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Master's Thesis

An Analysis of development of wheat production in India

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DIPLOMA THESIS ASSIGNMENT

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Economics and Management

Thesis title

An Analysis of development of wheat production in India

Objectives of thesis

The main objective of the study is to evaluate the development of the wheat market in India in the period 2005-2022 and to determine the factors that cause changes in the production and price of grain on this market. In order to fulfill the above main objective researcher has framed the following sub-objectives of the research study:

1. To examine the geographical structure of wheat production in India. (according to states)
2. To examine the trends in Wheat as a Commodity (Production, Consumption, Import & Export).
3. To study the relationship between dependent and independent variables i.e. Production, Consumption, Import & Export.
4. To understand the self-sufficiency of India in Wheat as a Commodity.

For the fulfillment of the above mentioned main and sub-objective the following research methodology has been adopted.

Methodology

The present research study is quantitative in nature. For the achievement of the above mentioned objectives of the research the thesis is divided into two parts. Where the first part focuses on the published literature relevant to the thesis topic. The purpose is to explain details of wheat and specifics of its growth and storage, as well as to provide an overview of the history of wheat farming and trading in India. It gives understanding about wheat as a grain, its types, production, growth and storage at domestic and at worldwide level. It gives the overview of historical wheat farming in India. It also gives idea regarding the commodity market and the importance of wheat as a commodity in India's foreign trade.

The second section of the study consists the practical part of the thesis including the analysis and interpretation of the secondary data with an overview of the Indian wheat market. A trend analysis will be performed making use of graphs, charts and tables for the data regarding wheat production, consumption, import and export. Additionally, it will be concentrated on achieving the thesis' primary objective through an examination of the last growth of the Indian wheat market from 2005 to 2022. Whereas, finding the relationship between variables Production, Consumption, Import and Export. The collected data will be analyzed making use of econometric models like Co-relation Co-efficient, Regression and Anova. The study also focuses on the self-sufficiency of India in Wheat as a Commodity. The last part of thesis comprises of the findings, suggestions and conclusion. The data collected will be analyzed using SPSS software and Microsoft office excel.

The proposed extent of the thesis

60 – 80

Keywords

wheat production, India, Wheat export, wheat consumption, self sufficiency, wheat import, commodity market

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Recommended information sources

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Declaration

I declare that I have worked on my diploma thesis titled "An Analysis of development of wheat production in India" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break any copyrights.

In Prague on 29.03.2024 _____

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An Analysis of development of wheat production in India

Abstract

In many cuisines across the entire globe, wheat is a major cereal crop as well as one of the most common staple foods. Having an all-time high annual output of 763.06 million tonnes of grain, wheat is grown around the world over an area of roughly 220 million hectares. The largest amount of land cultivated with wheat is in India (14%), later being followed by Russia (12.43%), China (11.14%), and the USA (6.90%), which collectively make up nearly 45% of the world's land. Through a record 136mt of wheat produced, China is the world's largest producer. India, Russia, as well as the USA are next. The traditional wheat-growing nations that is China, India, Russia, the USA, Canada, Ukraine, and Pakistan collectively generated over 449 million tonnes (58%) of the world's total wheat production. In India wheat output has increased dramatically since the development and widespread use of high yielding wheat cultivars during the Green Revolution. In addition to assisting India in achieving self-sufficiency, wheat production and protection technology made it easier for the country to manage the seasonal variations in food grain output. Moreover, India has improved food security by making notable progress.

Therefore, the study aims to analyse the development of wheat market in India from the period of 2005-2022. It aims to study the agricultural area under cultivation for wheat as per state, moreover the trends in import, export, production and consumption of wheat from the country and the factors responsible for the changes in the production and price of wheat. The research also aims to evaluate the importance of wheat commodity for India foreign trade, while performing the comparative analysis of Indian wheat production with the international wheat production, as well as calculating self-sufficiency ratio for India. The research study is quantitative in nature. Secondary data is being utilised from different sources. While, percentage, trends, graphs and charts have been developed making use of Microsoft Excel for the graphical and tabular representation of data collected. While, SPSS software is used for hypothesis testing making use of various statistical tools like Corelation, Regression and Anova for data analysis and interpretation purpose.

Keywords: Wheat Growth, Wheat Production, Commodity Market, Foreign Trade, Crop Area, Self-Sufficiency, Gross Harvest, Import & Export

Analýza vývoje produkce pšenice v Indii

Abstrakt

V mnoha kuchyních po celém světě je pšenice hlavní obilninou a také jednou z nejběžnějších základních potravin. S historicky vysokou roční produkcí 763,06 milionů tun obilí se pšenice pěstuje po celém světě na ploše zhruba 220 milionů hektarů. Největší množství půdy obdělávané pšenicí je v Indii (14 %), později následuje Rusko (12,43 %), Čína (11,14 %) a USA (6,90 %), které dohromady tvoří téměř 45 % světového přistát. Díky rekordním 136 mt vyprodukované pšenice je Čína největším světovým producentem. Další jsou Indie, Rusko a také USA. Tradiční země pěstující pšenici, kterými jsou Čína, Indie, Rusko, USA, Kanada, Ukrajina a Pákistán, dohromady vytvořily více než 449 milionů tun (58 %) z celkové světové produkce pšenice. V Indii produkce pšenice dramaticky vzrostla od vývoje a širokého používání vysoce výnosných kultivarů pšenice během zelené revoluce. Kromě pomoci Indii při dosahování soběstačnosti produkce pšenice a technologie ochrany usnadnily zemi zvládat sezónní výkyvy v produkci potravinářského obilí. Kromě toho Indie zlepšila zajišťování potravin tím, že dosáhla značného pokroku.

Studie si proto klade za cíl analyzovat vývoj trhu s pšenicí v Indii v období 2005-2022. Zaměřuje se na studium zemědělské plochy pěstované pro pšenici podle státu, dále trendy v dovozu, vývozu, produkci a spotřebě pšenice z tuzemska a faktory odpovědné za změny produkce a ceny pšenice. Cílem výzkumu je také zhodnotit význam komodity pšenice pro zahraniční obchod Indie, provést srovnávací analýzu indické produkce pšenice s mezinárodní produkcí pšenice a vypočítat míru soběstačnosti Indie. Výzkumná studie má kvantitativní charakter. Sekundární data jsou využívána z různých zdrojů. Zatímco procenta, trendy, grafy a grafy byly vyvinuty s využitím Microsoft Excel pro grafickou a tabulkovou reprezentaci shromážděných dat. Zatímco software SPSS se používá pro testování hypotéz s využitím různých statistických nástrojů jako Corelation, Regression a Anova pro účely analýzy a interpretace dat.

Klíčová slova: Růst pšenice, produkce pšenice, komoditní trh, zahraniční obchod, plocha plodin, soběstačnost, hrubá sklizeň, dovoz a vývoz

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1 Introduction

Cereals are essential to supplying the world's expanding population with food, especially in underdeveloped countries where a production system centred on cereals is the sole significant basis for nutrition and caloric intake. In terms of calories and nutritional consumption, wheat happens to be one of the main cereal crops farmed globally and an indispensable staple. Along with rice, wheat is one of the main sources of protein in low- and middle-income countries. Winter wheat is produced in cold regions like Europe, the United States, Australia, and the Russian Federation, whereas spring wheat is grown in Asia and in select regions of the United States.

With its diversified agroecological conditions, which India has been gifted with, it serves as the second-biggest producer of wheat, providing sufficient nourishment and food to a large segment of its population. Among one of the nutrient-dense cereals, wheat contributes for roughly 20% of all proteins plus 19% of all calories in India's food grain output, making up approximately 36% of the entire output. With the use of institutional framework, policies, technological advances, extension, plus extension throughout the middle of the 1970s, wheat production became self-sufficient. The researchers and decision-makers, however, face a challenging task in preserving wheat's availability as well as accessibility in the years to come. The need to develop a model on technology-extension-policy-institution to achieve the required level of wheat production is driven by the demands caused by the growing population along with the hazards and difficulties associated with changes in the climate.

India experienced an overall food production deficiency after gaining independence, necessitating the purchase of wheat for domestic use. In particular, the farming and cultivation of wheat and rice, India's new approach that led the "Green Revolution" during the years 1966–1967. By reaching milestone as well as excess wheat output, coordinated research and multiple food security and development-based projects in various stages have brought the country closer to realising "food and nutrition for all." Even under unfavourable meteorological circumstances, the country has successfully avoided starvation since the Green Revolution. The All India Coordinated Research Project (AICRP) had a clear influence on wheat development and made a substantial contribution to the country's food security.

Therefore, the main purpose of the study is to analyse the development of the wheat production in India along with the development of wheat market in India in the period 2005-2022 and to determine the factors that cause changes in the production and price of grain in this market. Moreover, the study also aims to describe the geographical structure of wheat production in India (production as per states) and to evaluate the importance of the wheat commodity for India's foreign trade (import and export). To check whether there has been an increase or decrease in the export and imports of wheat in India from the period of 2005-2022. The study also aims to perform a comparative analysis of international wheat production with Indian wheat production as well as calculating self-sufficiency of India in wheat. The study is quantitative in nature and makes use of secondary data from various sources like research articles, publications, magazines, journals, newspapers, government websites, etc. The collected data is then analyzed with the help of SPSS and Microsoft Excel to present the data in the tabular and graphical form for better understanding.

2 Objectives and Methodology

There is a specific purpose behind conducting research it can be expanding knowledge, development of theories, ideas, innovations, etc. In the same way the present research also aims to fulfil certain objectives and to accomplish these objectives the proper selection of methodology is indeed required. The objective and the methodology for the current research is as under:

2.1 Objectives

The main objective of the study is to evaluate the development of the wheat market in India in the period 2005-2022 and to determine the factors that cause changes in the production and price of grain on this market. To fulfill the above main objective researcher has framed the following sub-objectives of the research study:

1. To examine the geographical structure of wheat production in India. (according to states)
2. To examine the trends in Wheat as a Commodity (Production, Consumption, Import & Export).
3. To study the relationship between dependent and independent variables i.e. Production, Consumption, Import & Export.
4. To understand the self-sufficiency of India in Wheat as a Commodity.

For the fulfillment of the above-mentioned main and sub-objective the following research methodology has been adopted.

2.2 Methodology

The present research study is quantitative in nature. For the achievement of the above mentioned objectives of the research the thesis is divided into two parts. Where the first part focuses on the published literature relevant to the thesis topic. It gives understanding about wheat as a grain, its types, production, growth and storage at domestic and at worlwide level. It gives the overview of historical wheat farming in India. It also gives idea regarding the commodity market and the importance of wheat as a commodity in India's foreign trade. This chapter outlines the production of wheat in India as per the geographical structure. The literature regarding the present topic is collected from the sources like articles, journals,

government websites, publications, magazines, research papers, conference proceedings, etc.

The second section of the study consists the practical part of the thesis including the analysis and interpretation of the secondary data with an overview of the Indian wheat market. A trend analysis will be performed making use of graphs, charts and tables for the data regarding wheat production, consumption, import and export. Additionally, it will be concentrated on achieving the thesis' primary objective through an examination of the last growth of the Indian wheat market from 2005 to 2022. Wheareas, finding the relationship between variables Production, Consumption, Import and Export. The collected data will be analysed making use of econometric models like Corelation Co-efficient, Regression and Anova. The last part of thesis comprises of the findings, suggestions and conclusion. The data collected will be analyzed using SPSS software and Microsoft office excel.

2.3 Analysis Tools

Following are the analytical tools which have been used to analyse the secondary data collected and for drawing inferences.

2.3.1   Corelation Coefficient

It is a statistical measure which showcases the strength of a linear relationship between two data variables. It describes as to how a change in one variable may cause a change in another variable. A positive corelation indicates that both the variables move in the same direction whereas, a negative corelation indicates that both the variable move in the opposite direction. A value of 1 denotes a perfect positive corelation while a value of -1 denotes a perfect negative corelation or can be also called as inverse relation. When the value is 0 it means there is no linear correlation between the variables (Fernando, 2021). The formula is given as below:

$$Corelation\ Coefficient = \frac{\Sigma(x_{i-\bar{x}})\,(y_{i-\bar{y}})}{\sqrt{\Sigma(x_{i-\bar{x}})^2\,\Sigma(y_{i-\bar{y}})^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where,

$x_1 =$ Values of X-variable in a sample

$\bar{x} =$ mean of the value of the x-variable

y$_1$ = Values of Y-variable in a sample

$\bar{Y}$ = mean of the value of the x-variable

2.3.2 Regression Analysis

It is a statistical technique that relates an independent variable with a dependent variable based on line for best fit. It shows that the changes observed in dependent variable are associated with the changes in independent variable. A regression analysis can be conducted to understand the strength of the relationship between the two variables (Beers, 2023). The formula for regression is given as below:

Simple Linear regression $= a + bX + u$

Multiple Linear Regression $= a + b_1X_1 + b_2X_2 + b_3X_3 + \cdots + b_tX_t + u \ldots\ldots\ldots$ *(2)*

Where,

Y=The dependent variable trying to predict or explain

X=The independent variable(s) you are using to predict or associate with Y

a=The y-intercept

b=(beta coefficient) is the slope of the independent variable(s)

u=The regression residual or error term

For the above corelation and regression analysis following independent variable and dependent variable associations have been tested for the present research study.

- Import (Dependent) & Export (Independent)
- Export (Dependent) & Consumption (Independent)
- Import (Dependent) & Consumption (Independent)
- Consumption (Dependent) & Production (Independent)
- Import (Dependent) & Production (Independent)
- Export (Dependent) & Production (Independent)

2.3.3 Anova

Analysis of variance is a statistical tool which is used to determine the influence of independent variable on dependent variable in a regression study. ANOVA groups differences by comparing the means of each group and includes spreading out the variance into diverse sources (Kenton, 2023). P-Value is derieved if the P-value is greater than 0.05 then it is interpreted that there is no siginificant difference between the two variables and null hypothesis is accpeted while if the P-value is lesser than 0.05 then it can be interpreted, that there is a significant difference and null hypothesis is rejected.

2.3.4 Self Sufficiency Ratio

Self Sufficiency ratio is a measure which portrays a country's ability to meet its food demand. The ratio is calculated by comparing the domestic production of a particular crop with the total domestic consumption of that crop. It is expressed in percentage whereby, 100% means that country's production is enough to meet its consumption requirements. While SSR below 100% indicates that the country is dependent on its imports for consumption and SSR above 100% indicates that country is exporting that particular crop. The formula for calculating Self Sufficiency Ratio is as under:

$$\text{SSR Self Sufficiency Ratio} = \frac{Domestic\ production\ of\ wheat}{Total\ Domestic\ Consumption\ of\ Wheat} \ x\ 100 \dots\dots\dots\dots \ (3)$$

2.3.5 Growth Rate Calculation

The growth rate shows the positive or the negative change in the production, consumption, import and export of wheat. The growth rate has been calculated making use of the following formula:

$$Growth\ Rate = \frac{Current\ value\ X\ 100}{Previous\ Value} - 100 \ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \ (4)$$

3 Literature Review

The literature review in a research study helps to gain familiarity and understanding with the current research topic and its different concepts and terminologies. It also showcases what research has already been done relevant to the current field of study and summarizing the existing ideas and arguments. The present literature review focuses on the Wheat, classes & grades, utilization, prices, and Storage. It also gives an overview about the production of wheat worldwide as well as state-wise production of wheat in India. It discusses the factors affecting the production of wheat. Commodity markets, types of commodity trading, Trading in commodity market, participants in commodity market, wheat as a part of commodity market, volatility in commodity trading and Food security in India.

3.1 Wheat

For the 5.3 billion people that live on the planet, wheat offers more than 20% of the calories. The predominant basic meal in many nations and an important grain that is loved across the world is wheat. Being one of the initially crops cultivated, it has been a staple food for many civilizations for more than 8,000 years. The main elements that contributed to making wheat the most widely grown crop in the world were its flexibility to growing in many climate zones, ease of storage, and simplicity in turning the grain into flour. Currently, wheat is grown on the most land (220 million hectares), and its global trading is larger than that of the rest of the crops combined (Janakiraman, 2020).

In majority of temperate areas, wheat is the primary source of carbohydrates and, on a worldwide scale, offers more nutrition for humans compared to any other source of food. Although lacking in several necessary amino acids, wheat is nevertheless a great diet. The majority of wheat protein is also easily digestible. The grain includes vitamins, minerals, and lipids, and wheat products are extremely nutrient-dense when they are combined with tiny amounts of animal or legume protein. Compared to a diet focused mostly on meat, a diet high in fibre and low in fat is healthier (Quisemberry, 1973).

3.1.1 Wheat Classes/Grades

The term "wheat" really relates to three separate categories of species that are part of the grass family, not just one particular species. Based on its agronomic as well as end-use characteristics, wheat is divided into a number of groups. These divisions often depend on the quality, colour, and growth pattern. The three different kinds of wheat, T. aestivum, T. durum, and T. dicoccum, are grown throughout the nation. Approximately 95 percent of the global production of wheat is made up of bread wheat, 4% of it is durum wheat, while only about 1% is dicoccum wheat (Gupta et al., 2014).

Wheat is often categorised into two distinct quality classes: both soft and hard, depending on whether it is suitable for making bread. Hard wheat is a grain that possesses a physically hard kernel which produces flour having high levels of protein plus gluten that may be used to make certain kinds of noodles and a piece of bread in the western manner. Conversely, soft wheat has a lower protein content and is best suited for making cakes and biscuits as they don't need a strong flour. There are other semi-hard wheats that combine some of the aforementioned qualities and are used to make Asian steamed bread, certain noodles, including unleavened breads like chapatis (Bushuk and Rasper, 1994). The colour of the outer layer of the wheat kernel, is referred to as colour. Different coloured wheats could be preferred in various markets based on the final product and the pace of milling extraction. Last but not least, wheat is also divided into categories based on its development pattern, or whether it is a winter or spring wheat. Since there might be a lot of variation among the different classes of wheat, it is graded in order to offer wheat of a constant quality. According to characteristics such test weight, level of protein, moisture, as well as foreign material content, the grain is rated. The major wheat exporting nations each have their own unique grading systems that are intended to deliver wheat that adheres to a particular standard (Bushuk and Rasper, 1994).

3.1.2 Wheat Utilization

Across 80% of the wheat harvested across the world is consumed in the nation where it is produced; the remaining 20% must either be stored or exported. There are four ways that wheat is used or lost: as food, as feed, as seed, and as additional uses (mostly industrial). By definition, global wheat output and consumption are equal over the long run. Since output

variations are mellowed down by the buildup or release of grain reserves, utilisation shows better year-to-year consistency over the near term.

With food making up almost two thirds of all consumption, wheat is mostly used for food. From 298 MMT in 1981–1982, to 375 MMT in 1990–1991 and beyond, the amount of wheat used for food has increased steadily during the previous ten years. There are several ways to eat wheat, all of which include some sort of processing or agriculture. While the bulk of wheat used for food is first milled into flour for use in products like bread, noodles, cookies, cakes, etc., products like morning cereals typically employ the entire kernel. Fascinatingly, in a recent survey performed in the US with the assistance of the Wheat Foods Council, over half (49%) of the respondents were unable to correctly recognise white bread as something made from wheat product.

3.1.3 Wheat Prices

In terms of area, tradeable value, and as a mainstay of family meals, wheat is an important worldwide commodity. Wheat prices are influenced by several variables such as weather, crop output, oil prices, imports, and lagging prices. These market dynamics are hypothesised to affect not just the steadily rising worldwide demand for wheat but also world pricing and, eventually, food security (Enghiad et al., 2017). Comparing recent years to previous decades, there has been a shift in the trends as well as variances of wheat prices. The cost of imports has gone up due to rising international wheat prices, which has also raised the cost of meals that are primarily made using wheat as an ingredient. Since a large portion of family meals in many developing nations consist of wheat-based items, price hikes for wheat will likely have an impact on both the cost of food and food security.

In developing nations, food costs are stabilized and/or lowered by government subsidies, which helps consumers more reliably satisfy their nutritional needs and, eventually, raises the degree of food security in households. Wheat prices, meanwhile, are under pressure due to increased wheat consumption brought on by population expansion and rising family incomes in emerging nations (Enghiad et al., 2017). The world's commodities markets have been severely shaken by the conflict in Ukraine. Due to disruptions in the

supply of many commodities, prices have dramatically increased, especially for energy, fertilisers, and some crops (World Bank Group, 2022).

Wheat production is influenced by a number of factors, including oil prices and the environment. Costs of inputs for producing wheat are influenced by oil prices, and there is a strong association between the two based on patterns of similarity involving variations in oil as well as wheat prices. Many factors, including variations in the duration of the growing season, average temperature, along with rainfall, can affect the climate of key producing regions and so have an impact on the cultivation of crops.

The following figure shows the fluctuations in the prices for procuring wheat in country India from the financial year 2014-2023.

Figure 1 Procurement Price of Wheat from 2014-2023 (Per Quintal)
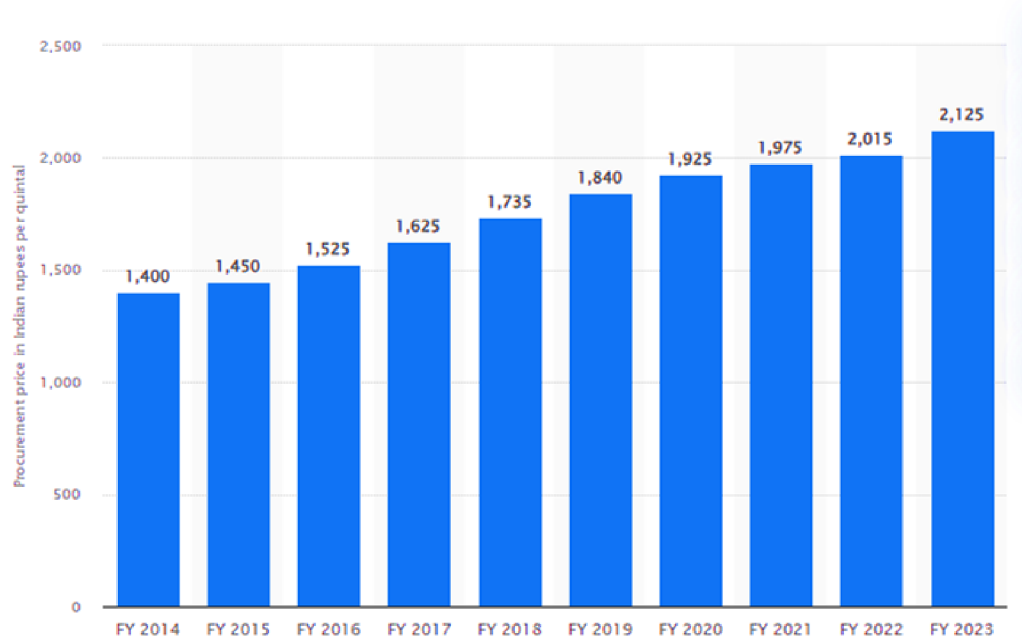
Source: (Keelery, 2023)

From the above figure it can be concluded that there is an upward moving trend in the wheat prices. Since 2014 prices of the wheat have increased from Rs.1400 per quintal to Rs. 1735 per quintal in the year 2018. While in the year 2023 it increased to Rs.2125 per

quintal. Thus, due to the impact of various factors as mentioned above the prices of wheat have continuously increased since the past years.

3.1.4 Wheat Storage

Agricultural produce's quality and shelf life after harvest mostly rely on how well it was grown. However, following the harvest, a number of connected elements develop intricate linkages amongst themselves that might cause the quality to degrade while being stored. Although agricultural output has a comparatively short harvest season, demand for consumption is year-round. In order to provide a reliable supply all year long, agricultural goods must be carefully kept using appropriate preservation techniques. Since they are the main source of energy for the vast majority of people on earth, cereals play a significant role in human nutrition. Cereals are kept in storage by farmers for use as feed, seed, and for their own food; however, marketing firms and dealers keep them for financial advantage. Government organisations frequently store food grains to assure domestic food security, availability, as well as market price stability in addition to export for foreign currency earnings. As a result, significant elements of economic and policy decisions are based on the changing dynamics of storage with respect to of quality maintenance and losses (Kumar et al., 2021). Following are the storage techniques for storing wheat:

CAP Storage

The scientific storage method known as "cover and plinth storage," or "CAP storage" in FCI, is used to store wheat. The storage site is created under the CAP system at a greater height than the surrounding land and far enough distant from drainage, canals, as well flood-prone areas to avoid waterlogged areas of the region. Brick and mortar are often used to construct the plinth, which is at least 450 mm above the ground. In order to prevent termite attacks, antitermite treatment is administered during construction. The pile of food grain sacks is coated with 800-1,000 gauge-thick polyethylene sheets after being stacked atop dunnage material, often wooden boxes positioned on a platform. Short-term storage, typically lasting less than a year, is done using the CAP storage system. The necessity for CAP storage originates from the requirement to store a large amount of procured wheat, especially just after harvest, in places where sheltered capacity for storage is insufficient. (Kumar et al., 2021).

Silos

The ideal method for storing wheat is silo storage. There are 2 types of Silos Steel and Concrete Silos for storage of wheat. Concrete silos: These long-lasting buildings are often utilised for extensive storage. They can hold a lot of wheat and offer good defence against pests and dampness. Steel silos are strong and appropriate for bulk storage, much like concrete silos. They are frequently employed in contemporary industrial grain handling operations.

Grain Bins/Bags

Grain bins are frequently utilised on fields and are available in steel or aluminium. They are excellent for medium-term preservation and are made to keep wheat in lesser amounts. When kept clean, grain bins offer defence from dampness and pests. Grain Bags are Flexible, airtight plastic bags made specifically for short-term storage are known as grain bags. They are perfect for temporary storage solutions since they are affordable and simple to put up. Appropriate sealing is necessary to keep out moisture and pests.

Climate-Controlled Warehouses

These sizable, enclosed spaces are ideal for storing wheat for an extended period of time. For the purpose of maintaining the quality of the wheat, they provide accurate temperature and humidity control. Wheat is frequently kept in climate-controlled warehouses for commercial purposes.

Hermetic Bags or Containers

To keep pests at away and avoid moisture intrusion, wheat is stored hermetically by being sealed in airtight bags or containers with specialised atmospheres. In areas with heavy pest pressure, it is frequently employed because it effectively preserves wheat quality.

3.2   Wheat Production

Of all cereal crops, wheat has the greatest adaptability and is produced in more than 100 different nations. Both northern Finland and southern Argentina are places where it is cultivated. The temperate portion of the northern hemisphere that exists between the 30th and 60th latitudes, which encompasses the main grain-growing regions of North America, Europe, Asia, and North Africa, has the highest concentration. Australia, Argentina, Brazil, and South Africa are the main countries with a smaller concentration between the 27th and the 40th latitudes in the south. African nation.

One of the most astounding accomplishments of the 20th century is certainly the increase in global wheat output during the previous 30 years. Forecasts for claims of widespread famine claimed in the 1960s and 1970s have so far been disproven, with except for certain parts of Africa. Since 1960, global wheat output has increased. been outpacing population growth. whereas the global population has almost doubled. The Wheat output has increased, from 3 billion tonnes in 1960 to 5.3 billion tonnes in 1990. Almost three times as much as in 1960 (Bushuk and Rasper, 1994).

3.2.1   Wheat Production Worldwide

The production of wheat grown all round the world is given as below for the year of 2021.

Figure 2 Wheat Production Worldwide for the year 2021 (In Tonnes)

As of 2021		*(in tonnes)	
China	136,952,000	Bulgaria	7,342,990
India	109,590,000	Italy	7,294,570
Russia	76,057,258	Uzbekistan	5,984,756
USA	44,790,360	Hungary	5,290,140
France	36,559,450	Ethiopia	5,214,000
Ukraine	32,183,300	Czechia	4,960,930
Australia	31,922,555	Lithuania	4,248,850
Pakistan	27,464,081	Iraq	4,233,714
Canada	22,296,100	Denmark	4,047,090
Germany	21,459,200	Afghanistan	3,900,000
Türkiye	17,650,000	Serbia	3,442,308
Argentina	17,644,277	Mexico	3,283,614
Poland	11,893,550	Sweden	3,027,800
Kazakhstan	11,814,124	Belarus	2,441,000
Romania	10,433,750	Latvia	2,407,700
Iran	10,093,579	South Africa	2,257,205
Egypt	9,000,000	Algeria	2,168,386
Spain	8,564,630	Nepal	2,127,276
Brazil	7,874,525	Slovakia	2,002,240
Morocco	7,543,848	Syria	1,951,806

Source: (RankingRoyals, 2023)

Despite the fact that there are over 80 distinct nations producing wheat, The Food and Agriculture Organization of the United Nations (FAO) statistics shows that just a small number of those nations account for the bulk of the world's wheat output. On the basis of total production in tonnes during the year 2020-21, the following are the top 10 wheat-producing nations worldwide.

Table 1 Top 10 Wheat Producing Countries Worldwide For the Year 2020-21

Ranks	Countries	Production of Wheat in 2021 (in tonnes)
1	China	13,69,52,000
2	India	10,95,90,000
3	Russia	7,60,57,258
4	USA	4,47,90,360
5	France	3,65,59,450
6	Ukraine	3,21,83,300
7	Australia	3,19,22,555
8	Pakistan	2,74,64,081
9	Canada	2,22,96,100
10	Germany	2,14,59,200

Source: Researcher's own Compilation

From the above table it can be interpreted that the greatest wheat producer in the entire globe, China, has produced over 2.4 billion tonnes of wheat throughout the past two decades, accounting for nearly 17% of global output from 2000 to 2020. Most of China's wheat is consumed domestically to satisfy the nation's expanding food needs. The biggest consumer of wheat worldwide in 2020–21 was China, which made up around 19% of the world's total consumption. India is the nation that produces the second most wheat. 12.5% of the world's wheat production during the past 20 years has come from India. Due to the high need for food in the entire nation, India, like China, keeps the majority of its wheat local. As the third largest producer of wheat in the world, Russia also serves as one of the largest exporters of wheat worldwide. More than 7.3 billion dollars' worth of wheat was exported from the nation in 2021, making up around 13.1% of all wheat exports during that year (Ang, 2022).

Following China, India, and Russia in terms of world wheat production in 2020, the United States produced close to 49.75 million tonnes. There are eight main varieties of wheat recognised by the United States Department of Agriculture. Subsequent to soybeans and maize as the most widely grown crops in the US is wheat. Wheat was produced in the US in 2021 in an estimated 44.79 million tonnes. In practically all of the states in the US, wheat is farmed. By 2021, France's supply of wheat has increased to 36.6 million tonnes from 1972. In terms of production, Ukraine ranks sixth. 2019 saw more than 25.4% of the world's wheat shipped from Russia and Ukraine. Ukraine is the world's fifth-largest exporter of wheat, accounting for 7% of worldwide sales in 2019. Ukraine is Europe's breadbasket since 71% of its land is used for agriculture.

Australian agriculture depends heavily on the production of wheat. Over 29.5 million tonnes of grain were produced in Australia in the year 2021–2022. Over the past 10 years, this is 22% higher than the average. 20% of Australia's wheat exports to China in 2020, totalling $2.68 billion USD, were made to the Asian nation. That year, Asia was the primary recipient of practically all of Australia's exports of wheat. The eighth-largest producer of wheat is Pakistan. The amount of wheat produced in Pakistan increased from 6,476 metric tonnes in 1971 to 27,464,081 metric tonnes in 2021. Pakistan was the world's 13th-largest importer of wheat in 2020, bringing in $1.01 billion in purchases. Pakistan made $5.47M from exporting wheat in 2020. The ninth-largest producer in the world is Canada. It ranks as one of the top wheat growers and exporters, with an annual production of more than 22 million tonnes with an export of roughly 15 million tonnes. In terms of global wheat production, Germany came in at number 10. 50% of the wheat utilised within the EU was grown in Germany and France in 2022. However, in 2021, exports and output both gradually decreased.

3.2.2 State-Wise Wheat Production in India

Native Indian wheat developed a reputation for being of the highest quality as well as was frequently in demand from foreign customers. The grain quality of many other nations was improved throughout the latter part of the 19th century by using many Indian wheat types as parental lines. India did, in fact, export wheat to several nations during 1888 and 1910. India became a country with a food grain shortage because of the fast increase

population growth as well as the two world Wars. Wheat output remained at an extremely low level until 1965 due to conventional farming with little input, indigenous tall wheat varieties, insufficient irrigation infrastructure, and the general sluggish rural economy. Due to the effects of the green revolution, several visionaries anticipated that by 1970, India would not only achieve self-sufficiency but would also create a substantial buffer to fend off bad weather and other disasters. India has achieved significant advancements in the study and development of wheat as a result of this coming true.

India has six distinct agroclimatic zones where the wheat crop is cultivated. The meteorological factors, kinds of soil, and length of wheat growth have been used to classify these zones. In order to select modern varieties and complementary production and safeguarding technologies which have been developed particularly for limiting the potential expected consequences of climate change, it is necessary to take into account potential shifts in climate variables throughout the wheat growing season, including precipitation/winter rains, lowest and highest temperature, the speed of wind as well as its direction, sunshine hours, etc (Kumar et al., 2014).

Table 2 Zone Wise Wheat Production Area (In Hectares)

S. No.	Zone	States	Total Area (In Hectares)
1	Northern Hill Zone	Hilly areas of J&K (Except Jammu, Kathua, and Samba Districts), Himachal Pradesh (Except Una & Paonta Valley), Uttarakhand (Except Tarai Region) & Sikkim	0.8 Million ha
2	Northern Western Plains Zone	Punjab, Haryana, Western UP, (Except Jhansi, Div), Rajasthan (Excluding Kota & Udaipur Div), Delhi, Tarai Region of Uttarakhand, Una & Paonta Valley of HP, Jammu, Samba & Kathua districts of J&K and Chandigarh	11.55 Million ha
3	North Eastern Plains Zone	Eastern UP (28 DIST.), Bihar, Jharkhand, West Bengal, Assam, Odisha, and other NE States (Except Sikkim)	10.5 Million ha
4	Central Zone	MP, Gujarat, Chattishgarh, Kota & Udaipur Div of Rajasthan & Jhansi Div of UP	5.2 Million ha

S. No.	Zone	States	Total Area (In Hectares)
5	Peninsular Zone	Maharashtra, Tamil Nadu (Except Nilgiris & Palani Hills), Karnataka & Andhra Pradesh	1.6 Million ha
6	Southern Hill Zone	Nilgiris & Palani Hills of Tamil Nadu	0.1 Million ha

Source: (Sendhil et al., 2019)

India, the entire globe's second-largest producer of wheat, set an all-time high production in 2013–14 with 95.91 million tonnes. Despite a number of unanticipated setbacks, output has remained over 90 million tonnes over the past few years. The development of high yielding, disease-resistant cultivars and complementary production techniques might enable the robust nature of the Indian wheat project, as is demonstrated here. The ability to make a variety of final goods from wheat, including chapati, bread, biscuits, as well as pasta, makes wheat a particularly special gift from nature to humanity. Wheat can now be used more effectively thanks to the rising local demand for baked goods and pasta products, economic liberalisations, and international commerce.

Table 3 Wheat Production in India for the year 2019-20 & 2021-22 (State-Wise)

No.	State/UT	Area Under Cultivation in Thousand Hectares (2019-20)	Wheat Production in Thousand Tonnes (2021-22)
1	Uttar Pradesh	9853	33949.68
2	Madhya Pradesh	6551	22418.5
3	Punjab	3521	14821.94
4	Haryana	2533.9	10447.21
5	Rajasthan	3118	9484.08
6	Bihar	2150.2	6223.76
7	Gujarat	1018	3334.24
8	Maharashtra	1057	2473.71
9	Uttarakhand	316	863.6
10	West Bengal	188.3	661.52
11	Himachal Pradesh	286	570.35
12	Jharkhand	214.8	507.23
13	Jammu & Kashmir	243.9	489.3
14	Karnataka	150	211.53
15	Chattisgarh	109.8	188.59

No.	State/UT	Area Under Cultivation in Thousand Hectares (2019-20)	Wheat Production in Thousand Tonnes (2021-22)
16	NCT Delhi & UTs	19.2	93.3
17	Assam	11.3	17.63
18	Mizoram	0	12.6
19	Telangana	5	10.94
20	Arunachal Pradesh	3.4	7.7
21	Nagaland	3.4	6.3
22	Manipur	2.3	5.8
23	Meghalaya	0.5	0.9
24	Orissa	0.1	0.27
25	Sikkim	0.2	0.1
26	Tripura	0.1	0.1
27	Andhra Pradesh	na	na
28	Goa	na	Na
29	Kerala	na	Na
30	Tamil Nadu	na	Na
	Total	**31357**	**106844.9**

Source: (Sendhil et al., 2019)

The rise in consumer demand for convenience meals including ready-to-eat, frozen, microwaveable, and quick foods has encouraged the mechanisation of the production of food in larger industrial facilities and the sale of more wheat products in grocery stores. The baking sector is expected to increase at a pace of between 5 and 7% each year. Therefore, wheat quality has to get the utmost attention in order to fulfil future local and export needs.

Top Wheat Producing States in the year 2021-22

Due to climatic conditions like Heat Wave in the key growing states of India the wheat production for the year declined to 107.74 million tonnes in the year 2021-22 which was 109.59 million tonnes in the year 2020-20. The top 10 wheat producing states in India with their percent share in total contribution is given in the below table.

Table 4 Top 10 Wheat Producing States (2021-22)

S.No.	State/ UT	Wheat (Th. tonnes)	% Share in Total Production
1	Uttar Pradesh	33949.68	31.77
2	Madhya Pradesh	22418.5	20.98
3	Punjab	14821.94	13.87
4	Haryana	10447.21	9.78
5	Rajasthan	9484.08	8.88
6	Bihar	6223.76	5.83
7	Gujarat	3334.24	3.12
8	Maharashtra	2473.71	2.32
9	Uttarakhand	863.6	0.81
10	West Bengal	661.52	0.62

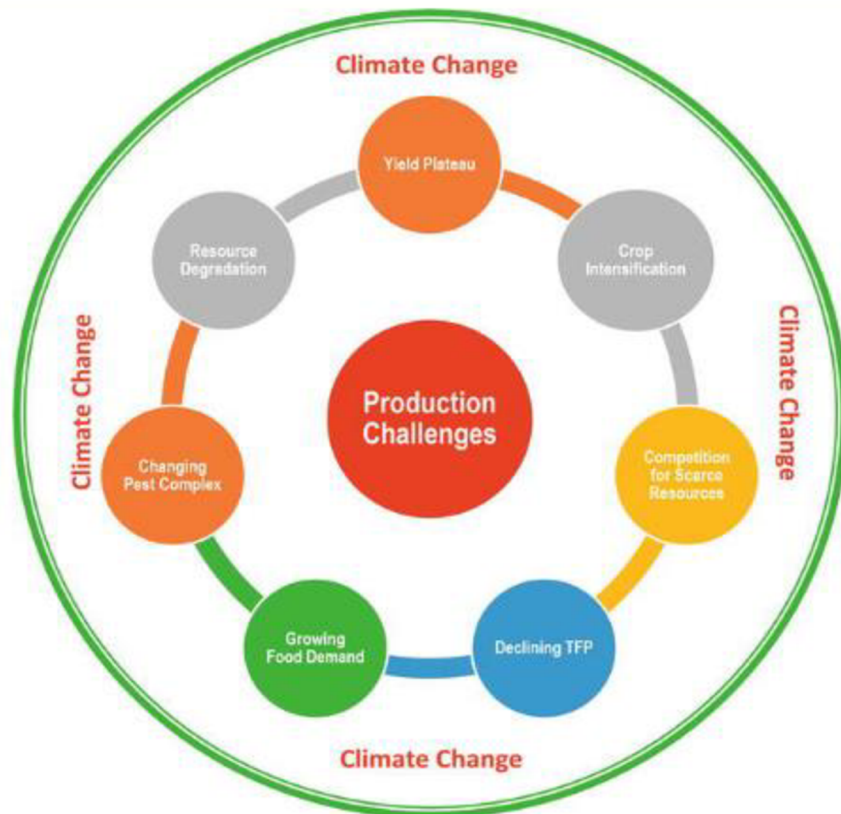*Source: (Sendhil et al., 2019)*

From the above table it can be observed that during the year 2021-22, Uttar Pradesh is the highest producer of wheat in India having a total production of 33949.68 (Th.Tonnes) which means 31.77% share to the total production is done in Uttar Pradesh. Madhya Pradesh is the second largest producer of wheat in the country having a total production of 22418.5 (Th.Tonnes) having a contribution of 20.98% to the total Production. Punjab is the third largest producer of wheat in the country having a total production of 14821.94 (Th.Tonnes) which comes to 13.87% share in the total wheat production in the country. It can be observed from the table that the top 3 states i.e. Uttar Pradesh, Madhya Pradesh & Punjab hold the maximum portion i.e. 66.63% of the total production of the wheat in the country.

3.2.3 Factors Affecting the Production of Wheat

There are several limitations to production that differ between crops and between geographical areas. Population growth in relation to a rapidly expanding demand for food, intensifying cropping, particularly in the Indo-Gangetic Plains, leading to an unreasonable utilisation of resources, pest-environment interaction, a decline in the base of natural resources, decreasing productivity of all factors, as well as yield plateau are some of the most significant obstacles facing the cultivation of crops (Gyanendra Pratap Singh, R. Sendhil and

Poonam Jasrotia, 2019). Due to wheat's sensitivity, in addition to the usual difficulties mentioned above, the impact of climate change is amplified (Sendhil et al., 2019).

Figure 3 Factors Affecting Production of Wheat

Source: (Sendhil et al., 2019)

Climate Vulnerability

While the severity of heat stress is modest in the northwest of the Indo-Gangetic Plains, it affects a sizable portion of the grain-producing area in India, with the Gangetic plains, the centre of India, as well as the Indian peninsula being the most affected (Joshi et al., 2007). Variability in the climate poses a significant environmental danger to Indian agriculture, with the potential to affect wheat security as well as productivity. According to predictions, India's wheat output will drop by 4-6 million tonnes for every degree Celsius as the temperature rises. For every 2–3.5°C increase in temperature, rainfed wheat output will decrease and profit will drop by 9–25% (Aggarwal, 2008).

Overutilization of Inputs and Land Resources

Owing to increasing use of plant protection agents, irrigated regions, and inputs, wheat production has grown dramatically since the Green Revolution. The overuse of pesticides, fertilisers, and irrigation has reduced the level of groundwater and weakened the soil's fertility of the land. The quality of the soil declined as a result of the monocropping method. Should the present pattern persist, the nation will have a significant challenge in making use of its limited natural resources (Ramadas, Kumar and Singh, 2019).

Problematic and salt-affected soils

A significant issue for regions watered by canals is the growing of wheat on approximately 4.5 million hectares of salt-affected land in India (Reynolds, 2001). The faster rate of restoration is not significant, despite the fact that soil supplements and appropriate drainage are the most beneficial solutions. This will cause the wheat yield to drop dramatically.

Disease and Pest Complex

Year after year, wheat pests have grown more resilient despite being managed under certain conditions. If not, a variety of new illnesses and pests have started appearing, severely limiting the output of wheat (Ramadas, Kumar and Singh, 2019).

Improved Seed Availability

Both official (organised) and informal (unorganised) methods have been used in India's adoption system along with germplasm dissemination (Joshi et al., 2006). 80% of all seeds are kept by farmers, despite the fact that NARS regularly develops new, better kinds and makes them available to farmers (Joshi et al., 2007). Furthermore, because of poor links, the majority of Indian farmers are unaware about improved wheat varieties (Joshi et al., 2007). To achieve goal wheat output, better varieties must be developed and widely disseminated.

Price Volatility

A lot of attention has recently been paid by producers, consumers, and policy makers to the volatility of agricultural commodity prices. Changes in price put wheat output at risk and have a detrimental effect on wheat producers' well-being by creating an unpredictable agricultural environment. The uninterrupted operation of international commerce is further hampered by the constantly changing of wheat prices on the global market (Ramadas, Kumar and Singh, 2019).

Declining Farm Size

The area of agricultural lands has been clearly shrinking over time, which is another significant worry for the country as a whole. The nuclear family system's tendency to partition farmland and urbanization's effect on the amount of cultivable land are the root causes of this. The average effective holdings in India was estimated to be 1.16 hectares based on data from the 2010–2011 agricultural census. Punjab had the greatest average operational holding (3.77 ha) within the main wheat-growing states, while Bihar had the lowest (0.39 ha). The two biggest obstacles to food production generally, and wheat production specifically, are shrinking agricultural land along with land used for agriculture being converted to residential areas (Ramadas, Kumar and Singh, 2019).

Reduced Factor Productivity

Policymakers are particularly concerned about the diminishing overall productivity of factors over time, which they attribute to yield levels stalling despite growing input and resource service consumption. It is a significant issue in the areas with intense farming, where rice and wheat are extensively farmed. Adopting better technology and making the most use of available resources will help combat this (Ramadas, Kumar and Singh, 2019).

3.3   Commodity

A commodity is a fundamental good that can be substituted for other items of the same kind and is used in commerce. The majority of the time, commodities are utilised as inputs to produce other items or services. Thus, the word often refers to a raw material that is employed in the production of final items. Conversely, a product is the final thing that is sold to customers. A particular commodity's quality varies significantly throughout producers, although it is generally the same. Commodities must furthermore fulfil certain minimal requirements, sometimes referred to as a base grade, in order to be traded on an exchange (Chen, 2021). Hard and soft commodities are the two general categories into which commodities are frequently divided. In contrast to soft commodities, which are animal or agricultural goods like maize, wheat, coffee, sugar, soybeans, and pig, hard commodities are resources like gold, rubber, and oil that must be mined or extracted (Hayes, 2021).

Because commodities usually appreciate in value when inflation picks up speed, investors frequently turn to them as a safety net when inflation spikes—especially when it

comes as a surprise. As a result, when more investors buy commodities, their prices rise, increasing demand for them. After then, the cost of products and services increases to reflect the rise. Because of this, as the rate of inflation rises, commodities frequently act as a protection against a currency's declining purchasing value (Vanguard, 2023).

3.3.1 Types of Commodities

Traded commodities are often classified into four main categories: metals, energy, livestock and meat, and agriculture.

Metals

Copper, gold, silver, and platinum are examples of commodities made of metals. Due to gold's reputation as a trustworthy commodity with actual, transferable value, a few investors may choose to purchase precious metals during volatile or downturn markets. To protect themselves from spikes in inflation or depreciation of their currency, investors may also choose to purchase precious metals (Lioudis, 2019).

Energy

Crude oil, heating oil, petroleum, natural gas, are examples of energy commodities. Oil prices have traditionally risen in response to changes in the global economy and lower oil output from well-established oil wells worldwide. This is because consumption of energy-related commodities has increased while supply levels have decreased. Those considering investing in the energy sector as a whole ought to know that market prices for commodities are likely to be significantly impacted by a number of factors, including recessions, changes in production mandated by the Organisation of the Petroleum Exporting Countries, as well as technological advancements in alternative sources of energy such as wind, solar, as well as biofuel, which aim to displace crude oil as the main energy source in the future (Lioudis, 2019).

Agriculture

Commodities used in agriculture include cotton, sugar, chocolate, coffee, wheat, soybeans, as well as maize. Grain prices in the agriculture industry are particularly erratic in the summer and throughout any weather-related shift. A restricted agricultural supply coupled with population increase might present chances for investors interested in the agriculture industry to reap rewards via increasing agricultural commodity prices (Lioudis, 2019).

Livestock & Meat

Pork belly, live cattle, feeder cattle, and lean pigs are examples of livestock as well as meat commodities (Lioudis, 2019). Entry to commodity items in a centralised, liquid market is made possible by commodities markets for producers as well as consumers. Future output or consumption might be hedged by these market participants using commodities derivatives. Additionally active participants in these markets include investors, arbitragers, as well as speculators. As an alternative asset class, a diverse range of commodities may aid in portfolio diversification. Some commodities, like precious metals, have even been seen as strong inflation hedges. During volatile market times, certain investors also place their trust in commodities considering their prices typically move against equities' movements (Hayes, 2021).

3.4 Types of Commodity Trading Market

Commodity Trading is done is two ways: Spot Market & Derivative Market. Following are the ways through which commodities can be traded.

Spot Market

Physical commodities are purchased or sold through the spot market at a price that is agreed by the one who is buying as well as seller. Commodities are bought and sold in the spot market involving cash payments and prompt delivery. Both the business-to-business and individual customer spot marketplaces exist. Traditional marketplaces that sell fruits and vegetables, like Azadpur Mandi in Delhi, are also considered spot markets (Mahajan and Singh, 2015)

Commodity Derivatives Market

An enforceable agreement wherein the value of the contract is determined by the value of the asset that underlies it is known as a derivative contract. Commodities, stocks, currencies, precious metals, bonds, interest rates, indexes, and so on can all be considered underlying assets (Mahajan and Singh, 2015).

Market condition and important information may be found in commodity derivatives markets. Commodity pricing along with raw material volatility create an unexpected and chaotic economic environment, with unanticipated risks. This is because commodities are widely employed as inputs in the creation of goods and services. Since that domestic and

international markets determine both supply and demand for commodities, raw material pricing volatility may have a substantial impact on enterprises. Business success can be enhanced by the capacity to control or reduce risks via appropriate hedging in commodities derivative products. The majority of commodity derivatives products available on an exchange are futures and options, which are well-structured and subject to strict regulations thanks to strong controls and systems (NSE India, 2024). Following are the commodity derivatives market.

Future Market

The term "futures market" refers to a marketplace wherein commodities are purchased and sold through contracts that stipulate that the transaction will be settled at a particular price as well as on a future date. The special quality of the futures trading system is that one may take delivery of the commodity in physical form without having to possess the real commodity in physical form. Cash is used to settle each transaction. Hedging or mitigating commodity risk associated with prices is the main goal of the commodity futures market. Everyone are well-aware that the spot market's pricing are erratic and constantly changing. Furthermore, one would want to reduce or completely avoid this kind of price risk as a trader or investor. Thus, one may settle the contract using the futures market. Commodity exchanges create standard contracts called futures, which have a predetermined set of prices, a minimum lot size required for trading, and a specified date for settlement or expiration. (Mahajan and Singh, 2015).

Forwards

A forward contract is an agreement amongst the two parties to swap the asset being traded at an agreed-upon price on a specified future date, and it can be customised or highly standardised. It's a two-way agreement with terms that have been discussed and decided upon by both sides. Instead, then being traded on an exchange, it is done over-the-counter. By providing the asset by the party selling it and accepting payment from the buyer for it on the due date, the two parties consummate the contract (Mahajan and Singh, 2015).

Options

Contracts known as commodity options allow an individual the right, but not the obligation, to purchase or sell a certain quantity of a commodity on or before a given future date (Mahajan and Singh, 2015). There are two types of options Call Option and Put Option:

- **Call Option**

The person who is the owner of a call option has the opportunity, instead of the obligation, to purchase the underlying securities before or on the day of expiration at the price specified in the strike price. Because calls possess a positive delta, their value will increase in tandem with the price of the underlying securities. Given its infinite upside potential and the fact that the maximum loss is equal to the option's premium, a long call can be utilised for speculating on the movement of the price of the underlying commodity's (Chen, 2019).

- **Put Option**

Put options, as opposed to call options, have the privilege, but not the obligation, of selling the commodity underlying at the price of the strike on or before the option's expiry. Because the put increases in value as the price of the underlying security decreases, a long put is essentially a position that is short in the underlying security. As a type of insurance, investors may buy protective puts, which provide them a minimum price on which they can hedge the positions they hold (Chen, 2019).

Financial instruments with flexibility are options. The buyer pays a premium for the rights that are offered by the contract in these buyer-seller agreements. Within a predetermined window of time, the holder of a call option may purchase the asset at a specified price. The holder of a put option, however, can sell the asset at a certain price during a predetermined window of time. The buyer and seller of each call option are bullish, whereas the buyer and seller of each put option are bearish (Chen, 2019).

Swaps

A commodity swap is a contract between two parties to swap cash (flows) for a predetermined future date, based on the value of commodities, currency, stocks or other assets. Swaps, unlike futures, are not exchange-traded securities. Swaps are typically created by banks and other financial institutions that also trade these bilateral contracts (Mahajan and Singh, 2015).

3.5 Trading in Commodity Market

Trade is the voluntary transfer of products or services between various businesses. An exchange of goods will only take place if both parties believe it will advance their interests, as they are not obligated to trade. In certain settings, the term "trade" might have

more precise connotations. Buying and selling stocks, commodities, or derivatives is referred to as trading in the financial markets (Nikitha, 2023).

Financial assets, such as commodities, are available for purchase and sale on specialised markets. One may purchase contracts on certain commodities (such as forwards, futures, as well as options) on well-established derivatives trading platforms. Due to the fact that commodities are not closely linked to various other financial assets and can act as a hedge against rising inflation, some experts advise investors to retain at least a percentage of a portfolio that is well-diversified in commodities (Arasu, 2022).

Having a longer track record than stock and bond trading, commodities trading is an old profession. The development of intricate commercial networks and the facilitation of commodity exchanges have been directly related to the establishment of several empires.Even in the present era, commodities are traded globally. An exchange for commodities can refer to a physical site where commodities are traded as well as organisations that were established legally to uphold the regulations governing the trading of standardised commodity contracts and associated investment products (Hayes, 2021).

For knowledgeable investors as well as traders, commodities possess the potential to develop into their own asset class. Due to their greater alignment with the principles of demand as well as supply in basic economics, commodities are comparatively easy for investors to gain insight into. Commodity prices have in the past been less erratic than stock prices, making them a viable choice for diversification. The commodities futures market, like any other, is a great resource for exchanging information and distributing risk. The market acts as a middleman between commodity buyers and sellers and helps with decisions on how to store and use commodities. By doing this, they increase the liquidity of the underlying market (Naidu, 2010).

All nations developed and emerging, as well as least developed countries (LDCs), depend heavily on commodities for their economic growth. Among the 48 LDCs that now exist, almost two-thirds of the working force is reliant on agriculture. More than 60% of people in India also depend on agriculture for their living. Statistics from UNCTAD show

that 27 LDCs export commodities. In actuality, from 2007 to 2009, about 80% of the items exported by LDCs were commodities. Any development plan aiming at promoting economic growth, reducing poverty, and ensuring food security must acknowledge the critical role that natural resources as well as commodities play in the economy of the least developed countries (LDCs), given their substantial reliance on them. The economies of LDCs continue to be fragile because of their excessive reliance on a small number of key commodities and price instability, as was shown during the most recent triple crises involving food, finance, and gasoline (Mahajan and Singh, 2015).

3.5.1   Market Participants in Commodity Trading

Brokers

When discussing exchanges, the first type of participant that springs to mind are the brokers. Similar to securities brokers, commodity brokers receive orders from customers and execute trades on behalf of their clients in the market. In order to assist the customers, they serve in engaging in transactions, they offer all the fundamental services, including analysis, every day's price updates, trading insight, news, along with additional resources. For the benefit of the customers, they essentially streamline the entire trading procedure. The brokerage fees are between 0.10 and 0.25 percent of the total contract amount. The transaction fees for each contract vary from Rs 6 to Rs 10 per lakh. For each commodity, there will be a distinct brokerage.

Additionally, it will vary according on delivery and trade activity. Should a contract lead to delivery, the brokerage can range from 0.25 to 1 percent of the whole contract amount. The brokerage is not permitted to go beyond the exchanges' maximum limit. (Mahajan and Singh, 2015).

Hedgers

Something must be physically owned in order to be hedged, or the buyer may be considering purchasing and accepting a physical delivery. Those who truly hold the commodities with them in their original physical form are known as hedgers. These individuals are concerned about any financial losses they could experience as a result of fluctuating commodity prices that they might be physically carrying about. To mitigate the potential danger of changes in the price of the commodity they are really physically trading

in, they trade via the futures market (Mahajan and Singh, 2015). Below is a list of a few of the hedges.

Scalpers/Day Traders

Individuals who enter into positions within futures contracts for a single trading day and exit them before the end of that trading day are known as scalpers or day traders. The smallest time span belongs to the scalpers. While traders who trade daily close their holdings prior to the conclusion of each day's trading, they maintain the positions they hold for a short period of time. The goal of day traders as well as scalpers alike is to benefit from the intraday fluctuations in commodities futures prices. Their position is not carried over to the following trading day. Because these market participants conduct a high amount of transactions, they offer liquidity in the futures market. But because of their over-reliance on speculative trading, these participants can also have a detrimental impact on how the market functions and how prices are formed. Extremely frequent traders, who utilise very quick algorithms as well as computers to hold onto contracts for just microseconds, are a unique kind of scalper (Mahajan and Singh, 2015).

Aggregators

In addition to providing farmers with discovering prices as well as price risk management, aggregators also add liquidity to the futures market. Agribusiness entities such as farmers' cooperatives, farmers' or producers' unions, as well as non-governmental organisations authorised to gather agricultural products from farmers and resell them in the futures market are examples of aggregators (Mahajan and Singh, 2015).

Arbitrageurs

Traders that take advantage of price differences across markets by buying and selling are known as arbitrageurs. In some marketplaces, they concurrently purchase or sell the same goods. Prices in several marketplaces are kept consistent with one another through arbitrage. These trades are often risk-free (Mahajan and Singh, 2015).

Speculators

Instead of hedging, traders who are speculators aim to benefit from price changes; they have no real economic relationship with the underlying. The expectation of a better return on investment along with a greater assumption of risk are common among speculators. The actual commodities do not really need to be purchased, sold, or delivered by them. In order to complete a strictly financial transaction, they want to sell their holdings prior to the

contract's expiration date. In the futures market, traders may operate with little capital because of the margin system. Traders who engage in large trades on behalf of institutions or individuals with smaller accounts may be considered speculators. Due to the fact that there are often more people looking for protection against increasing prices than against falling ones, speculators are expected to offer market liquidity (Mahajan and Singh, 2015)

Regulators

The exchange is managed by a regulator. India's commodities futures market is governed by the Forward Markets Commission (Mahajan and Singh, 2015).

Position Traders

In the hope of beneficial shift in the pricing of commodities futures, position traders hold extended positions that can last for weeks or even months. They can have jobs where they take on a lot of risk yet have the potential to make large gains (Mahajan and Singh, 2015).

3.5.2 Wheat as a Part of Commodity Trading

The trade of commodities, such as grain and other agricultural items, metals, as well as energy products, is not a recent development. Since commodity trade is perhaps one of the oldest forms of commerce, it wouldn't be inaccurate to say that it predates human civilization. The barter system, spot markets, futures markets, and other forms of commodity trade have all evolved significantly throughout the ages. There exist significant markets for commodities derivatives in India along with other emerging economies like China, Brazil, and South Africa. China and the United States have higher monthly turnover through Indian commodity exchanges. Yet, despite a sharp increase in trading volume, there has been a great deal of controversy surrounding the commodity futures markets in India for a number of reasons. These include widespread manipulation and abuse of the market that has negatively impacted market integrity, a weakening of the integration between the spot and futures markets, worries about price increases, and inadequate oversight and regulation (Mahajan and Singh, 2015).

3.5.3 Volatility of price in Commodity Trading

Variability within a specified time frame is measured by volatility. As a result, throughout time, there can be variations in the degree of volatility in commodity prices. The

current commodity prices as well as the corresponding volatility measures can also differ between markets owing to a variety of factors, including trade tariffs and transportation costs, as well as market fragmentation brought on by physical restrictions. Furthermore, the fluctuation in prices varies throughout individual commodities as well as between groups of commodities. Variations in supply as well as demand in addition to indirect effects on commodity markets from geopolitical along with economic developments can be the driving forces behind fluctuations in commodity prices. Many commodities, including food and energy, have short-term inelasticity in their supply and demand, so even little changes in either can have a big impact on prices (UNCTAD, 2023).

Supply Side

Severe weather conditions are hard to forecast and can cause supply disruptions in commodity markets, especially in the agriculture industry. Extreme weather conditions such as higher temperatures, more intense rainfall, especially that associated with tropical cyclones, and more intense droughts, can become more frequent and severe due to climate change, which will have an effect on the volatility of commodity prices. In addition to decreasing output and quality and raising costs of production in agricultural markets, pest infestations along with disease outbreaks may culminate in supply shocks. Supply shocks can result from manufacturing delays and disruptions caused by strikes and labor-related disputes. Geopolitical crises, like as the limitations imposed during the pandemic, can have an impact on commerce, transportation, and the manufacturing of commodities, which can cause supply shocks in the impacted markets. A further vulnerability of the global commodities markets to shocks is the concentration of output in some areas (UNCTAD, 2023).

Demand Side

Regarding demand, shocks typically manifest as abrupt shrinkage in the world economy, a decline in demand, or sharp spikes in demand worldwide, frequently brought on by rapid economic development in significant importer or consumer nations. The pandemic had a long-lasting impact on the volatility of commodities prices worldwide. Travel bans, supply chain interruptions, and containment policies all decreased demand across a wide range of economic sectors, which lowered the price of commodities including metals, oil, including agricultural items. The fluctuation of commodity prices is influenced by shifts in the monetary policies of major countries, like the US and the EU. The decisions central banks

make about interest rates have an impact on the growth of the economy and demand. A monetary strategy that is expansionary in nature, marked by low interest rates, has the ability to boost economic growth and aggregate demand. This might result in a surge in demand for commodities along with eventual price increases (UNCTAD, 2023).

According to some academics, investors outside of commodities industries, especially institutional investors like hedge fund managers and pension funds, have shorter time horizons than individual investors, which can exacerbate volatility, cause bubbles, and cause market instability. Commodity price instability is also influenced by speculators, who use financial instruments like futures and options to bet on commodity prices, exaggerating price fluctuations and elevating volatility. Trade limitations, such as prohibitions or limits on the overseas shipment of food, can exacerbate volatility during difficult times. Commodity price volatility may also be influenced by technological advances and innovation. Novel sources of demand for commodities may arise due to technological advancements. Commodity volatile prices may be greatly impacted by market instability and uncertainty brought on by informational frictions along with an absence of openness about global supply, demand, and inventories of commodities (UNCTAD, 2023).

3.6 Food Security in India

"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life." (Food and Agriculture Organization, 2013)

Individual, family, subnational, and national food intake are all correlated with food security. A home should be considered food secure if all of its members have access to enough food to meet their minimal required consumption. The minimum is contingent upon several factors, including but not limited to gender, occupation, body type, weight, and the situation of pregnant and nursing women (Alamgir and Arora, 1992).

A sufficient supply of food is a prerequisite for food security. In terms of grains, India is mostly self-sufficient, but it lacks essential oilseeds as well as pulses. The market is

nowadays seeing an increase in demand for fruits, vegetables, dairy, meat, poultry, as well as fisheries due to shifts in eating habits (S. Mahendra Dev and Sharma, 2010).

As per the report of (United Nations India, 2024) India has succeeded in a good job of increasing food output and accumulating sufficient food grain safety stockpiles. More than 70% of Indian rural families still rely primarily on agriculture, particularly raising animals. Food grain output in India increased sixfold between 1950–1951 (50MT) and 2019–20 (almost 300MT). India currently ranks as the globe's ninth-biggest provider of agricultural goods and a net food exporter. In the years 2020–21 and 2021–22, the percentage of the economy's total Gross Value Added that comes from agriculture and related industries increased to 20.2% & 18.8%, respectively. India has transformed over the previous 30 years from a food-deficit country to an independent food producer thanks to these improvements.

By guaranteeing access to sufficient amounts of high-quality food at reasonable rates, the National Food Security Act of 2013 seeks to promote security in terms of nutrition and food. Priority families are eligible to get 5 kg of food grains every individual each month at the issue rates of Rs. 3, Rs. 2, and Rs. 1/kg of rice, wheat, as well as coarse grains, respectively, via 543,562 fair price stores using 237 million ration cards (United Nations India, 2024).

The National Food Security Act (NFSA) of 2013 made this feasible by providing 813 million individuals with subsidized monthly family rations (rice, wheat, or millets) by means of Public Distribution. The Public Distribution System, which was first used in the 1940s as a way to control food scarcity, has developed into an efficient way to distribute food grains at reasonable costs and is a crucial component of the government's food management strategy. The primary goals of food management are to distribute food grains to consumers, especially the weaker segments of society, at reasonable prices; purchase food grains from farmers at fair prices; and maintain food buffers for stabilization of prices as well as food security (Pillay and Kumar, 2018).

3.6.1 Dimensions of Food Security

There are four dimensions of food security i.e. Availability, Accessibility, Utilization and Stability. Following is the explanation of the four dimensions of food security.

Availability

The term "availability" describes the actual state of food supply in the appropriate amounts. Put otherwise, it signifies "adequate." The foundation of food security is food production. There are claims that greater food availability is a prerequisite for India to achieve food security. The supply of food is determined by its production, distribution, carryover inventories, and imports. Food production's net availability is calculated by adding imports and subtracting exports. One of India's greatest achievements during the Post-Independence era has been achieving food grain self-sufficiency. The necessity for imported food was all but eliminated because to the green revolution, which brought about a sharp and sustained growth in domestic food grain production. The only exception to this was in extremely rare circumstances, such as severe crop failure, famine, or drought (Ittyerah, 2013).

Food security is closely related to food availability. Enough food must be provided to a population, but this is not a sufficient need to guarantee that everyone have appropriate access to food. Food availability per person has increased throughout the past 20 years as a result of emerging nations' food supply expanding more quickly than their population. The majority of emerging regions now have better levels of energy sufficiency due to the fact that dietary energy sources have increased more quickly than typical dietary need for energy (Food and Agriculture Organization, 2013).

Access

Both physical and financial access are prerequisites for having access to food. The availability and affordability of social assistance, discretionary money, and food costs all influence economic access. The accessibility of a marketplace is contingent upon the quality as well as the availability of its infrastructure, which encompasses food preservation, transportation, communications, ports, as well as related amenities. Food security results are mostly determined by the incomes obtained from agriculture, forestry, fisheries, and aquaculture (Food and Agriculture Organization, 2013).

Food access is defined as both the availability of food via safety nets of distribution and its affordability as a matter of a person's capacity to buy it. The impoverished must have sufficient purchasing power in order to be secure in their access to food. The Government of India implemented food-based initiatives, including the Public Distribution System (PDS), Integrated Child Development Scheme (ICDS), and Mid-day Meal Scheme (MDM), to address the fundamental requirements of the most marginalized population in the nation (Jain, 2016).

Utilization

There are two ways that food is utilized. Anthropometric markers impacted by undernutrition which are commonly accessible for children below five years old are used to measure the first. The terms "wasting," "stunting," and "underweight" refer to a state of being too thin given one's height, age, or body type, respectively. The nutritional condition of every individual may be roughly approximated by measuring children below the age of five. A variety of factors, or input indicators, which include the quality of food along with preparations as well as hygienic and medical conditions, are responsible for capturing the second dimension and expressing how efficiently food may be used (Food and Agriculture Organization, 2013).

Stability

To gauge the degree of being exposed to risk, two categories of indicators have been established. Important markers of being exposed to risk consist of the area that can be irrigated, which indicates how exposed a region is to climatic shocks like droughts, and the percentage of food imports compared to exports, which indicates how much foreign exchange reserves are needed to cover food imports. Variations in the cost, supply, as well as production of food and inputs, in addition to other hazards or shocks, are captured by a second set of indicators. The set of indicators encompasses several stability metrics, one of which is the World Bank's metric for political instability (Food and Agriculture Organization, 2013).

3.6.2 Challenges to Food Security in India

Long-term and short-term limitations and issues affect Indian agriculture. These are mirrored in the common farmer suicides that are rising in some states. Farming is turning into a less profitable endeavor as yields rise at a slower rate. The farming community is

facing more issues due to increasing land degradation, declining soil fertility, and water logging. Many areas are experiencing a decrease in surface irrigation and a drop in ground water levels (Ittyerah, 2013). Following are the challenges to food security in India

Climate Change

The effect of climate change upon agriculture constitutes one amongst the new concerns in food security. India has good reason to be worried about global warming. The great majority of Indians make their living from climate-sensitive industries including forestry, agriculture, and fishing. The negative effects of climate change, such as decreasing precipitation as well as rising temperatures, which exacerbate drought and flooding, will inevitably jeopardize food security and economic lives (S. Mahendra Dev and Sharma, 2010).

Diversification of Land

Food security could be further threatened by land being used for non-food crops as well as other uses. Nonetheless, some land may be safely converted to non-food crops if productivity on land producing foodgrains as well as food crops are raised (S. Mahendra Dev and Sharma, 2010). The agrarian issue is being made worse by the reduction in farm size brought on by subdividing and alienating property. The farming community faces significant difficulties from a number of other significant concerns, including as the repurposing of land used for agriculture for special economic zones, changes in land usage brought about by urbanization, and the expropriation of tribal territory for mining and other industrial operations (Ittyerah, 2013).

Output Price Fluctuations

Producer and consumer pricing differ significantly. When it comes to tomatoes, for instance, farmers may receive 50 paise per kilogram, while customers in metropolitan areas pay Rs. 15. Price stability funds are necessary to shield farmers from fluctuations in both domestic and foreign prices (S. Mahendra Dev and Sharma, 2010).

Seeds

In order to increase crop yields and guarantee steady development in agricultural production, seeds are an essential component. It is not only vital to manufacture seeds, but also to provide assured quality seeds. However, one of the biggest challenges facing the Indian agriculture sector is that farmers find it difficult to acquire quality seeds due to their high cost (ispp.org, 2023). The difficulty facing the seed industry is providing farmers

around the nation with high-quality, genetically promising seeds at a reasonable cost so they may maximize output under the specific agroclimatic circumstances (Jain, 2016).

Poverty

Even in situations when there is a sufficient supply overall, there are several reasons why certain individuals could not have access to food. Among the most basic is the fact that there is no assurance that a market economy would produce an income distribution sufficient for everyone to buy the food they require (Martin, 2010). Poverty is a significant factor in the food security access component. Undernourishment is more common in areas with greater poverty levels.

Lack of Investment

The reduction in funding for rural infrastructure as well as agriculture from both the governmental and private sectors. Despite a notable rise in agricultural financing, there has been a noticeable fall in investment in irrigation, technical advancement and agricultural diversification, and fertilizer usage. Though there is some indication that agricultural development has resumed recently, this trend is hardly promising given how important the agricultural industry is to maintaining food security along with livelihoods (Ittyerah, 2013).

Public Distribution System

Increasing food insecurity throughout the nation is partly a result of insufficient food distribution via public distribution systems. Due to the arbitrary and state-specific criteria used to classify households that fall below the poverty line (BPL), the Targeted Public Distribution System has the drawback of excluding eligible individuals who would otherwise qualify for the subsidy. The distribution of food grains has significantly decreased as a consequence of the frequently incorrect categorization into above and below the poverty line (APL and BPL) groups. The issue has also been exacerbated by the inadequate quality of the grains along with the unsatisfactory service at PDS stores (Upadhyay and Palanivel, 2011).

Wastage and Faulty Food Habits

A study conducted by the FAO found that more than one-third of the food produced worldwide is wasted. In many places of the world, it is not only not consumed but also squandered. Furthermore, overindulging and poor eating habits make the issue worse. In the US, almost 35% of adults are fat. The US National Center for Health Statistics states that those in the upper income bracket are more likely than those in the middle or lower income bracket to be obese as a result of overeating. Malnourishment results from a lack of necessary

nutrients among persons living in underdeveloped nations or in lower socioeconomic groups, as food is scarce in these areas (Rajput, n.d.).

Lack of Mechanisation

Even with substantial mechanization in some parts of the nation, manual labor is still employed in many agricultural activities there, employing simple instruments like sickles and wooden ploughs. Crop operations such as plowing, sowing, irrigating, thinning and pruning, weeding, harvesting, threshing, and transportation are carried out either entirely or mostly without the use of machines. For small and marginal farms in particular, this is accurate. Because of this, a lot of human effort is needed, which results in low productivity per person (ispp.org, 2023).

Irrigation

Just one-third of India's agriculture is irrigated, despite being the second-largest irrigated country in the globe after China. Given the nation's tropical monsoon environment, which produces erratic and varied rainfall, this is a serious restriction. More than half of the farmed land must have consistent irrigation in order to make significant agricultural progress (ispp.org, 2023).

Globalization

Globalization has brought about good developments in many areas, such as transportation, technology development, quick communication, and the increase of the service sector, but it has also presented challenges. Undoubtedly, the international market's economies are now more interdependent and competitive than ever before, which has made things worse for home producers and farmers. The creation of special economic zones (SEZs) as a result of globalization's effects also contributed to the expansion of the wealth divide (Jain, 2016).

Agricultural Marketing

Supply chain management in India's agriculture marketing is yet another important and significant concern. Poor roads, overbearing regulations, and inadequate market infrastructure make it difficult for farmers to access the market. Thus, in order to increase the marketing of agricultural goods in India, actions must be done that promote the private sector as well as foreign direct investment (Jain, 2016).

Mismatch Between Water Demand and Supply

The nation experiences wide variations in rainfall as well as water supply both in terms of time and space. The monsoon season provides the majority of the water supply, but only during a few periods of heavy rain. In India, there is 1170 mm of rainfall on average. Because of urbanization, industrialization, and population increase, there is a rising need for water for a variety of uses. Approximately 83% of water resources are now used by the agriculture sector; but, in 2050, due to demand from other sectors, availability may drop to 68%. water supply as well as demand are therefore out of balance (Brahmanand et al., 2013).

4 Practical Part

The practical part of the present quantitative research deals with the analysis and interpretation of secondary data. Whereby, secondary data is categorised into table forms and graphs, charts and percentage showing the trend in the production, consumption, import and export of wheat. It also presents the hypothesis testing with the help of statistical tools Corelation, regression and Anova to determine the strength, nature and significance of relationship between the Independent and Dependent variable considered in the current study. The practical part also includes calculation regarding the self-sufficiency ratio of country India in terms of wheat to determine whether India is a self-sufficient country in Wheat.

4.1 Fundamentals of Wheat Production in India

In order to study the upward moving trend or the downward moving trend of the Production, Export, Import & Consumption of wheat in (1000MT), it have been discussed as below. The production of wheat determines the consumption pattern as well as the export pattern of a country. The increase in production of wheat may lead to change in consumption or exports of wheat. Whereas increase in imports of wheat may lead change in production. Therefore, to examine the effects on one variable on another variable it is important to study the individual variable and its changing pattern.

4.1.1 Wheat Production & its Growth Rate

The following table shows the wheat production (in million tonnes) in India from the year 2005-2022. It also shows the growth rate (Calculated using Formula 4) in the production of wheat in India for the duration:

Table 5 Wheat Production & its Growth Rate

Year	Production (in 1000MT)	Growth
2005	68637	-4.88
2006	69355	1.05
2007	75807	9.30
2008	78570	3.64
2009	80679	2.68
2010	80804	0.15
2011	86874	7.51
2012	94882	9.22
2013	93506	-1.45
2014	95850	2.51
2015	86527	-9.73
2016	87000	0.55
2017	98510	13.23
2018	99870	1.38
2019	103600	3.73
2020	107860	4.11
2021	109586	1.60
2022	103000	-6.01

Source: Researcher's own compilation based on FAO

The graphical representation for the above table is given in the following clustered bar graph for the better comparison of wheat production and its growth rate for the year 2005-2022.
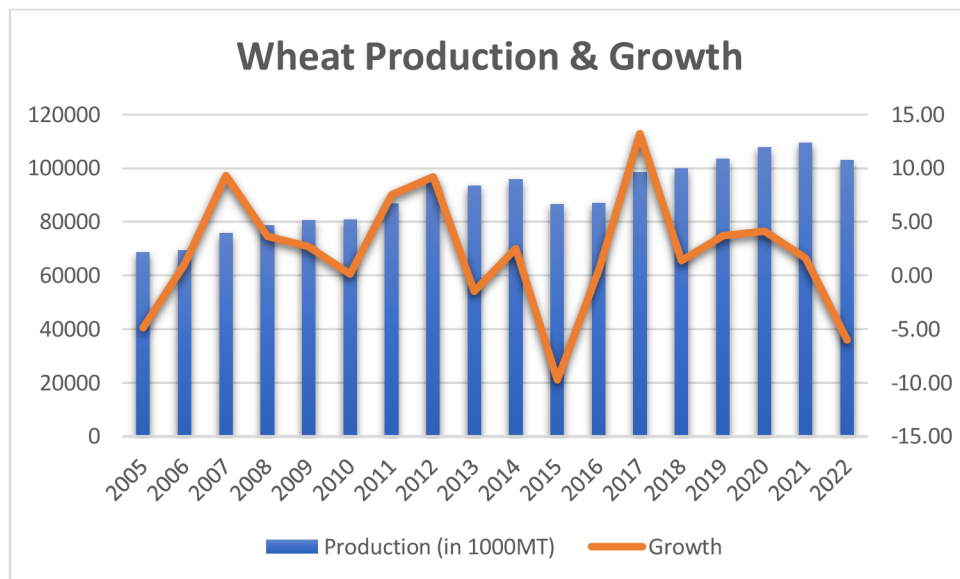
Wheat Production & Growth

Source: Researcher's own compilation based on FAO

From the above figure it can be inferred that the production of wheat for the year 2005 was 68637(1000MT), which increased to 69355(1000MT) in the year 2006 there was a rise in production of wheat by 1.05% in the year 2006. While the production of wheat further increased to 75807(1000MT) in the year 2007 showing an increase of 9.30% compared to the year 2006.

In the year 2008 there was increase in production of wheat by 3.64% compared to the previous year 2007. In the year 2009 the production of wheat increased by 2.68% compared to previous and was 80679(1000MT). While in the year 2010 it stood at 80804(1000MT) production an increased by 0.15%. In the year 2011 production was 86874(1000MT) with an increase of 7.51% from the previous year 2010. In the year 2012 wheat production stood at 94882(1000MT) showing a 9.22% increase compared to previous year. From 2013 a downfall is observed in the production of wheat and its growth reduced to 93506(1000MT) with a 1.45% fall from previous year 2012. Moreover, it increased by 2.51% in the year 2014 compared to the year 2013 and reduced to 86527(1000MT) in the year 2015.

In the year 2016 productions increased to 87000(1000MT), while it increased to 98510(1000MT) in the year 2017 and further increased by 99870(1000MT) in the year 2018. In the year 2019 production of wheat was 103600(1000MT) which increased to

109586(1000MT) in the year 2021 and was at 103000(1000MT) in the year 2022 showing a downfall of 6.01% compared to the year 2021.

4.1.2 Wheat Export & its Growth Rate

The following table shows the wheat exports (in 1000 million tonnes) in India from the year 2005-2022. It also shows the growth rate (Calculated using Formula 4) in the export of wheat in India for the duration:

Table 6 Wheat Exports & its Growth Rate

Year	Wheat Exports(1000MT)	Growth
2005	801	-62.22
2006	94	-88.26
2007	49	-47.87
2008	23	-53.06
2009	58	152.17
2010	72	24.14
2011	891	1137.50
2012	6824	665.88
2013	6053	-11.30
2014	3409	-43.68
2015	1130	-66.85
2016	501	-55.66
2017	569	13.57
2018	496	-12.83
2019	509	2.62
2020	2561	403.14
2021	8033	213.67
2022	6500	-19.08

Source: Researcher's own compilation based on FAO

The graphical representation for the above table is given in the following clustered bar graph for the better comparison of wheat exports and its growth rate for the year 2005-2022.

Figure 5 Wheat Exports & Its Growth
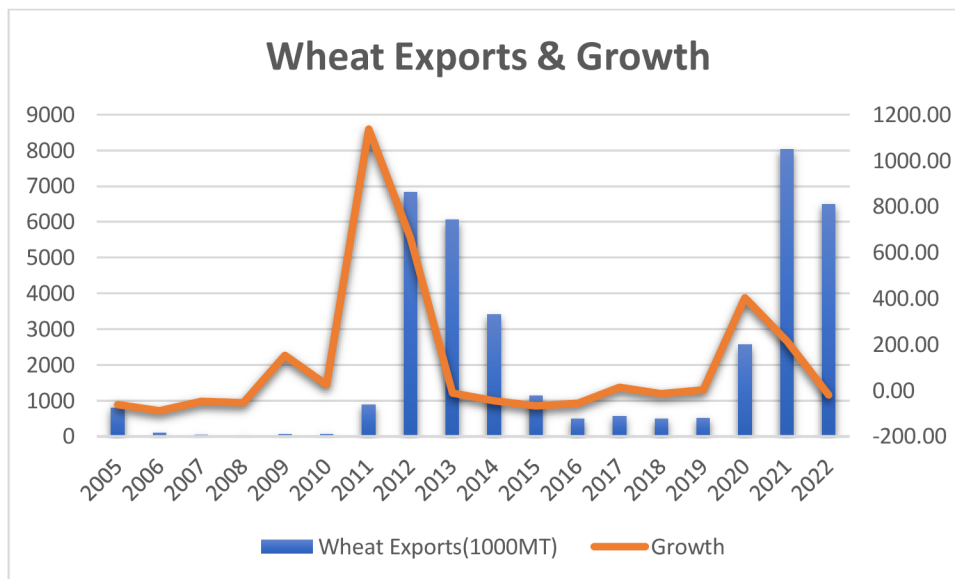
Source: Researcher's own compilation based on FAO

From the above figure it can be inferred that the exports of wheat for the year 2005 was 801 (1000MT), which decreased to 94 (1000MT) in the year 2006 there was a downfall in export by 88.26% of wheat in the year 2006. While the export of wheat further reduced to 49(1000MT) in the year 2007 showing a downfall of 47.87% compared to the previous year 2006. In the year 2008 there was a downfall in export of wheat by 53.065 compared to the previous year 2007. In the year 2009 the export of wheat increased by 152.17% compared to previous and was 58(1000MT).

While in the year 2010 it shows an upward moving trend i.e. exports increased by 24.14%. The largest increase in export can be seen in the year 2011, i.e. 1137.50% compared to the previous exports of 72(1000MT) which increased to 891 (1000MT). In the year 2012 wheat exports stood at 6824(1000MT) showing a 665.88% increase compared to previous year. From 2013 a downward trend is seen in the export of wheat and its growth which significantly reduced to 501(1000MT) in the year 2016. Moreover, it increased by 13.57% in the year 2017 compared to the year 2016 which was 501(1000MT) and it increased to 569(1000MT) in the year 2017.

In the year 2018 exports reduced to 496(1000MT), while it increased to 509(1000MT) in the year 2019 and it increased by 403.14% in the year 2020, i.e. 2561(1000MT) compared

to the year 2019 and was at 8033(1000MT) in the year 2021 being the highest export of all years into consideration. For the year 2022 the wheat export reduced by 19.08% compared to the year 2021 and were 6500(1000MT).

4.1.3   Wheat Import & its Growth Rate

The following table shows the wheat Imports (in 1000 million tonnes) in India from the year 2005-2022. It also shows the growth rate (Calculated using Formula 4) in the Import of wheat in India for the duration:

Table 7 Wheat Import & Its Growth

Year	Wheat Imports(1000MT)	Growth
2005	41	412.50
2006	6721	16292.68
2007	1962	-70.81
2008	7	-99.64
2009	218	3014.29
2010	272	24.77
2011	15	-94.49
2012	16	6.67
2013	25	56.25
2014	51	104.00
2015	471	823.53
2016	5995	1172.82
2017	1166	-80.55
2018	17	-98.54
2019	20	17.65
2020	18	-10.00
2021	25	38.89
2022	25	0.00

Source: Researcher's own compilation based on FAO

The graphical representation for the above table is given in the following clustered bar graph for the better comparison of wheat imports and its growth rate for the year 2005-2022.

Figure 6 Wheat Import & Its Growth
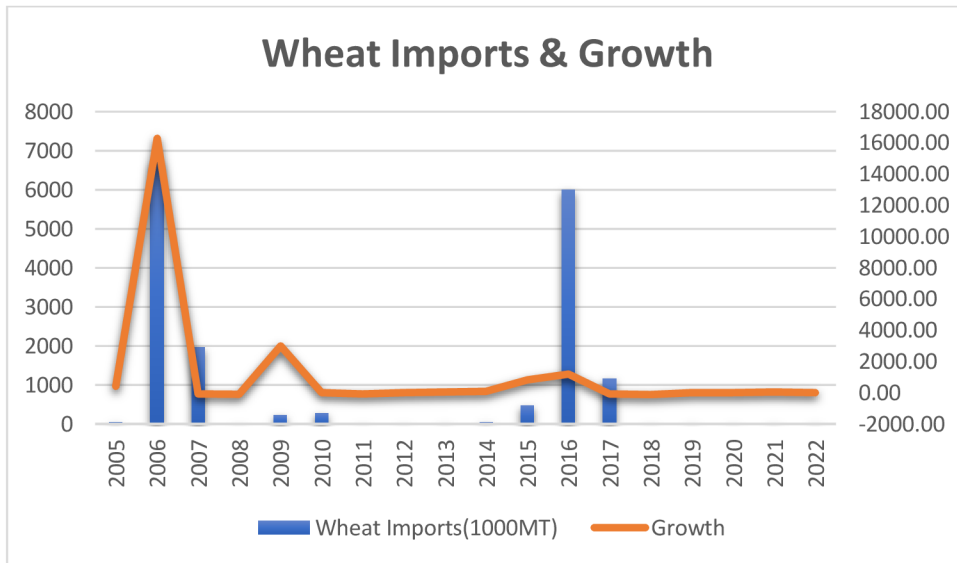
Source: Researcher's own compilation based on FAO

From the above figure it can be inferred that the imports of wheat for the year 2005 was 41(1000MT), which increased to 6721(1000MT) in the year 2006 there was an increase in import by 16292% of wheat in the year 2006. While the import of wheat further reduced to 1962(1000MT) in the year 2007 showing a downfall of 70.81% compared to the previous year 2006. In the year 2008 there was a downfall in import of wheat by 99.64% compared to the previous year 2007. In the year 2009 the import of wheat increased by 3014.29% compared to previous and was 218(1000MT).

While in the year 2010 it shows an upward moving trend i.e. imports increased by 24.77%. The imports decreased by 94.49% in the year 2011, i.e. 15(1000MT) compared to the previous imports of 272(1000MT) in the year 2010. In the year 2012 wheat imports stood at 16(1000MT) showing a 6.67% increase compared to previous year. From 2013 an upward trend is seen in the import of wheat which significantly increased to 5995(1000MT) in the year 2016. Moreover, it decreased by 80.55% in the year 2017 and was 1166(1000MT).

In the year 2018 imports reduced to 17(1000MT), while it increased to 20(1000MT) in the year 2019 and it decreased by 10% in the year 2020, i.e. 18(1000MT) compared to the year 2019 and was at 25(1000MT) in the year 2021. For the year 2022 the wheat import remained the same i.e. 25(1000MT).

4.1.4 Wheat Consumption & its Growth Rate

The following table shows the wheat consumption (in 1000 million tonnes) in India from the year 2005-2022. It also shows the growth rate (Calculated using Formula 4) in the consumption of wheat in India for the duration:

Table 8 Wheat Consumption & its Growth Rate

Year	Consumption (in 1000MT)	Growth
2005	67777	-3.79
2006	71182	5.02
2007	73920	3.85
2008	68424	-7.44
2009	75349	10.12
2010	78864	4.66
2011	78308	-0.71
2012	80424	2.70
2013	89048	10.72
2014	88602	-0.50
2015	84348	-4.80
2016	92534	9.71
2017	90677	-2.01
2018	90629	-0.05
2019	89403	-1.35
2020	95717	7.06
2021	102878	7.48
2022	98000	-4.74

Source: Researcher's own compilation based on FAO

The graphical representation for the above table is given in the following clustered bar graph for the better comparison of wheat imports and its growth rate for the year 2005-2022.

Figure 7 Wheat Consumption & Its Growth
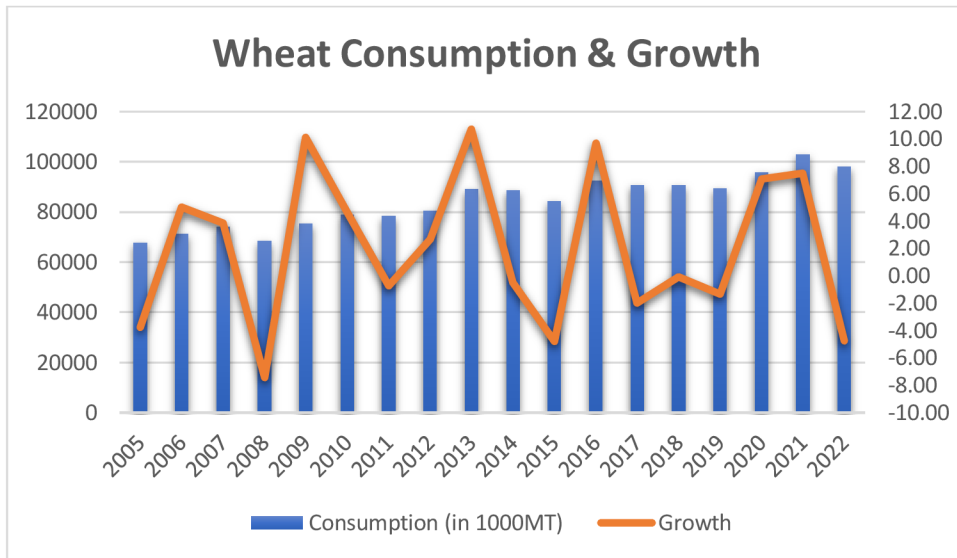
Source: Researcher's own compilation based on FAO

From the above figure it can be inferred that the consumption of wheat for the year 2005 was 67777(1000MT), which increased to 71182(1000MT) in the year 2006 there was an increase in consumption by 5.02% of wheat in the year 2006. While the consumption of wheat further increased to 73920(1000MT) in the year 2007 showing an increase of 3.85% compared to the previous year 2006. In the year 2008 there was a downfall in consumption of wheat by 7.44% compared to the previous year 2007. In the year 2009 the consumption of wheat increased by 10.12% compared to previous and was 75349(1000MT).

While in the year 2010 it shows an upward moving trend i.e. consumption increased by 4.66%. In the year 2011 it reduced to 78308(1000MT) compared to the previous year consumption of 78864(1000MT). The consumption of wheat in the year 2012 which increased to 80424(1000MT) with a growth of 2.70% than previous year. In the year 2013 wheat consumption stood at 89048(1000MT) showing a 10.72% increase compared to previous year. From 2014 a downward trend is seen in the consumption of wheat and its growth which significantly reduced to 88602(1000MT) in the year 2014 while it was 84348(1000MT) in the year 2015. Moreover, it increased by 9.71% in the year 2016 compared to the year 2015, it increased to 92534(1000MT) in the year 2016 and then the consumption reduced to 90677(1000MT) in the year 2017.

In the year 2018 consumption is reduced to 90629(1000MT), which further decreased to 89403(1000MT) in the year 2019 and it increased by 7.06% in the year 2020, i.e. 95717(1000MT) compared to the year 2019 and was at 102878(1000MT) in the year 2021 being the highest consumption of all years into consideration. For the year 2022 the wheat consumption reduced by 4.74% compared to the year 2021 and was 98000(1000MT)

4.2 Hypothesis Testing

The following hypothesis have been framed and tested so as to study the strength, nature and significance of association of independent variable with that of dependent variable. For Hypothesis testing Corelation, Regression and Anova have been performed.

4.2.1 Corelation & Regression Analysis between Import & Export

Making use of Formula No. 1 the co-relation coefficient for the relation between Import and Export is given in the below table:

Table 9 Co-Relation Co-efficient of Import & Export

	Wheat Exports(1000MT)	Wheat Imports(1000MT)
Wheat Exports(1000MT)	1	
Wheat Imports(1000MT)	-0.321553491	1

Source: Researcher's own calculation

From the above table it can be inferred that Import of wheat has a negative corelation i.e. -0.32 with the Export of wheat. It means the with the increase in import of wheat the export of wheat decreases from the country and with the increase in Export of wheat the import of wheat decreases in the country.

Table 10 Regression of Import & Export

Regression Statistics	
Multiple R	0.321553491
R Square	0.103396647
Adjusted R Square	0.047358938
Standard Error	1987.532566
Observations	18

Source: Researcher's own calculation

Making use of Formula No. 2 the above calculations have been done. From the above table regression analysis can be studied to predict the independent variable towards dependent variable. Here in the table the value of R- Square is 0.103 which shows how much independent variable are influencing the dependent variable. It can be inferred that independent variable of the study i.e. import has an influence of 10.3% only on the dependent variable i.e. export.

Table 11 Anova of Import & Export

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	7288775.733	7288776	1.845126	0.193197
Residual	16	63204571.21	3950286		
Total	17	70493346.94			

Source: Researcher's own calculation

From the above table Anova represent that the value of significance of the model is .19 which is greater than the level of significance that is 0.05. This represents that the overall model of regression is not statistically significant.

4.2.2   Corelation & Regression Analysis between Consumption & Export

Making use of Formula No. 1 the co-relation coefficient for the relation between Consumption and Export is given in the below table:

Table 12 Co-Relation Co-efficient of Consumption & Export

	Consumption (in 1000MT)	*Wheat Exports(1000MT)*
Consumption (in 1000MT)	1	
Wheat Exports(1000MT)	0.571834355	1

Source: Researcher's own calculation

From the above table it can be inferred that Consumption of wheat has a positive corelation i.e. 0.57 with the Export of wheat. It means the with the increase in consumption of wheat the export of wheat increases from the country and with the increase in Export of wheat the consumption of wheat increases in the country.

Table 13 Regression of Consumption & Export

Regression Statistics	
Multiple R	0.571834355
R Square	0.326994529
Adjusted R Square	0.284931687
Standard Error	2332.266545
Observations	18

Source: Researcher's own calculation

Making use of Formula No. 2 the above calculations have been done. From the above table regression analysis can be studied to predict the independent variable towards dependent variable. Here in the table the value of R- Square is 0.326 which shows how much independent variable are influencing the dependent variable. It can be inferred that independent variable of the study i.e. consumption has an influence of 32.7% only on the dependent variable i.e. export.

Table 14 Anova of Consumption & Export

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	42286159.15	42286159	7.773952	0.013158
Residual	16	87031475.8	5439467		
Total	17	129317634.9			

Source: Researcher's own calculation

From the above table Anova represent that the value of significance of the model is .013 which is lesser than the level of significance that is 0.05. This, represents that the overall model of regression is statistically significant.

4.2.3 Corelation & Regression Analysis between Consumption & Import

Making use of Formula No. 1 the co-relation coefficient for the relation between Consumption and Import is given in the below table:

Table 15 Co-Relation Co-efficient of Consumption & Import

	Consumption (in 1000MT)	Wheat Imports(1000MT)
Consumption (in 1000MT)	1	
Wheat Imports(1000MT)	-0.147751763	1

Source: Researcher's own calculation

From the above table it can be inferred that Consumption of wheat has a negative corelation i.e. -0.147 with the Import of wheat. It means the with the increase in Consumption of wheat the import of wheat decreases from the country and with the increase in Import of wheat the consumption of wheat decreases in the country.

Table 16 Regression of Consumption and Import

Regression Statistics	
Multiple R	0.147751763
R Square	0.021830583
Adjusted R Square	-0.039305005
Standard Error	10618.1453
Observations	18

Source: Researcher's own calculation

Making use of Formula No. 2 the above calculations have been done. From the above table regression analysis can be studied to predict the independent variable towards dependent variable. Here in the table the value of R- Square is 0.021 which shows how much independent variable are influencing the dependent variable. It can be inferred that independent variable of the study i.e. Consumption has an influence of 2.1% only on the dependent variable i.e. import.

Table 17 Anova for Consumption & Import

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	40259518.13	40259518.13	0.357084702	0.558493128
Residual	16	1803920154	112745009.6		
Total	17	1844179672			

Source: Researcher's own calculation

From the above table Anova represent that the value of significance of the model is .55 which is greater than the level of significance that is 0.05. This represents that the overall model of regression is not statistically significant.

4.2.4 Corelation & Regression Analysis between Production & Consumption

Making use of Formula No. 1 the co-relation coefficient for the relation between Production and Consumption is given in the below table:

Table 18 Co-Relation Co-efficient of Production & Consumption

	Production (in 1000MT)	Consumption (in 1000MT)
Production (in 1000MT)	1	
Consumption (in 1000MT)	0.909603555	1

Source: Researcher's own calculation

From the above table it can be inferred that Production of wheat has a strong positive corelation i.e. 0.909 with the Consumption of wheat. It means the with the increase in Production of wheat the Consumption of wheat increases from the country and with the decrease in production of wheat the consumption of wheat decreases in the country.

Table 19 Regression of Production and Consumption

Regression Statistics	
Multiple R	0.909603555
R Square	0.827378627
Adjusted R Square	0.816589791
Standard Error	4460.555086
Observations	18

Source: Researcher's own calculation

Making use of Formula No. 2 above calculations have been made. From the above table regression analysis can be studied to predict the independent variable towards dependent variable. Here in the table the value of R- Square is 0.827 which shows how much independent variable are influencing the dependent variable. It can be inferred that independent variable of the study i.e. production has an influence of 82.7% on the dependent variable i.e. consumption.

Table 20 Anova of Production & Consumption

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1525834845	1.53E+09	76.68840663	0.0000001683
Residual	16	318344826.7	19896552		
Total	17	1844179672			

Source: Researcher's own calculation

From the above table Anova represent that the value of significance of the model is 0.00 which is lower than the level of significance that is 0.05. This represents that the overall model of regression is statistically significant.

4.2.5 Corelation & Regression Analysis between Production & Import

Making use of Formula No. 1, the co-relation coefficient for the relation between Production and Import is given in the below table:

Table 21 Co-Relation Co-efficient of Production & Import

	Wheat Imports(1000MT)	*Production (in 1000MT)*
Wheat Imports(1000MT)	1	
Production (in 1000MT)	-0.413069915	1

Source: Researcher's own calculation

From the above table it can be inferred that Import of wheat has a negative corelation i.e. -0.41 with the production of wheat. It means the with the increase in production of wheat the import of wheat decreases from the country and with the decrease in production of wheat the import of wheat increases in the country.

Table 22 Regression of Production & Import

Regression Statistics	
Multiple R	0.413069915
R Square	0.170626755
Adjusted R Square	0.118790927
Standard Error	11860.19952
Observations	18

Source: Researcher's own calculation

Making use of Formula No. 2 above calculations have been done. From the above table regression analysis can be studied to predict the independent variable towards dependent variable. Here in the table the value of R- Square is 0.170 which shows how much independent variable are influencing the dependent variable. It can be inferred that independent variable of the study i.e. production has an influence of 17% only on the dependent variable i.e. import.

Table 23 Anova of Production & Import

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	463021420.6	463021420.6	3.291676088	0.088427099
Residual	16	2250629324	140664332.8		
Total	17	2713650745			

Source: Researcher's own calculation

From the above table Anova represent that the value of significance of the model is .08 which is greater than the level of significance that is 0.05. This represents that the overall model of regression is not statistically significant.

4.2.6 Corelation & Regression Analysis between Production & Export

Making use of Formula No. 1 the co-relation coefficient for the relation between Production and Export is given in the below table:

Table 24 Co-Relation Co-efficient of Production & Export

	Wheat Exports(1000MT)	*Production (in 1000MT)*
Wheat Exports(1000MT)	1	
Production (in 1000MT)	0.586308564	1

Source: Researcher's own calculation

From the above table it can be inferred that Production of wheat has a positive corelation i.e. 0.59 with the export of wheat. It means the with the increase in production of wheat the export of wheat increases from the country and with the decrease in production of wheat the export of wheat decreases in the country.

Table 25 Regression of Production & Export

Regression Statistics	
Multiple R	0.586308564
R Square	0.343757732
Adjusted R Square	0.302742591
Standard Error	10549.918
Observations	18

Source: Researcher's own calculation

Making use of Formula No. 2 above calculations have been made. From the above table regression analysis can be studied to predict the independent variable towards dependent variable. Here in the table the value of R- Square is 0.343 which shows how much independent variable are influencing the dependent variable. It can be inferred that independent variable of the study i.e. production has an influence of 34.3% on the dependent variable i.e. export.

Table 26 Anova of Production & Export

ANOVA					
	Df	*SS*	*MS*	*F*	*Significance F*
Regression	1	932838426.6	932838426.6	8.381239658	0.01054909
Residual	16	1780812318	111300769.9		
Total	17	2713650745			

Source: Researcher's own calculation

From the above table Anova represent that the value of significance of the model is .01 which is lower than the level of significance that is 0.05. This, represents that the overall model of regression is statistically significant.

4.3 Self Sufficiency Ratio

The self-sufficiency ratio is calculated on the basis of Total production of Wheat divided by the total consumption of wheat multiplied by 100. If the SSR is less than 100%, it means that the country is depending on the import of wheat for meeting its consumption needs and if the ratio exceeds 100% then, it means that country is the net exporter of wheat.

The self-sufficiency ratio of wheat from the year 2005-2022 is calculated with the help of the following table:

Table 27 Production and Consumption of Wheat from 2005-2022

Year	Production (in 1000MT)	Consumption (in 1000MT)
2005	68637	67777
2006	69355	71182
2007	75807	73920
2008	78570	68424
2009	80679	75349
2010	80804	78864
2011	86874	78308
2012	94882	80424
2013	93506	89048
2014	95850	88602
2015	86527	84348
2016	87000	92534
2017	98510	90677
2018	99870	90629
2019	103600	89403
2020	107860	95717
2021	109586	102878
2022	103000	98000
Total	1620917	1516084

Source: Researcher's own compilation based on FAO

Making use of Formula No. 3 Following calculations have been made:

$$\text{Self Sufficiency Ratio} = \frac{Domestic\ production\ of\ wheat}{Total\ Domestic\ Consumption\ of\ Wheat} \ x\ 100$$

$$= \frac{1620917}{1516084} \ x\ 100$$

$$= 106.91\%$$

From the above calculation of self-sufficiency ratio of wheat, it can be inferred that the SSR is 106.91% which is greater than 100%. Thus, it can be inferred that country India is the exporter of wheat.

5   Results and Discussion

The result sections comprise of the main findings of the study. While, the discussion section deals with the interpretation of the results signifying the findings of the study. The results and discussion derived from the present study are as under:

5.1   Results

From the study it can be found that there was an increase in production from the year 2005 i.e. 68637 (1000MT) and it kept on increasing, showing an upward moving trend till the year 2012 i.e. 94882 (1000MT). The highest growth in the production of wheat was in the year 2017 i.e. 13.23% compared to previous year 2016. While the maximum decline in the production was in the year 2015 by -9.73%. The highest production of wheat was in the year 2021 with the production of 109586 (1000MT). It is also found that the export of wheat kept on decline from the year 2005 to 2008. In the year 2008 export of wheat was 23 (1000MT) being the all-time lowest. While from the year 2009 the exports kept on increasing till the year 2012. In the year 2012 the export of wheat was the highest of all recording it at 6824 (1000MT). The highest growth in export of wheat is found the year 2011 by 1137.50% compared to the previous year 2010. While the maximum downfall in the export of wheat is observed in the year 2006 with a decline of -88.26% in exports.

It is found from the study that imports of wheat have shown fluctuations, as it kept on declining and improving year to year. The highest import of wheat was in the year 2006, it was 6721 (1000MT). While the lowest import of wheat was in the year 2008 which was 7 (1000MT). It is also observed that the highest growth in the import of wheat was in the year 2006 which was 16292% compared to the previous years import. While the highest decline in the import of wheat was in the year 2008 which was -99.64% compared to the previous years import. Whereas, it can be inferred from the study that consumption of wheat has shown an increasing trend since 2005 with a minor ups and downs in between. It can be observed that the minimum consumption of wheat was in the year 2005 i.e. 67777 (1000MT). While, the highest consumption of wheat was in the year 2021 i.e. 102878 (1000MT). Moreover, the highest increase in the consumption of wheat was in the year 2013

by 10.72% compared to previous year 2012. While the highest decrease in the consumption of wheat was in the year 2008, it declined with -7.44%.

5.1.1   Findings from Correlation and Regression Analysis

From the **Hypothesis 1,** it can be found that Import of wheat has a negative corelation i.e. -0.32 with the Export of wheat. While, independent variable of the study i.e. import has an influence of 10.3% only on the dependent variable i.e. export. Also, the value of significance of the model (p-value) is .19 which is greater than the level of significance that is 0.05. This, represents that the overall model of regression is not statistically significant.

While, from **Hypothesis 2,** it can be observed that Consumption of wheat has a positive corelation i.e. 0.57 with the Export of wheat. It can be inferred that independent variable of the study i.e. consumption has an influence of 32.7% only on the dependent variable i.e. export. While, the value of significance of the model is .013 which is lesser than the level of significance that is 0.05. This, represents that the overall model of regression is statistically significant.

From Hypothesis 3, it can be observed that Consumption of wheat has a negative corelation i.e. -0.147 with the Import of wheat. It can be inferred that independent variable of the study i.e. Consumption has an influence of 2.1% only on the dependent variable i.e. import. While, the value of significance of the model (p-value) is .55 which is greater than the level of significance that is 0.05. This, represents that the overall model of regression is not statistically significant.

It is observed from **Hypothesis 4,** that Production of wheat has a strong positive corelation i.e. 0.909 with the Consumption of wheat It can be inferred that independent variable of the study i.e. production has an influence of 82.7% on the dependent variable i.e. consumption. While, the value of significance of the model (p-value) is 0.00 which is lower than the level of significance that is 0.05. This, represents that the overall model of regression is statistically significant.

While it can be inferred from **Hypothesis 5,** that Import of wheat has a negative corelation i.e. -0.41 with the production of wheat. It can be inferred that independent variable

of the study i.e. production has an influence of 17% only on the dependent variable i.e. import. While the value of significance of the model (p-value) is .08 which is greater than the level of significance that is 0.05. This, represents that the overall model of regression is not statistically significant.

From the **Hypothesis 6,** it can be found that Production of wheat has a positive corelation i.e. 0.59 with the export of wheat. It can also be inferred that independent variable of the study i.e. production has an influence of 34.3% on the dependent variable i.e. export. While the value of significance of the model (p-value) is .01 which is lower than the level of significance that is 0.05. This represents that the overall model of regression is statistically significant.

Whereas, from self-sufficiency ratio of wheat, it can be inferred that the SSR is 106.91% which is greater than 100%. Thus, it can be inferred that country India is the exporter of wheat.

5.2 Discussions

It is found from Hypothesis 4 & 6, that there is significant effect of production of wheat on exports and consumption of wheat, therefore it is recommended to increase the production of wheat so as to increase the consumption and export. From the literature review (Aggarwal, 2008) it has been found that climate changes pose a challenge for farmers, thus leading to decreased productivity, it is recommended to adopt climate resilient practices, implementing crop rotation, diversification of crop and agroecology.

From the literature review of (Ittyerah, 2013) reduction in funding of rural infrastructure, it is recommended to increase the agricultural infrastructure by promoting water efficient technology, drip irrigation, and investing in transportation infrastructure along with modern cold storage facilities to reduced food wastage (Rajput, n.d.). Production can be enhanced by making use of organic farming, integrated pest management and agroforestry which can lead to increased fertility of soil, reduction in chemical inputs, and it will help in conserving water. Moreover, with the increased use of fertilizers and manures can lead to increased yields.

From Literature Review, the challenges to Food Security in India (Upadhyay and Palanivel, 2011), it is recommended to strengthen the public distribution system, provide them with adequate quality of grains and improve their working. Better governance and appropriate institutions are needed for the effecting functioning of these PDS. The study recommendes to develop seeds which can lead to high yields and can withstand drought and pest. Farmers should be encouraged to adopt modern technologies like precision agriculture, digital farming tools.

From the literature review of (Jain, 2016), farmers lack with high quality seeds in India. So, it is recommended to government to provide nation-wide high-quality seeds to the farmers at reasonable cost so as to maximize the output. Whereas, it is recommended to the policy-makers and government to generate more employment opportunities so as to reduce poverty for the success of food security in India as poverty is one of the biggest reason in food security access component (Martin, 2010).

It is recommended to the government to enact programmes or schemes like Mid-Day Meals, Antyodaya Ann Yojana, Self-employement schemes at country wide level so as to increase accessibility of food and nutrition (Jain, 2016). It is found from the literature (Upadhyay and Palanivel, 2011) excluding eligible individuals qualifying for subsidies, the study recommends to the government, to make changes in the structure of subsidies and incentives being provided to farmers and implement proper governance for the utilisation of same so as to get better results.

6 Conclusion

Wheat is one of the most important food crop and primary source of energy. It is also one of the most important food sources and amongst a significant contributor to global food security. It serves as a source for variety of vitamins and nutrients in least developed countries and middle-income earning nations. India is the world's second-largest producer of wheat and about 80% of it being consumed in the country itself. It also helps in providing work for millions of Indian farmers. To assist research, development, as well as extension efforts aimed at enlightening farmers about novel cultivars and enhanced agricultural technology, the Indian government allots substantial financial resources. Exporting wheat helps the government to generate revenue for the country, enhancing foreign exchange earnings leading to overall economic growth.

Thus, the present study aimed at evaluating the development of wheat market in India. For the accomplishment of the main objective sub-objectives were framed, which aimed at determining the factors that cause changes in the production and price of grain in the market. Moreover, it also aimed to examine the geographical structure of wheat production in India as per state-wise. It also tried to study examine the trends in Wheat as a commodity and to understand the self-sufficiency ratio of country India in Wheat as a commodity. In order to accomplish the primary and the sub-objectives, the study is divided into two parts. Where the first part focuses on the published literature relevant to the thesis topic, for which the secondary data has been gathered. It gives understanding about wheat as a grain, its types, production, growth and storage at domestic and at worldwide level. It gives the overview of historical wheat farming in India. It also gives idea regarding the commodity market and the importance of wheat as a commodity in India's foreign trade. This chapter outlines the production of wheat in India as per the geographical structure. It also gives a brief idea about factors affecting the wheat production. Lastly, food security in India and the challenges faced have been covered in the literature section. The secondary data is collected from the sources like articles, journals, government websites, publications, magazines, research papers, conference proceedings, etc.

While, the second section of the study focuses on the practical part including the analysis and interpretation of the secondary data with an overview of the Indian wheat

market. Secondary data from the year 2005-2022 is collected from FAO website. A trend analysis is performed making use of graphs, charts and tables for the data to study the trends regarding wheat production, consumption, import and export. Whereas, hypothesis testing have been performed to check the relationship between the variables of the study. For hypothesis testing conometric models like Corelation Co-efficient, Regression and Anova have been used to study the strength, nature and significance of association of independent variable with dependent variable. The practical part also portrays the self-sufficiency ratio of India in Terms of Wheat.

From the first sub-objective i.e. examining the geographical structure of wheat production in India, it has been found that Uttar Pradesh is the highest producer of Wheat in India followed by Madhya Pradesh at second, Punjab at third, all these three states accounting for majority of the wheat production in the country. From the second sub-objective i.e. examine the trends relating to production, consumption, import and Export in Wheat as a Commodity, it has been found that From the third sub-objective i.e. studying the relationship between dependent and independent variables i.e. Production, Consumption, Import & Export, it has been found that there has been a continuous rise in growth rate of the production of wheat till the year 2017 and with an in-between downfall in the year 2015. But after 2017, it can be inferred from the trendline that it's a downward moving trend showing a downfall in percentage growth rate of wheat production for the current years. It can also be observed from the trendline of exports that the export of wheat kept on decline from the year 2005 to 2008. While from the year 2009 the exports kept on increasing till the year 2012. In the year 2012 the export of wheat was the highest of all. It is also inferred from the study that imports of wheat have shown fluctuations, as it kept on declining and improving year to year. It is found that the highest import of wheat was in the year 2006, while the lowest import of wheat was in the year 2008.

Whereas, it can be inferred from the study that consumption of wheat has shown an increasing trend since 2005 with a minor ups and downs in between. It can be observed that the minimum consumption of wheat was in the year 2005 and the highest consumption of wheat was in the year 2021. Moreover, the highest increase in the consumption of wheat was in the year 2013 and the highest decrease in the consumption of wheat was in the year 2008. From the fourth sub-objective i.e. understanding the self-sufficiency of India in Wheat as a

Commodity, it can be inferred that the SSR is 106.91% which is greater than 100%. Thus, it can be inferred that country India is the exporter of wheat.

From the hypothesis testing 1, it can be it can be inferred that Import of wheat has a negative corelation with the Export of wheat and the overall model of regression is not statistically significant. From the hypothesis testing 2, it can be concluded that Consumption of wheat has a positive corelation with the Export of wheat and the overall model of regression is statistically significant. From Hypothesis testing 3, it can be inferred that Consumption of wheat has a negative corelation with the Import of wheat and the overall model of regression is not statistically significant. From Hypothesis Testing 4, it can be inferred that Production of wheat has a strong positive corelation with the Consumption of wheat and the overall model of regression is statistically significant. While, it can be inferred from Hypothesis Testing 5, that Import of wheat has a negative corelation with the production of wheat and the overall model of regression is not statistically significant. From the Hypothesis Testing 6 it can be inferred that Production of wheat has a positive corelation with the export of wheat and the overall model of regression is statistically significant.

Based on Hypothesis 4 & 6, wherein there is significant effect of production on exports and consumption of wheat, therefore it is recommended to increase the production of wheat so as to increase the consumption and export. The study also revealed that climate changes pose a challenge for farmers, thus leading to decreased productivity. Hence the study recommends to adopt climate resilient practices, implementing crop rotation, diversification of crop and agroecology. From the literature review of (Ittyerah, 2013) reduction in funding of rural infrastructure, it is recommended to increase the agricultural infrastructure by promoting water efficient technology, drip irrigation, and investing in transportation infrastructure along with modern cold storage facilities to reduced food wastage (Rajput, n.d.). Moreover the study recommneded to increase soil fertility by increasing the use of fertilizers and manures, making use of organic farming, integreted pest management and agroforestry.

The study found from the study that the Public Distributioon System is poor and weak (Upadhyay and Palanivel, 2011). Therefore it is recommended to strengthen the public distribution system, provide them with adequate quality of grains and improve their working.

Better governance and appropriate institutions are needed for the effecting functioning of these PDS. The study recommendes to develop seeds which can lead to high yields so that it can withstand drought and pest. Farmers should be encouraged to adopt modern technologies like precision agriculture, digital farming tools. It has also been inferred from the study that the climatic ocndition in India are adverse therefore the study recommended, to develop seeds which can lead to high yields and can withstand drought and pest. Farmers should be encouraged to adopt modern technologies like precision agriculture, digital farming tools

Poverty has been an issue and a challenge for Food Security in India (Martin, 2010) and the study recommends to the policy-makers and government to generate more employment opportunities so as to reduce poverty for the success of food security. Moroever, the literature review (Jain, 2016) revealed, farmers lack with high quality seeds in India. So, it is recommended to government to provide nation-wide high-quality seeds to the farmers at reasonable cost so as to maximize the output. The study also recommended government to enact programmes or schemes like Mid-Day Meals, Antyodaya Ann Yojana, Self-employement schemes at country wide level so as to increase accessibility of food and nutrition and make changes in the structure of subsidies and incentives being provided to farmers and implement proper governance for the utilisation of same so as to get better results.

Laslty it can be conlcuded from the study that, there has been the development of wheat market in India. Moreover, government have been taking measures to bring about changes and enhance wheat productivity so as to meet the Food Security in India. The present study suffers from certain limitations pertaining to the commodity being considered in the research is only wheat and hence the results may differ for other commodities. It also suffers from the geographical limitation of country India. It suffers from the limitation relating to time duration which ranges from 2005-2022 i.e. data only for these years have been taken into consideration for analysis and interpretation purpose. Lack of accuracy in secondary data may also be a concern for the current research study.

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8 List of Figures, tables, graphs and abbreviations

8.1 List of Figures

8.2 List of tables