and yield estimation. It's a valuable tool for farmers and researchers to make informed decisions. Land-sat 9 images was chosen because its data is accurate and free. These images are freely available for research and development purposes. Land-sat 9 is used as latest technology, state of the art, user friendly. They are easy to process. Their resolution is also good for research. In Worldwide, land-sat 9 images are used as the latest technology for agricultural research. We have selected these images on the basis of time, taking data from the same season in different years. To collect data for mapping and temporal analysis of wheat crops, satellite imagery is used to track changes in vegetation over time. This data helps monitor crop health, growth stages, and estimate yields. It's an effective method that provides valuable insights for farmers and researchers. l analyzed of wheat crops, various methods had been used. This might include on-ground observations, data collection through satellites, and even manual measurements of crop parameters. This methodology would help gather important data on crop growth, health, and other factors that contribute to the analysis process in (fig 2). Satellite images in the

field for mapping and temporal analysis of wheat crops. That's a great approach! Satellite images provided a bird's-eye view of the field, allowing you to monitor crop health, growth stages, and changed over time. It's a convenient and effective way to gather data for analysis. Capturing images in the field could be done using various methods. These images could be used to assess crop health, growth stages, and other important factors. It's a practical way to gather visual data for analysis. This methodology could help with mapping and analysis by providing clear reference points. GIS or mapping tools were used to digitally mark and outline the area. It's important to carefully observe the wheat crops, noting their growth stages, overall health, and any signs of pests or diseases. I took the note of any variations within the field and gather data on plant height, leaf colour, and any other relevant parameters. Remote sensing is an innovative technique that allows us to collect a variety of data. Satellites give us up-to-date information. In the proposed methodology, this methodology is created by collecting and integrating satellite and field data. These observations would provide valuable insights for analysis. After comparing the images, we could analysis the differences in crop health, growth, and any changes over time. Look for variations in colour, density, and size of the wheat crops. This methodology would help us to understand the progress and identify any potential issues. Remote sensing imagery analysis in Burewala, Pakistan, reveals a correlation between land cover changes and agricultural shifts, particularly in wheat crops. Temporal analysis using statistical methods strengthens the understanding of these dynamics. The dynamic observed in Burewala, Pakistan, involves changes in land cover over time, notably affecting agricultural areas with a specific focus on wheat crops.

3.1 Study Area

Burewala is a city located in the Vehari district of Punjab province in Pakistan. It is situated in the southern part of the province, close to the border with Sindh province. Geographically, Burewala is located at 30.1667° N, 72.6500° E, on the banks of the Sutlej River, which flows from the Himalayas and forms the border between Pakistan and India. Burewala has a hot desert climate with extremely hot summers and mild winters. The average temperature in the summer months (June to August) is around 40°C (104°F), while in the winter months (December to February) the average temperature is around 15°C(59°F). The city receives very little rainfall, with an annual average of around 200mm (8 inches). Burewala is located on the National Highway N-5, which connects it to other major cities of Pakistan such as Lahore, Islamabad, and Karachi. The city also has a railway station, which is located on the Khanewal–Bahawalnagar railway line. Location of the Burewala shows in map of Pakistan in (fig 3).

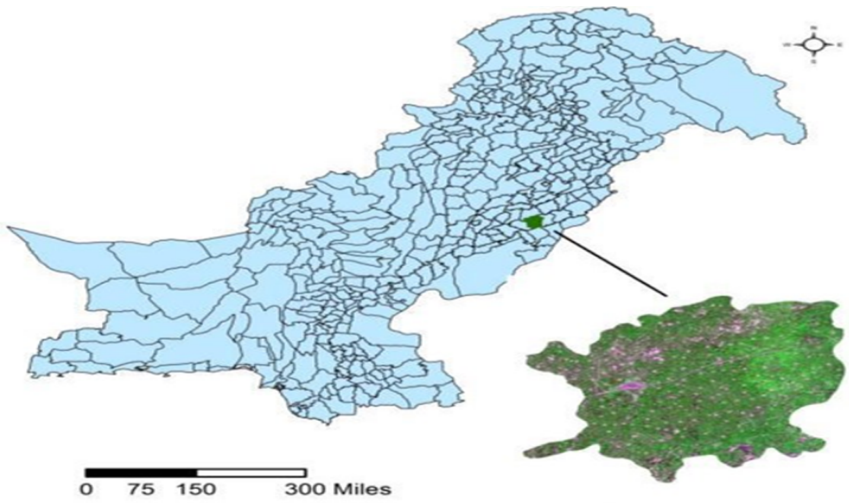


**Figure 3.** Location of study area (tehsil Burewala) in Pakistan [1]

## 4. Results and discussion

4.1 Area of Rabi Crops (Acers)

**Table 2.** Area of Rabi crops

| Year | Wheat | Oilseeds | Canola | Maize |
|---|---|---|---|---|
| 2015-16 | 699 | 06 | 3.5 | 40 |
| 2016-17 | 626 | 06 | 3.6 | 42 |
| 2017-18 | 605 | 12.1 | 5.5 | 55 |
| 2018-19 | 530 | 13 | 05 | 120 |
| 2019-20 | 442 | 21 | 1.42 | 184 |
| 2020-21 | 432 | 31 | 3.0 | 190 |
| 2021-22 | 500 | 40 | 3.3 | 200 |
| 2022-23 | 540 | 35 | 3.5 | 220 |

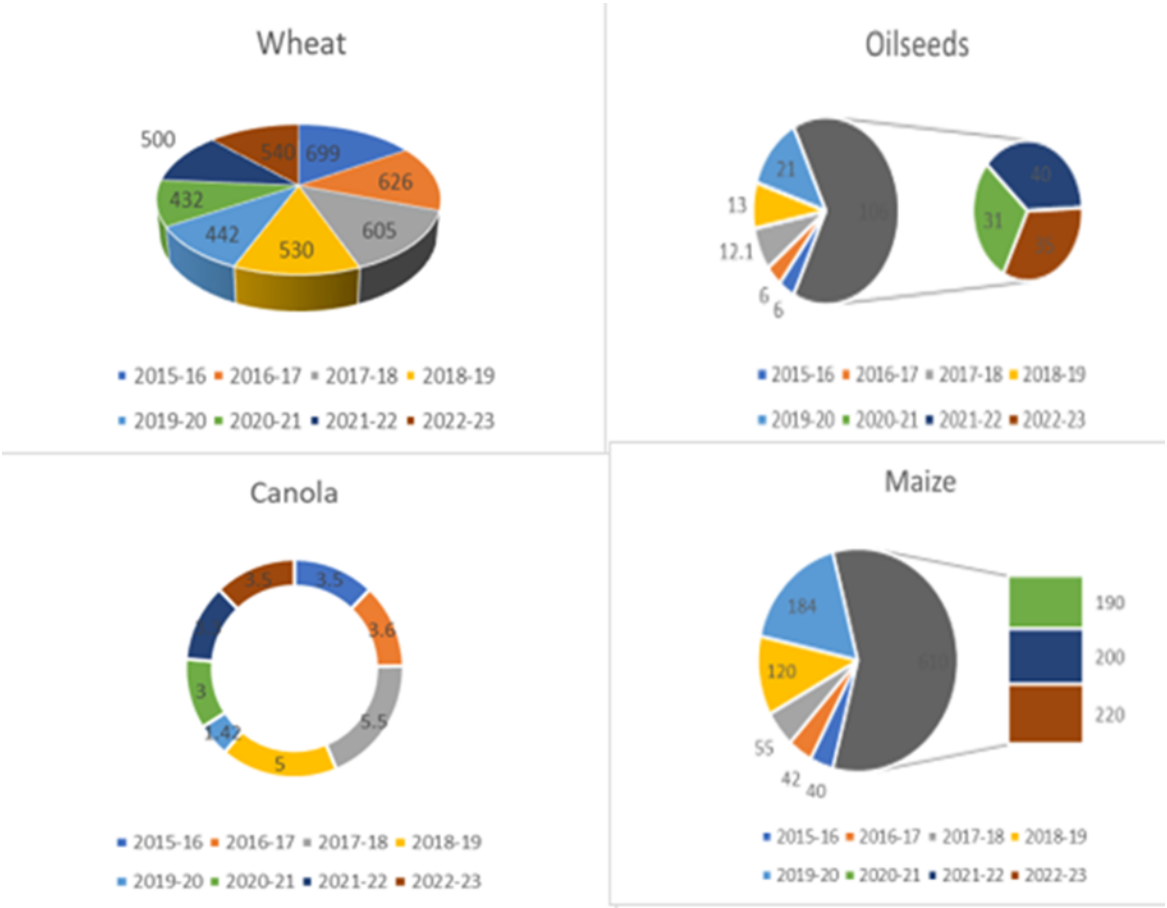


**Figure 4.** Area of Rabi Crops

4.2 Production of Rabi Crops (Acers)

**Table 3.** Production of Rabi crops

| Year | Wheat | Oilseeds | Canola | Maize |
|---|---|---|---|---|
| 2015-16 | 885.94 | 3.4 | 1.92 | 126.31 |
| 2016-17 | 852.83 | 3.9 | 2.251 | 132.64 |
| 2017-18 | 789.48 | 8.3 | 3.687 | 175.6 |
| 2018-19 | 699.79 | 9.2 | 3.555 | 367.5 |
| 2019-20 | 588.13 | 15.104 | 1.06 | 802.4 |
| 2020-21 | 570 | 16.0 | 2.00 | 820.5 |
| 2021-22 | 590.10 | 17.5 | 2.5 | 840.3 |
| 2022-23 | 600 | 16.3 | 2.30 | 845.5 |

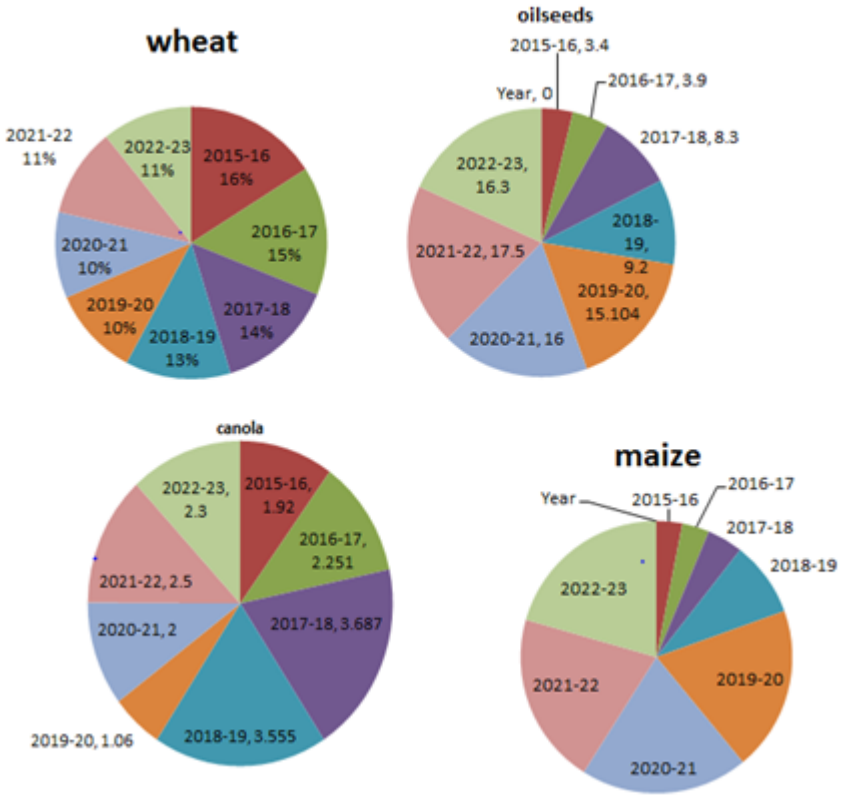


**Figure 5.** Production of rabi crops

The study data for this paper we obtained from [https://vehari.punjab.gov.pk/agriculture-dis] and some data are taken from satellites. The table shows data in (Acers) from 2015 to 2020 for wheat crop, oilseeds canola and maize.

Production of wheat crop in the Burewala Pakistan from 2015 to 2020 shows the result in (table 2) and (fig 7). We collect this data from [https://vehari.punjab.gov.pk/agriculture-dis]. Wheat crop, Oilseeds, canola and Maize data in Bales. Some data (Images) collected from the GIS satellites shows in (table 1) and (fig 4).

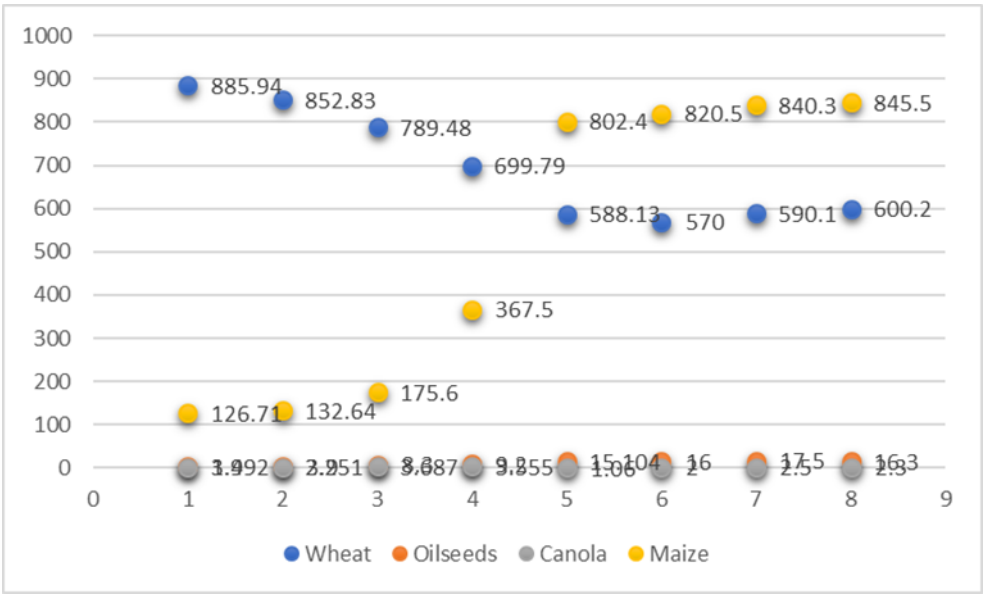


**Figure 6.** Area and production of Rabi Crops

Comparison of wheat crop with respect to the other Rabi crops shows in the (fig 6). This graph shows that area of wheat crop reduces with the passage of time. As the property owned the area of wheat crop as the result wheat production reduces gradually. But in 2022, 2023 area of crop slowly increases because at high price of wheat grain.


**Figure 7.** Area of Burewala in 2000


**Figure 8.** Area of Burewala in 2005


**Figure 9.** Area of Burewala in 2010


**Figure 10.** Area of Burewala in 2015


**Figure 11.** Area of Burewala in 2020


**Figure 12.** Area of Burewala in 2023

The study area several hectors are covered area is 100km shown in (fig 7). On the satellite images green colour is representing the crops are the vegetation cover. The image of Burewala collected from the 2005 through Google Earth shows in (fig 8). Rest of the others there are pockets of constructions materials, buildings, colonies and other development of the city display in (fig 9). Agricultural land has been occupied the construction are the town development. The green colour is demolishing or decreasing shows in (fig 10). Numbers of the crops are the area covered is depleting in 2020 (fig 11). Grey colour which is represented by construction area town development is increasing also represent in Burewala 2023 in (fig 12). These images which has been taken from the landsat-9 of Burewala shows that area of the wheat crop rapidly decreasing with the passage of the time and area of other crop increases also as well as housing scheme takes the place of the wheat crop. According to the survey of the wheat crop area with respect to the different years wheat crop area decreases. It is observed that the green vegetative area has been depleted significantly and occupied by the construction on the town development and this trend continuously going on till 2023. Farmers are not giving priority to growing wheat crop. Wheat crops, and agricultural land has been replaced by towns, which has led to the loss of agricultural land. It is also a socio-economic factor that when it was time to sow the wheat crop, it rained or there was a flood due to which the crop would be damaged. Another factor is that the price of fertilizer is very high which the farmer cannot afford. Inflation is rising all over the world due to which the prices of fertilizers are increasing. Due to which the farmer cannot bear the price. Non-availability of fertilizer on time, shortage of seeds, flood is another reason people's preference has changed, people prefer to eat other crops more. Failure to get fertilizer on time, shortage of seeds, flood is another reason people's preferences have changed. People prefer to eat other crops. People prefer Afghanistan's wheat. But due to lack of good import and export policy, the wheat crop is greatly affected. People have started to replace the production of wheat crop with other crops like rice etc.

In which we could easily observe 90 to 95% vegetation will cover in comparison 2000 to 2023 has been replaced by the development of the town.

**5. Conclusion**

The area of wheat crop had been decreasing instead of increasing with the passage of time. Population increases Burewala in 2020 housing scheme, Properties owned this area. Similarly, from my childhood as well as during my field observation the farmers of Burewala were interested in garden like Guava, strawberry, Orange, corn crop, rice crop, sugar cane took the place of the wheat crop having the good price as compared to the wheat price. Irrigation systems of the Burewala come from river satluj. Which also some time affect the area of wheat crop. It Is my recommendation to the government about the price of wheat grain should be at the level of other crops compared to the rice, sugar cane and corn as being followed in India. In the Sindh province they have a good policy about the wheat crop having good price of wheat as compared to the KPK, Baluchistan and Punjab Pakistan. During my campaign according to the advice of respected vice chancellor of UAF it is proposed to the government by farmers having national and international experience about wheat crop. They proposed that government should maintain the less price of fertilizer and confirm the availability of fertilizer during the season of wheat crop. During my visit to village to village I concluded that the government should have policy to motivate the people to eat rice and use of more corn in the place of grain bread. Habit of people should be changed like other countries of the world like Asian country, Japan, Bangladesh, China, Malaysia, Thailand, people always eat rice more as compared to the grain bread. It is predictive that if the grain productivity reduces rapidly it is recommended to the government by the farmers during their interviews policy of the government should

provide a good quality of seed delivered to the farmer free of cost. If wheat crop area in Burewala decreased and wheat grain productivity reduced rapidly. It would lead to dangerous position till in 2040. Future work could focus on refining classification accuracy through advanced machine learning algorithms. Additionally, exploring the impact of climate change on wheat crop dynamics in Burewala would provide valuable insights for sustainable agricultural practices.

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