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Diploma Thesis

Analysis of Wheat Production in India

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Thesis title

Analysis of Wheat Production in India

Objectives of thesis

The main objective of the following thesis lies in characterizing the main tendencies of the wheat production in India. In addition to that, the author seeks the goal of identifying if India is self-sufficient in wheat; if the country is benefitting from the terms of trade and the author also identifies the most important factors that influence the change in the production of wheat in India.

Methodology

To reach her goals, the author uses primarily quantitative or empirical methods that include terms of trade ratio, self-sufficiency ratio, trend estimation, linear regression estimation based on the OLS method, elasticities and logarithmic dissolution of factors.

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wheat, India, self-sufficiency, production, farmers, industry, yield, area, terms of trade, import

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Declaration

I declare that I have worked on my Diploma thesis titled "Analysis 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 31.03.2023 _____

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Analysis of Wheat Production in India

Abstract

The main objective of the following thesis lies in characterizing the main tendencies of the wheat production in India. In addition to that, the author seeks the goal of identifying if India is self-sufficient in wheat; if the country is benefitting from the terms of trade and the author also identifies the most important factors that influence the change in the production of wheat in India.

To reach her goals, the author uses primarily quantitative or empirical methods that include terms of trade ratio, self-sufficiency ratio, trend estimation, linear regression estimation based on the OLS method, elasticities and logarithmic dissolution of factors.

The author, after conducting her research, is able to highlight the most important findings of the practical part: the country is self-sufficient in India but the tendency is likely to change under the heavy burden of unbelievably high population growth rate; the country does not really have a good position in the international trade of wheat as the terms of trade index is primarily lower than 1; the most important factors influencing the production of wheat in India are area that accounts for over 6.66% increase in the total amount of wheat produced caused by 1% increase in million hectares and yield that accounts for over 1.01% increase in the total amount of wheat produced caused by 1% increase in ton/ha; the country was focused more on increasing its yield rather than area, which is primarily caused by the overpopulation problem and inability to increase the arable land area.

Keywords: wheat, India, self-sufficiency, production, farmers, industry, yield, area, terms of trade, import

Analýza produkce pšenice v Indii

Abstrakt

Hlavním cílem následující práce je charakterizovat hlavní tendence produkce pšenice v Indii. Kromě toho se autor snaží zjistit, zda je Indie soběstačná v pšenici; pokud země těží z obchodních podmínek a autor také identifikuje nejdůležitější faktory, které ovlivňují změnu produkce pšenice v Indii.

K dosažení svých cílů autorka používá především kvantitativní nebo empirické metody, které zahrnují obchodní poměr, soběstačnost, odhad trendu, lineární regresní odhad založený na metodě OLS, elasticity a logaritmické rozpuštění faktorů.

Autor, po provedení svého výzkumu, je schopen zdůraznit nejdůležitější zjištění praktické části: země je v Indii soběstačná, ale tendence se pravděpodobně změní pod těžkým břemenem neuvěřitelně vysokého tempa růstu populace; země ve skutečnosti nemá dobré postavení v mezinárodním obchodu s pšenicí, protože index obchodních podmínek je primárně nižší než 1%.; nejdůležitějšími faktory ovlivňujícími produkci pšenice v Indii jsou plocha, která představuje více než 6,66% nárůst celkového množství vyprodukované pšenice způsobený 1% nárůstem v milionech hektarů a výnos, který představuje více než 1,01% nárůst celkového množství vyprodukované pšenice způsobený 1% nárůstem tuny/ha; země byla zaměřena spíše na zvýšení svého výnosu než na plochu, což je primárně způsobeno problémem přelidnění a neschopností zvětšit plochu orné půdy.

Klíčová slova: pšenice, Indie, soběstačnost, výroba, zemědělci, průmysl, výnos, plocha, obchodní podmínky, dovoz

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List of abbreviations

Kcal	Calories
Gr	Grams
Mg	Milligrams
Mcg	Micrograms
FAO	Food and Agriculture Organization
LRM	Linear Regression Model
OLS	Ordinary Least Squares
GDP	Gross Domestic Product
HS	Harmonized System
USD	United States Dollar
BEP	Break-Even Point
FC	Fixed Cost
UVC	Unit Variable Cost
CARD	Climate Adaptation in Rural Development Assessment Tool

1. Introduction

Wheat production in India has long been regarded as a significant contribution to the general growth and development of the country's economy, and this recognition has only increased over time. Wheat is an important aspect of the agricultural industry, which has been a substantial contributor to the nation's ability to ensure its own food security and provide job opportunities.

India is now the world's second-largest producer of wheat, and during the last several years, this sector has witnessed a tremendous amount of expansion. Despite this expansion, there are still a number of possibilities and difficulties in the Indian wheat sector that need greater investigation and attention. Despite this growth, however, the industry is expected to continue to expand.

The purpose of this Master's thesis is to present a comprehensive examination of the wheat sector in India, including a discussion of its current situation, difficulties, and potential for the future. The author, who was born in India and has a personal interest in the subject matter, was inspired to conduct this study both by the crucial significance of this business for India's economy and food security and by the author's own personal interest in the topic.

Additional idea of this thesis is to identify the major drivers and limitations of the wheat sector in India, including production, distribution, consumption, and trade, by conducting an exhaustive study of the relevant literature and doing an analysis of the relevant data. In addition, the research investigates the role that technology and innovation might play in enhancing the productivity and viability of the wheat sector, as well as its influence on the lives of rural residents and the general welfare of society.

Ultimately, the goal of this study is to contribute to a better knowledge of the wheat sector in India, including its recent struggles and potential for the future. It is anticipated that the results of this study will enlighten policymakers, industry stakeholders, and other researchers about the major concerns and possibilities and that they will influence future research and policy initiatives. The author suggests that this research can prepare a foundation for more profound research reflecting the situation with the industry.

2. Objectives and Methodology

2.1. Objectives

The main objective of the following thesis lies in characterizing the main tendencies of the wheat production in India. In addition to that, the author seeks the goal of identifying if India is self-sufficient in wheat; if the country is benefitting from the terms of trade and the author also identifies the most important factors that influence the change in the production of wheat in India.

Effectively, one of the main objectives of the author's thesis eventually lies in describing the state of play in the agriculture sector of the country with the regard on a particular commodity, which supplies the country's population with one of the most important sources of nutrition. Additionally, the author verifies if the quantity of the commodity is sufficient for the domestic population and what is the overall development of the industry. The author's research questions can be summed up by the following five research questions:

1) Is India self-sufficient in wheat?
2) Does India have beneficial terms of trade in the trade of wheat?
3) What are the most important factors influencing wheat production in India?
4) Does India's wheat production catch up with the population growth?
5) What is the quantitative effect of individual factors on the wheat production of India?

2.2. Methodology

To reach her goals, the author uses primarily quantitative or empirical methods that include terms of trade ratio, self-sufficiency ratio, trend estimation, linear regression estimation based on the OLS method, elasticities, and logarithmic dissolution of factors. The author uses data obtained from FAO from the time interval of 2006-2021, where this interval is at times reduced to smaller periods due to unavailability of data. For the analysis, the author considers the HS system with the particular focus on HS1001 commodities, which represent wheat and meslin commodities. In addition to that, the author considers CARD

model for the prediction of wheat production with regard to the climate change for the upcoming decade.

To be more specific and in order to better explain the methodology of the work so that it can be repeated by other authors and implemented in their research, the author considers it as highly important to specify formulas for each piece of computation implemented in the work. First, the author starts with the formula that will help her to estimate a linear regression – the OLS formula for parameters of LRM. The following formula is based on Dougherty (2011) :

$$Parameters\ of\ LRM = (X^T X)^{-1} X^T X \quad (1)$$

Then, the author also indicates the chain base index, which helps to better see annual change in indicators and serves as a good tool of descriptive statistics. The formula below is also based on Dougherty (2011):

$$Average\ Growth\ Rate\ or\ Chain\ Base\ Index = \left(\frac{X_i}{X_{i-1}} - 1\right) * 100 \quad (2)$$

When it comes to the logarithmic dissolution of factors, this is something that involves the following formula to be implemented by the author:

$$Factor's\ impact = \frac{Ln_x}{Ln\ p}, \text{ with x being a given factor} \quad (3)$$

For the self-sufficiency, the author considers the following formula reflecting the status with the sufficiency of a given commodity:

$$Self - Sufficiency\ Index = \frac{P}{Z} * 100 \quad (4)$$

P - Domestic production of wheat

Z - Total volume of domestic consumption of the given commodity.

Finally, terms of trade are the last piece of calculation implemented by the author and this technique implies the calculation of average prices for both exports and imports, which are calculated as follows:

$$Average\ Price\ of\ Export\ or\ Import = \frac{Total\ Volume}{Total\ quantity} \quad (5)$$

Then, the author proceeds to the calculation of the ratio:

$$Terms\ of\ Trade = \frac{Average\ Price\ of\ Exports}{Average\ Price\ of\ Imports} * 100 \quad (6)$$

Additionally, the author also implements the calculation of a Pearson correlation coefficient, which is done according to the following formula:

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 (Y_i - \bar{Y})^2}} \quad (7)$$

For the analysis of microenvironment and profitability of farms, the author calculates the break-even point for wheat. The formula is presented below:

$$BEP = \frac{FC}{P - UVC} \quad (8)$$

The very last formula implemented by the author is related to the calculation of elasticities, which are found according to the following formula:

$$Elasticity = parameter\ of\ x * \frac{x_{ij}}{\hat{y}} \quad (9)$$

The author relies on empirical methods, so the author consequently will interpret all results of her calculations and compare the obtained findings with findings of other academists. Econometric model of the author is described in more detail in the specific chapter dedicated to the linear estimation with a detailed specification of parameters.

3. Literature Review

3.1. Wheat as a Commodity

3.1.1. Nutrition Value

Before discussing the impact that wheat has had and the significance it has for such a large nation as India, which is home to about 20% of the total population of the globe. First things first, author need to choose out the components that are included within such a crucial resource as wheat. The nutritional value of wheat is one example of this kind of factor. The selected item's foundation is broken down into its component parts in the table that follows.

Energy value (calorie content) of durum wheat grains is 304 kcal per 100 grams of the product (edible part). The ratio of proteins, fats and carbohydrates can be seen below.

Table 1, Calorie content and nutritional value of durum wheat grains

Property	Value
Calorie content	304 kcal
Proteins	13 gram
Carbohydrates	57.5 gram
Fats	2.5 gram

Source: Cozannet, 2010

It is also important to note the chemical composition of wheat, as it includes quite important elements of micro and macro elements in durum wheat grain.

Table 2, Micro and macro elements in durum wheat grains

Micro and Macro Element	Value
Mono and disaccharides	2 gr
SFA - Saturated fatty acids	0.5 gr
Ash	1.7 gr
Starch	54.5 gr
Water	14 gr
Dietary fibre	11.3 gr
Unsaturated fatty acids	1.36 gr
Sodium	8 mg
Potassium	325 mg
Phosphorus	368 mg
Magnesium	114 mg
Calcium	62 mg
Sulphur	100 mg
Copper	530 mcg
Silicon	48 mg
Aluminium	1570 mcg
Titanium	52.8 mcg
Strontium	203 mcg
Iodine	11 mcg
Manganese	3.7 mg
Chromium	5.5 mcg
Fluorine	80 mcg
Molybdenum	42 mcg
Cobalt	5.4 mcg
Nickel	21.6 mcg
Zinc	2.81 mg
Iron	5.3 mg
Chlorine	30 mg

Source: Cozannet, 2010

It is hard to ignore the fact that wheat contains vitamins, seeing as how vitamins are on par with chemical components in terms of their significance.

Table 3, Vitamins in durum wheat grain

Vitamin	Value
Vitamin B1 (thiamine)	0.37 mg
Vitamin B2 (riboflavin)	0.1 mg
Vitamin B6 (pyridoxine)	0.6 mg
Vitamin B9 (folic)	46 mcg
Vitamin E (TE)	3.4 mg
Vitamin PP (Niacin equivalent)	7 mg
Choline	94 mg
Vitamin A (RE)	2 mcg
Beta-carotene	0.01 mg
Vitamin B5 (pantothenic)	1.2 mg
Vitamin PP	4.9 mg
Vitamin H (biotin)	11.6 mcg

Source: Cozannet, 2010

3.1.2. Importance

Most of the human food has traditionally consisted of wheat. Because of the community extension of national economies, issues pertaining to the manufacturing and worldwide interaction of grains are of the greatest priority in terms of achieving a balance between supply and demand on the worldwide industry and ensuring the long-term viability of food security in individual states. It should come as no surprise that agricultural plays a significant role in the functioning of the international economy. It has a wide range of functions, some of which are as follows: maintaining food security; boosting economic and industrial growth; lowering poverty levels; lowering income disparity; providing environmental services; and structurally transforming organizations. Food security continues to be the top priority for all governments, regardless of the state of the economy or the political climate. The current epidemic highlights the significance of agricultural commerce for ensuring the safety of food supplies throughout the world, which in turn raises the role and duty of nations that export

food. Wheat has a long and significant history in human civilisation and continues to be one of the most important commodities in international commerce.

Cereals, such as wheat, rice, corn, and barley, are foundational components of the foods of several nations and regions, in addition to being key components of the diets of many people. Wheat, rice, corn, and barley are examples of cereals (Harlan, 1973). As of olden history, underneath the impact of both organic and climatic changes as well as the cultural preferences of individuals in various parts of the globe, the certain differentiation of an agricultural intricate in the manufacturing from certain kinds of cereals has developed. This has occurred because of the interplay between organic and climatic factors as well as the cultural preferences of people. Organic agriculture benefits have been translated into the economic behaviour of nations in the global market as producers, exporters, and consumers of diverse grain crops because of the growth of international commerce (De Cock, 2005)

3.2. Wheat Industry

3.2.1. Essence

The development of grains forms the foundation of all other forms of agricultural output. The degree of growth of wheat farming is a significant factor in determining the stage of growth of the other sub-sectors of agriculture. The production of wheat is the fundamental activity for crop production as well as overall agricultural output. The interdependent relationships that grain production has with other sectors of industry and agriculture in the surrounding area are what make this possible.

It has been demonstrated through effective implications that it is not possible for economic regions to specialize with in manufacturing of livestock products, to create the manufacturing of agricultural crops, or to advance in any other aspect of agriculture without first having a developed grain production. Grain is an essential component of both the diets of cattle and poultry, in addition to its use as a food source for the human population. Wheat is an essential raw material source for the brewing business, the alcohol industry, the food sector, and, in the not-too-distant future, the biofuel industry (Dziki, 2014). In terms of economics, grain possesses a variety of benefits that set it apart from other agricultural

products. It can be safely kept in a dry state for extended periods of time and is simple to transport over great distances; it possesses a high level of permeability.

When looking at wheat from the perspective of energy and food natural resources, it is important to keep in mind that the current global population is expanding at a rapid rate, which results in a rise in the demand of various products. Wheat is a raw material for both food and energy. It is common knowledge that the majority of the food consumed by humans across the world consists of grain and products derived from the processing of grain. Grain is a reliable and common source of protein, which is essential for human survival.

At the same time, there is a reduction in area that is appropriate for producing crops, which is generating food shortages like author of this work This is due to the different circumstances that are occurring all over the world. Additionally, there is active mining (of oil and gas), and because the subsoil is being exhausted, there is a deficit that can cover the space left by the gas emitted from cereal crops (Castellano, 2019). It is important to highlight those low-income nations began becoming more reliant on wheat following the conclusion of World War II, and this trend only accelerated during the 1970s (Friedmann, 1993). However, relying on outside sources for one's food supply does not automatically indicate a lack of control over one's diet. If additional variables, including such income levels, are taken into consideration, reliance on wheat may very well be a substantial contributor to food insecurity. Because wheat-based products that make up a relatively large percentage of low-income nations' overall cereal consumption, a significant dependency on wheat imports might be considered as a threat to food security in these countries (Oldeman, 1998).

The majority of countries put up opposition to the idea of liberalizing agricultural commerce, and it wasn't until the eighth round and trade negotiations, sometimes referred as the Uruguay Round, that the industry was even considered for inclusion. Despite the fact that agricultural continues to account for a relatively small percentage of global commerce, this industry is extremely skewed. Nevertheless, because of the relatively high degree of protection, the industry is responsible for roughly 70 percent of the potential actual benefits that may be achieved through trade liberalization. The economic consequences of tariffs on imports and tariff quotas continue to be large (Laborde, 2012)

As a result of the widespread recognition of the significance of the international trade in agricultural goods, several nations recently liberalized their trade policy. Even while agricultural items continue to have the highest tariffs, the actual duties that are being levied have been drastically decreased. Specifically, concessions made at the multilateral, unilateral, and regional levels helped bring about a 27.4 percentage point reduction in the global average agriculture tariff (Baldwin, 2016). It is important to stress that the level of agricultural protection that has been imposed, although still present, is far less than what is permitted under the multilateral discipline of a World Trade Organization (Hoekman, 1995). In addition to this, the majority of the decrease in tariffs was the result of voluntary reductions and regional trading arrangements (Seshadri, 2009).

As a result, wheat plays a vital role in a variety of countries and offers a sizeable amount of the calories consumed on a daily basis. Wheat is produced in both underdeveloped nations and rich countries. Wheat imports continue to be critical to maintaining adequate food supplies since local output in the majority of nations is insufficient to fulfill domestic demand. On the international wheat market, nations in the Eurasian area such as Russia, Ukraine, and Kazakhstan play a key role, such as supplying significant amounts of wheat. Their choices .regarding wheat exports have an effect on the pricing and consumption levels across the world. A number of nations are experiencing political instability as a direct result of rising wheat prices. Because of this, these nations and any others who export wheat have a responsibility to examine the political and economic repercussions of their policies. It is important to note that nations have started liberalizing their policies regarding the trade of food and have succeeded in lowering both tariffs and non-tariff obstacles. This program has the potential to result in cheaper pricing and an increased level of food security for them.

3.2.2. Importance

Wheat has always been an important component of human existence due to the many benefits it provides. People's diets are becoming increasingly composed of beef and other goods made from ingredients other than grains, which is leading to a progressive reduction in the quantity of grain as well as other cereals that people consume on a daily basis. Wheat is also commonly utilized as a feed ingredient for cattle. Additionally, the properties that allow it to be ground into flour have virtually little impact on the food's nutritional profile. For instance, in the United States of America, grinding residue was traditionally utilized for

animal feed before entire wheat began to replace it (Mohanty, 2019). In ages past, waste from milling operations was fed to cattle. Garbage with a high cellulose concentration were given to cows and horses, whereas waste with a low cellulose concentration was provided to chickens and pigs. Sheep and young cows have traditionally benefited greatly from consuming wheat bran as a dietary supplement because of its high nutritional content. In the past, due to the laxative effects of these, they were also administered to horses. The most beneficial type of bran for pigs is tiny bran, which still has germs and flour attached to it. As a supplement to grain feed, they work best when combined with fishmeal, by-products of dairy production, and waste from slaughterhouses. The use of grinding residue in the poultry business, particularly in the production of broilers, has been on a recent downward trend due to the increasing popularity of diets low in fiber.

The protein that is found in wheat grains was the original source of monosodium glutamate, which was then extracted from that protein (Shi, 2010). It is a component that may be added to dishes in order to make them taste better. Throughout the history of soy sauce production throughout Japan, monosodium glutamate had played a significant role. On the other hand, they have just discovered how to extract it from the exact same soy (Chakraborty, 2019). Up until quite recently, the application of wheat research focused mostly on enhancing the nutritional qualities of the grain. Research conducted in laboratories has demonstrated that wheat gluten has the potential to be used as a raw material in the manufacturing of polymers, textiles, and adhesives. The difficulty with these items is that they are fragile and soluble in water, that implies that they do not have any value from a business perspective. As a result of the recent decreased tendency in wheat use, there has been resurgence in interest in the investigation of applications of wheat that are not traditionally recognized. Therefore, with the assistance of specific processing, they learnt how to make "rapid" foods from flour, appearing to be similar to semolina. High-protein flake for a speedy meal is made from gluten, and grain flour is used to reinforce paper. And wheat sprout, the health benefits that have been scientifically demonstrated, are also starting to make their way into raw food diets.

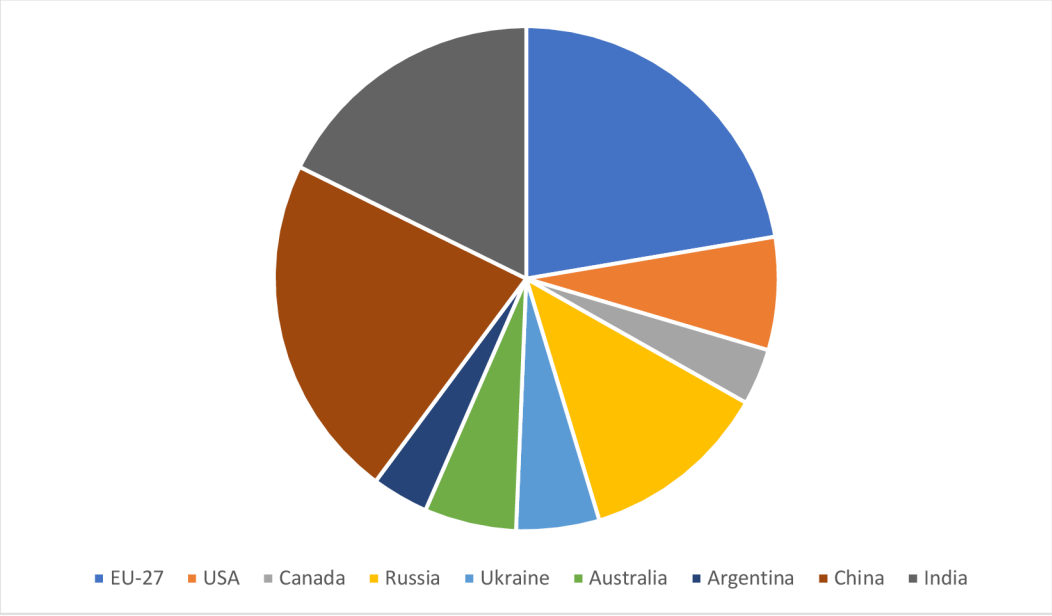
Because of its adhesive and viscous qualities, wheat has found use in a variety of industrial applications. In the process of oil production, flour is frequently included as an addition to drilling fluids. In addition, it acts as a flocculant during the process of gold

extraction from solution. In fact, flour is utilized in the manufacturing process of drywall in order to bond the minerals and paper components more effectively. Flour is also utilized as a filler in water-resistant adhesives for plywood. These are only some of the most popular uses of wheat bread in industrial settings.

3.2.3. Current Status

These days, the emerging countries located in the Asia-Pacific region, particularly China, India, and Indonesia, are responsible for providing approximately half of the world's grain output (Mitchell, 2008). The total amount of grain harvested in China and other Asian nations combined reaches million tons, while the other 779 million tons are harvested in other Asian countries (Asseng, 2020). Grain is the most essential staple food for most people living in Asia's nations with the biggest populations; this includes both the poorest inhabitants, for whom it forms the foundation of their diet, and the more affluent ones. Both the countries of North America (the United States of America and Canada) and the countries of the European Union produce substantial amounts of grain. And below are wheat production data for this year and the previous year (Table 4).

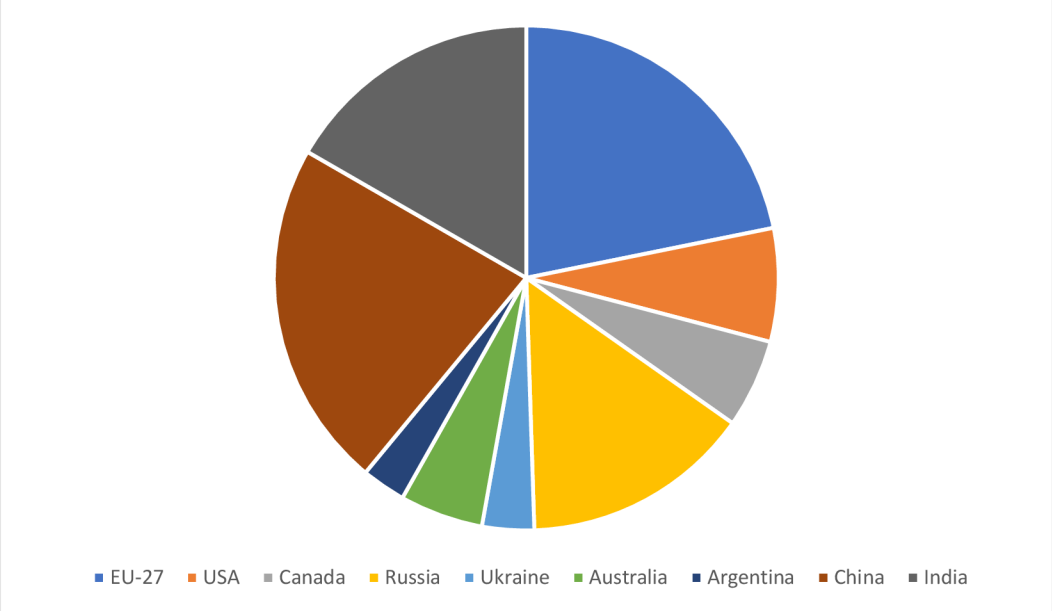
Table 4, Wheat production total in 2021/2022 (all wheat; million tons)



Source: Business Standard, 2022

It should also be mentioned and emphasized that the prediction for production in the world of grains (wheat and coarse grains) in 2022/23 is raised by 2.2 million tons when compared to the production levels of the previous year and the year that is now ongoing. This is accomplished by raising the amount of wheat and barley that is produced (mostly for Russia, Canada, and Australia), which compensates for the falling amount of maize that is produced in the United States. The total amount of wheat that will be harvested all across the world will be 781.7 million tons (Asseng, 2020). The following table provides a forecast for both the current year and the following year.

Table 5, Wheat production forecast on 2022/2023 (all wheat; million tons)



Source: Business Standard, 2022

It is anticipated that total worldwide grain output in 2022/23 will be 2.2% lower than the record set in the previous season. Annual decreases in wheat and cereals production will be contrasted by gains in wheat and barley production.

The cost of wheat has experienced a substantial shift. Wheat cost $113.2 dollars per metric ton at the time, in December of 1990, when it was being sold (Barnett, 2000). They reached a high of $128 in the month of December 2000 (Rinaldi, 2003). Prices started going up at the turn of the century and reached an all-time high of over $440 in March of 2008

(Mitchell, 2008). Wheat prices were impacted negatively as a result of the worldwide financial crisis as well as a major drop in oil prices.

The cost of foodstuffs throughout the world shot up a long time before February 2022. As soon as the worldwide supply chains were affected by the coronavirus pandemic, the contamination began to spread over practically all product categories. Even by end of the year 2021, it was nearly impossible to locate any food item that did not experience a price increase of at least 70 percent. When compared to the times before the crisis, the price of something increased by a factor of three or more. Grain priced $5 per bushel with in middle of the year 2020, but by November 2021, that price had risen to $8. The majority of forecasts suggested that growth would carry on for some time to come.

However, the scenario in the shape of a special campaign in Ukraine emerged unexpectedly and, within a few weeks, drove prices to levels that were far higher than anybody had anticipated. Even when taking into account the effects of inflation, the price of a bushel of wheat within United States was above $14 on March 7 (Cropley, 2022). These prices have never been seen before. Something that is eerily similar to the current scenario was witnessed in 2008, which was just on the cusp of the global financial crisis. It was explained by a string of crop failures in several nations, as well as the massive planting of rapeseed. It is important to note that throughout the 2000s, the post-Soviet nations played a considerably more subdued role in the global market. This is due to the fact that their agricultural sectors have not yet recovered fully from the economic disaster that occurred in the 1990s (Noy, 2009).

3.2.4. Derivatives

This idea looks odd at first glance because wheat groats are produced from wheat grains; what else could they be composed of? But there are actually two varieties of wheat: soft, which is the most common variety, and durum (Triticum aestivum and Triticum durum) (Sears, 1950). The protein content of soft wheat grains ranges from 10–15 percent, whereas the protein content of durum wheat grains is at least 16 percent and can even exceed 20 percent. But unfortunately, wheat is more susceptible to harsh circumstances and is inferior to wheat dough in terms of production; as a result, soft wheat types are the most common

type of wheat used in agriculture across the world. Despite this, the majority of cereals are manufactured from durum types.

A seed, the shells, as well as the endosperm, which is a mealy kernel that retains reserve nutrients, are the three primary components that make up a grain of wheat. The endosperm of the wheat grain is milled into groats after being properly separated from of the germ and, if at all practicable, from the shells. Wheat germ includes protein, phytoestrogens, and phytosterols, in addition to an oil that is high in beneficial vitamin E and important polyunsaturated fatty acids, including linoleic and linolenic acids (Dedic, 2022). However, in order to prevent the cereal from becoming rancid while it is being stored, all of its utility needs to be thrown away (Sarkar, 2020).

3.3. Indian Agriculture

3.3.1. Employment

India is a massive country that is blessed with an abundance of natural resources. There are 169 million hectares of land in India that is used for agricultural purposes. India is home to a wide range of climates, from icy alpine regions and lush green rainforests to rich fertile plains and hot arid deserts. India also contains a range of climatic zones. This kind of topographical and physical variety is almost certainly unmatched anywhere else in the globe. Because of its vast natural resources and predominant agricultural economy, India is well-positioned to become a global leader in the agricultural sector.

In and of itself, the food processing industry is a considerable contributor to the country's overall economy. In addition to offering the greatest potential for employment, the industry is also a substantial contributor to the revenues the country receives from its exports. Given the prospects for continued expansion in the food processing industry in India, there is a wealth of opportunities for investment that is certain to provide additional value.

In the late 1980s, the Ministry of Food Industry attempted to involve farmers as well as those involved in the food processing in hopes of achieving communication among technology, economics, environmental authorities, and society in to maximize the actions of the food-processing industry in terms of meeting domestic requirements and realise export opportunities. This was done so as to enhance the events of the food-processing industry in

terms of meeting domestic needs and realize export potential. These efforts were made with the objective of ensuring focused expansion as well as industrialization of a food industry in attempt to establish a strong foundation for the manufacturing of finished farm commodities for domestic and international markets. The goal of such attempts was to ensure that the food industry would be able to meet demand.

Several steps have been made by the government to help the food manufacturing sector. State control of the industry has been done away with, and all licenses have been revoked, with the exemption of the ones required for the manufacture of alcoholic drinks. With a few notable exemptions, fully owned foreign corporations were free to invest up to 100% of their capital in the food business (for alcohol and SSI sector products) (Lakshminarayanan, 2011). The right to duty-free importation of raw resources and production equipment was granted to one hundred percent of export firms, and the use of foreign trademarks was also made duty-free. This industry was listed on the prioritized list for receiving loans at more favourable interest rates, and it was given priority status. The excise tax that was formerly applied to the manufacturing of fruits and vegetable products has been eliminated entirely.

A proposal National Policy for Processing and Food Industry has been ready by the Ministry to fulfil the total average objective in full accordance with the Agricultural Policy (Grant, 1997). The Ministry's objective is to establish a climate that begins up more opportunities for investment and rationalizes procedures to make certain that that the sustained development of the progress of the food industry. This will ensure that the food industry can continue to develop in the country. The program calls for a rise in the percentage of crops and foods in use for process from 2% at the current time to 10% within the next 10 years. To accomplish this goal, the processing sector will necessitate an investment of 1,400 billion rupees. This would result in a rise in the cost of items after processing of anywhere from 7% to 85%, but it will also result in job growth for upwards to 7.5 million people (Beniwal, 2022).

Now, the Ministry is also working on the creation of the Decree on the Development of Food Processing, that is not a regulatory document but rather an evolving one due to the nature of the legislation itself (GeeksForGeeks, 2022). It is taken for granted that it is feasible to function independently of the myriad of laws and agencies that are responsible for their

enforcement. Building infrastructure, building or upgrading organizations for food processing, carrying out development and research for product lines, food processing of food technology, coaching experts through the establishment of FPTC, carrying out EDP, as well as generating infrastructure and services including such proposals for experiment in institutions, establishment of quality control laboratories, and for goal of obtaining HACCP/ISO certification, as well as offering support, are all examples of activities that are eligible for financial support. The type of the organization or patron that provides financial assistance is taken into consideration; nevertheless, the maximum amount of help is capped at Rs 5 million for regular regions or Rs 7.5 million for problematic areas that author will touch later (Sharma, 2022). This support totals forty million rupees when Food Parks are taken into consideration alone. Additionally, financial assistance is currently offered for the establishment of grain mills, rice mills, pulse mills, oil seed processing facilities, and the like.

3.3.2. Sectoral Breakdown of the Economy

The Gross Domestic Product (GDP) of India reported growth of 9,2% percent in the first quarter of 2022. The Indian economy is now in a boom phase. This information is remarkable within itself when one take into consideration statistics coming from all around the world: most nations are now surviving, if not even suffering to live, excluding the Chinese market, that is still expanding at a pace of 6.8-6.9 percent. Because of this, it should not come as a surprise that India's economy is one of the most rapidly expanding in the world and that it is projected becoming the second biggest economy of the planet by the year 2050 (Chenic, 2022). Its economy is influenced by a wide variety of different causes.This favourable scenario is the result of a confluence of several variables, including significant shifts in politics, regulations, the law, and bureaucracy. Overall, India has been a participant in the of development for quite a few years, and this is the outcome of all the changes, advancements, and initiatives that have taken place during that time. Additionally, the economy of India is broken up into four different sectors: the agricultural sector, the economic sector, service sector and farming sector.

The farming industry in India is one of the most significant contributors to the country's overall economy. It creates a substantial number of jobs and makes a sizeable contribution

to India's gross domestic product, all of which are critically important roles. In this research paper, we will investigate the significance of the agricultural sector to the Indian economy, paying particular attention to its impact on employment and the gross domestic product of the nation.

The agriculture industry in India is one of the most significant contributors to the country's overall GDP. The Indian Ministry of Agriculture and Farm Welfare estimates that the gross domestic output from farming in the country reached around 4.31 trillion rupees in the year 2020. This is equivalent to around 17% of India's overall GDP (Gulati, 2022).

The agricultural industry provides a living for more than fifty percent of India's total population, making it the country's most important economic sector. In addition to this, it plays a significant part in maintaining the nation's food security. The practice of agriculture in India encompasses a wide variety of subcultures and geographical distinctions. Rice, wheat, cotton, sugar cane, tea, coffee, and other commodities are only few of the crops that are grown in this nation.

More over half of India's working population is employed in some capacity by the farming sector. Millions of Indian farmers rely on it as a significant source of income; therefore, it is also an important economic factor. Despite the fact that farming remains the primary means of subsistence for a large number of people living in rural areas, the industry is plagued by a variety of obstacles, including low productivity, restricted access to capital, technology, and land management. These issues have contributed to a decline in the quality of life for those living in rural regions as well as increased inequality between urban and rural settings.

In recent years, however, the government of India has made measures to assist agriculture. These actions include the implementation of programs that provide finance, training, and access to technology. For instance, the government of India initiated a program called the Mission for Integrated Development of Horticulture (MIDH), with the intention of encouraging the cultivation of fruits, vegetables, and flowers and providing the essential assistance to farmers in the form of financial loans, educational opportunities, and

improvements to the physical environment. The percentage of total economic output that may be attributed to India's agriculture sector (Shivalingaiah, 2020).

The contribution of India's agriculture industry to the country's overall gross domestic product is enormous. In addition, other parts of the economy, such as the manufacture of textiles, the processing of food, and the working of wood, all rely heavily on the agricultural sector as their primary supply of raw materials.

The agriculture industry in India is one of the most significant contributors to the country's overall economy. It creates a substantial number of jobs and makes a sizeable contribution to India's gross domestic product, all of which are critically important roles. Yet, agriculture also confronts a number of issues that need to be solved to enhance the lives of rural people and strengthen the industry. It is essential to create technology and infrastructure in order to enhance access to loans and expand the availability of markets for agricultural products in order to raise agricultural product production.

The government of India is taking steps to support the farming sector; however, the implementation of these measures needs to be more carefully considered, and the barriers to the sustainable development of farming need to be removed. Despite these challenges, the government is taking steps to support the agricultural sector. It is possible that the successful growth of the agricultural sector will play a significant part in the enhancement of the quality of life for millions of people living in rural areas of India as well as the expansion of the economy as a whole.

The availability of natural materials is an important factor for this industry's services, which are vital for supporting day-to-day operations. Examples of such industries include mining, fishing, logging, dairying, and others. Agriculture is the primary source of revenue in India, employing over half of the country's total population (Sengupta, 2022). As a result, the government is putting a lot of effort into enhancing working conditions, encouraging innovation, and increasing productivity in the agricultural sector. It is also crucial to note that agriculture in India, along with fishery and forests, collectively account up one third for India's GDP. Agriculture is also the most significant source of revenue in India, and around twenty percent of the country's GDP comes from primary industries like these (Shah, 2022).

Farming has historically served as India's primary source of income and employment. In addition, India is the country that produces the most milk in the world, as well as the second most wheat, sugar, freshwater fish, and peanuts. In addition, India is a leading producer of black pepper, ginger, cashew nuts, turmeric, ginger, and turmeric powder. This incredible accomplishment was accomplished by the agriculture sector of India as a direct result of the Indian government's simultaneous implementation of several reforms across the country. Significant upheavals occurred in India's primary sector during the Black Revolution, which resulted in the extraction of oil, as well as the Brown Revolution, that resulted in the production of leather, non-traditional items, and cocoa. Both revolutions led to the creation of goods (by Jus, 2022). Because of this, it is essential to recognize that the two most significant challenges this industry has right now are underemployment and concealed employment.

The economy sector is predicated on the usage of natural resources, which are used in the production of goods and services, which are subsequently utilized by customers. This sector is responsible for the transformation of items from the primary sector (raw resources) into completed goods that may be sold to businesses or consumers inside the country, as well as abroad. A good number of these businesses require significant quantities of energy, manufacturing facilities, and machinery; hence, they are frequently categorized either as lighter or heavier depending on the qualities listed above.

When it comes to giving products and services more value, the economic sector is far and away the winner. Two of the most significant examples in this field are the transportation and industrial sectors. Additionally, more than a third of India's overall work force is employed in this area. In addition, the service sector is accountable for roughly a quarter of total GDP (ADB, 2022). This industry subsector will continue to expand and flourish if it serves as the foundation for the Indian economy.

The service sector is responsible for the production of services rather than completed goods. The term "services" encompasses a wide variety of activities, including referrals, access, experiences, and emotional labour. The services section within the industry is the portion of the business that is responsible for delivering services to end users as well as other

firms. The focus is not on altering the physical products themselves, but rather on the people who interact with them and provide service to customers.

Certain essential services are included in the realm of the service sector even if they do never contribute directly to the production of commodities.

Before they can be marketed in retailers or wholesalers for example, goods that were created inside the first or second sectors need to be supplied through the process of logistics. This industry encompasses all service-based firms, such as those providing information technology services, consultancy, and personal services, such as educators, medical professionals, and others. This sector is responsible for more than sixty percent of India's overall gross domestic product.

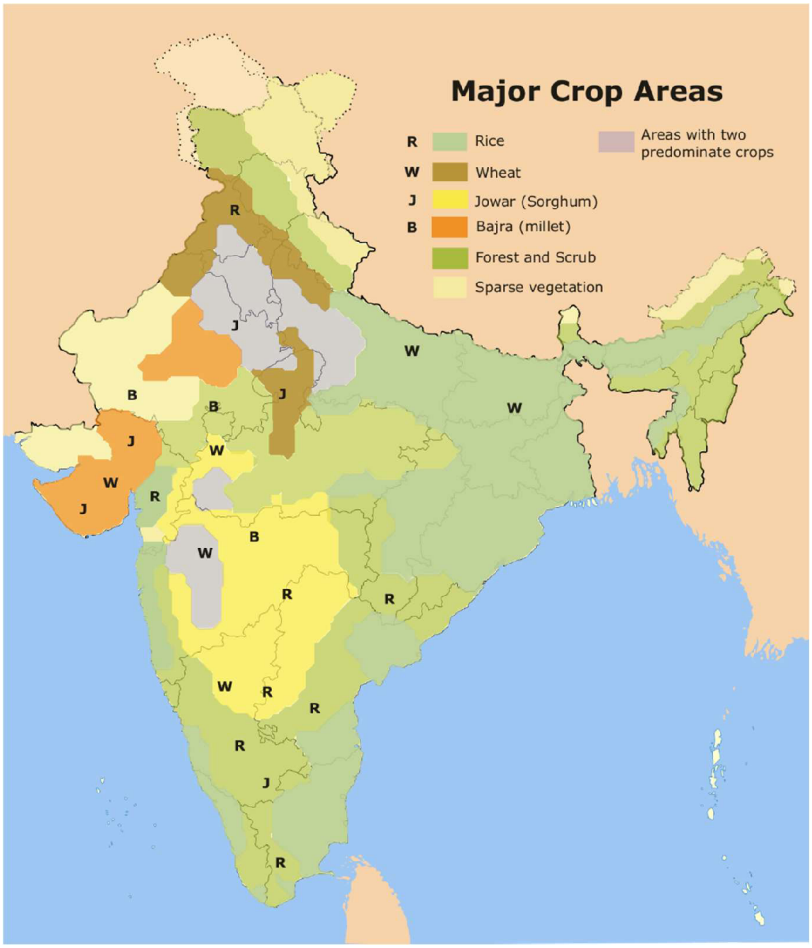
3.3.3. Regions

Large tracts of land in the country have been tilled for agriculture, which accounts for more than half of the land in the nation. Food crops take up 85 percent of the available land here. The coastal lowlands, as well as the valleys of the Ganges and the Brahmaputra rivers, are all a part of the world's largest rice belt. Rice is the primary crop, and in certain regions (like Bengal), there may be as many as three harvests in a single year. The region that produces most of the India's wheat is the northwest. In the winter, wheat is cultivated on grounds that are irrigated. India is transitioning from a country that mostly grows rice to one that primarily grows wheat.

In inland regions that are dry and have insufficient irrigation, key roles are played by crops including sorghum, millet, beans, and peas. Oilseed crops, the most common of which are peanuts and cashews, are virtually everywhere, and they are virtually the sole sources of lipids. Sesame, castor, mustard, rapeseed, flax, and coconut palm are among of the crops that are produced in certain areas of the nation to produce vegetable oil. Both sugar cane plus cotton is produced in greater quantities in India than in any other country on the planet. The Ganges Valley is the primary growing region for sugar cane in India. Western India is home to cotton production. The irrigated areas of Punjab are home to the cultivation of a kind of particularly high-quality long-fibre cotton.

Additionally, India is the third largest producer of tobacco in the entire globe (the Godovari and Krishna Deltas). There are several types of export tobacco for Virginia cultivated there. India is the greatest producer of tea in the world, accounting for up to 35 percent of the total harvest. The Brahmaputra Valley is the most important part of the region. In addition, the lower parts of the Himalayan range and southern India (Insights on India, 2022).

Figure 1, Major Crop areas of India



Source: Drishtiias, 2019

4. Practical Part

4.1. Analysis of Total Production

To begin with, it is worth to start the analysis by following the pattern of total production of wheat in India and identifying if the country has been increasing its wheat production over the course of last decade, or the total volume of wheat produced was fluctuating over the chosen period of 15 years (from 2006 to 2020). The following table contains the annual figures for the production of wheat in India in million tons.

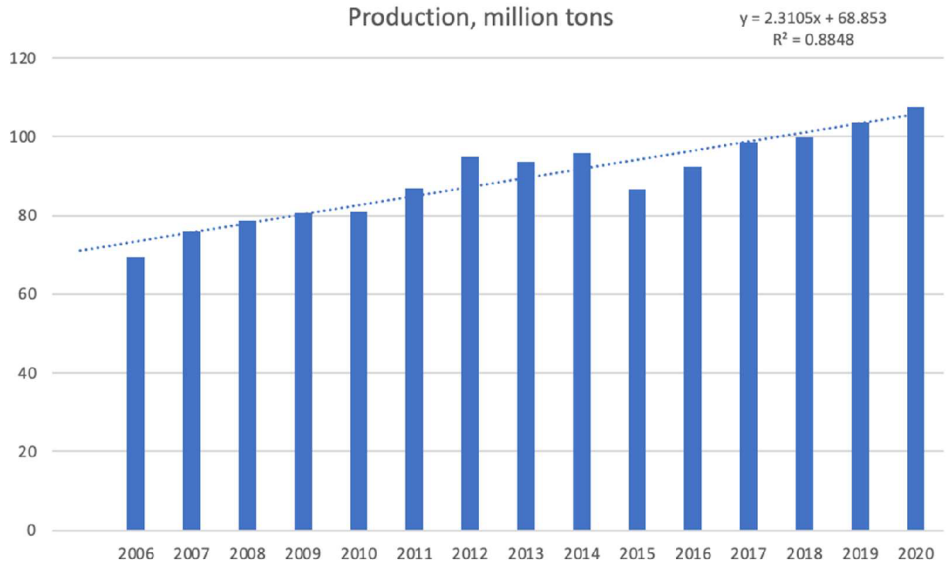
Table 6, production figures per each year

Year	Production, Million Tons
	y1
2006	69.354
2007	75.807
2008	78.570
2009	80.679
2010	80.804
2011	86.874
2012	94.880
2013	93.510
2014	95.850
2015	86.530
2016	92.290
2017	98.510
2018	99.870
2019	103.596
2020	107.590

Source: FAOSTAT, 2022

Clearly, it is already visible without even constructing a trend function that the production of wheat in India is an upward pointed function with the volume increasing per each year. Consequently, the author estimates a trend function reflecting the development of the indicator, whose output is presented below.

Figure 2, trend function for wheat production



Source: own processing based on FAO

After getting an output for the trend function generated by the Excel, the author estimates the following equation for the total production:

$$y = 71.163 + 2.3105t + \varepsilon$$

Based on the trend, it is possible to say that the average annual increment is equal to 2.310 million tons, which is a lot and helps the author to conclude that India is rapidly increasing its volume of wheat production. When it comes to the quality of the trend, the coefficient determination (R^2) is equal to 0.88, meaning that approximately 88% of variation was explained. This is a fairly good result. Additionally, the author proceeds to the computation of a prediction for the upcoming decade because on the results of the trend analysis. Table 7 presents the fitted values based on the trend from Figure 2.

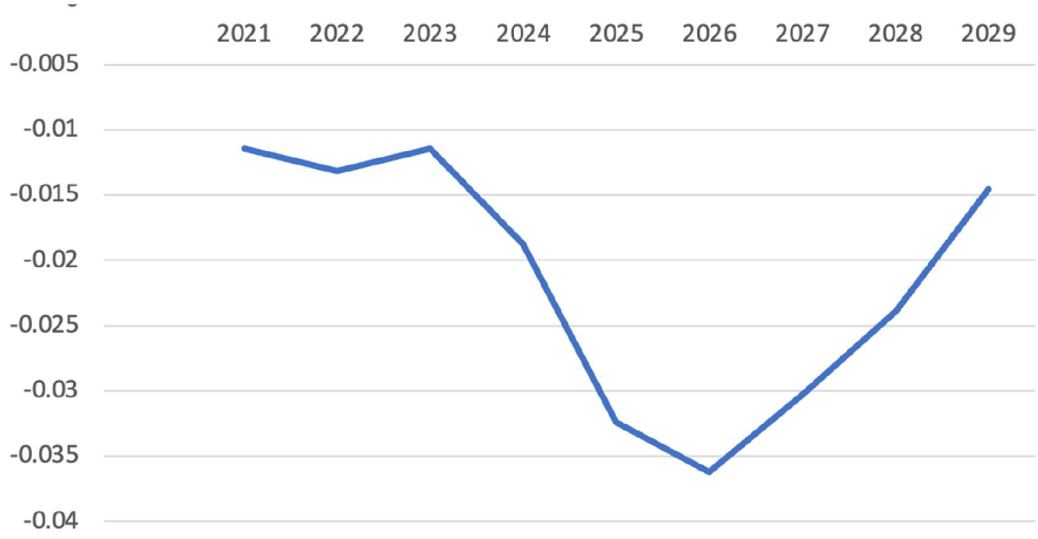
Table 7, Prediction for the upcoming decade

Year	Production (Million Tons)
2021	105.821
2022	108.132
2023	110.442
2024	112.753
2025	115.063
2026	117.374
2027	119.684
2028	121.995
2029	124.305

Source: own processing based on FAO

Clearly, based on the table created, it becomes more than obvious that the level of production of wheat in India will almost reach 125 million tons annually, which is a fairly good result indicating a positive tendency. Effectively, the author also considers CARD prediction (under median risk level) with the development of base indices displayed in Figure 3 for the variable of crop yield.

Figure 3, prediction for yield (2021-2029) considering climate change



Source: CARD model of IDAF,

Clearly, according to the CARD prediction, the scenario is not so optimistic in relation to yield, which is expected to drop under climatic problems. Hence, according to the logic behind CARD, it is wise to assume that a driving factor behind a potential increase in the production can be an increase in area.

In addition to the prediction, the author does also estimate a correlation between the total annual volume of wheat production and the population of India, because population growth is usually the most frequent reason for increasing wheat production due to the fact that whenever the total number of people living in a country increase, it is quite sensible for a country to increase its food supply. When it comes to wheat, due to the fact that a lot of basic goods are produced from it, wheat production is usually the one that is targeted by authorities more often than other ones.

The following table contains data used for the correlation coefficient estimation as well as computed average chain indices for two variables.

Table 8, dataset for correlation analysis

Year	Production, million tons	Population, million people	Production per millions of people
2006	69.354	1165.486	16.805
2007	75.807	1183.209	15.608
2008	78.570	1200.670	15.281
2009	80.679	1217.726	15.093
2010	80.804	1234.281	15.275
2011	86.874	1250.288	14.392
2012	94.880	1265.780	13.341
2013	93.510	1280.842	13.697
2014	95.850	1295.601	13.517
2015	86.530	1310.152	15.141
2016	92.290	1324.517	14.352
2017	98.510	1338.677	13.589
2018	99.870	1352.642	13.544
2019	103.596	1366.418	13.190
2020	107.590	1380.004	12.827
Average Growth Rate	**3.3%**	**1.2%**	

Source: own processing based on FAO

Clearly, it is visible that the average growth rate of production of wheat exceeds the average growth rate of the population, which is a good sign suggesting that the production successfully catches up with the rapid course of the population growth variable. In Table 9, the author presents the result of the correlation analysis for the pair (Production x Population).

Table 9, correlation coefficient calculated

	Population million people
Production, million tons	0.9441

Source: own processing based on FAO

Above is a statistical analysis of the connection between India's population and total wheat output. According to the analysis, there is a significant positive correlation between the two variables, with a correlation coefficient of **0.944.** This relationship was anticipated because it makes sense that a larger populace would need more food, which would increase production levels.

The concluding chapter of the practical section will further explore these factors, which the analysis also implies may have an impact on wheat production. The quantitative impact of these additional variables on wheat production will be examined in this additional analysis, which will also give us a more complete understanding of the connection between production and population in India. Overall, this correlation emphasizes the value of statistical analysis in unraveling the complexities of interrelationships between variables and the need for more investigation to completely comprehend the variables affecting wheat production in India.

After analyzing yield and production, it is also essential to analyze the third component of every production of agrarian commodities – harvested area. In Table 10, the author presents the dataset containing information about the total harvested area of wheat in India.

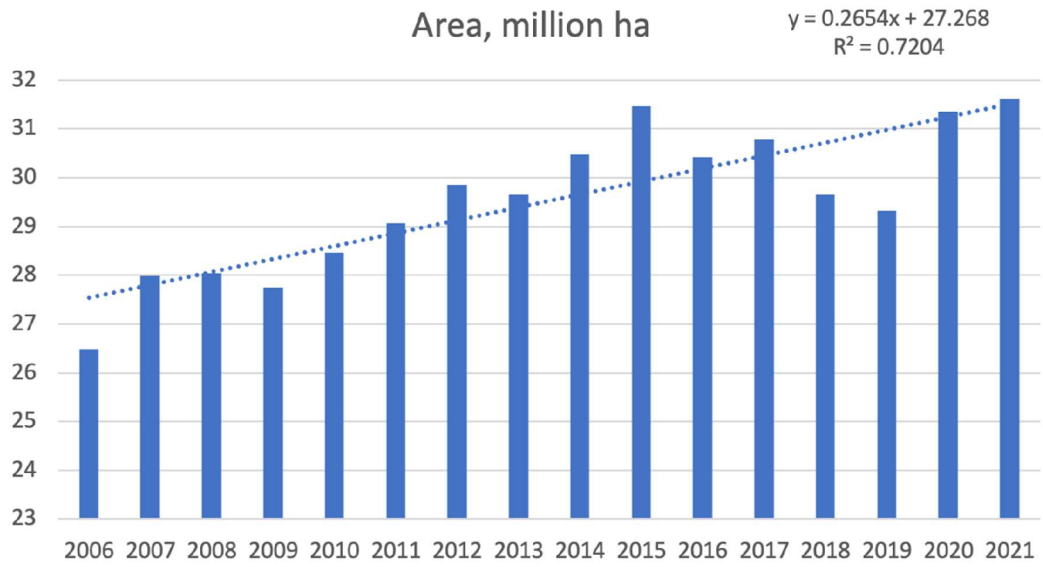
Table 10, harvested figures per each year

Year	Area, Million hectares
2006	26.4836
2007	27.9945
2008	28.0386
2009	27.7524
2010	28.4574
2011	29.0686
2012	29.86
2013	29.65
2014	30.47
2015	31.47
2016	30.42
2017	30.78523
2018	29.65059
2019	29.31878
2020	31.35702
2021	31.61

Source: own processing based on FAO

Based on Table 10, it is pretty evident that the total volume of harvested area for wheat in India was increasing with a minor setback in 2018-2019, when the volume of the production dropped from 30.78 million hectares in 2017 to 29.31 million hectares in 2019. Based on the original dataset, the author proceeds to the linear prediction for the variable, which will be based on the trend estimated in Figure 4.

Figure 4, trend function for area harvested



Source: own processing based on FAO

According to information from Figure 4, the author can estimate the following linear trend:

$$y = 27.268 + 0.2654t + \varepsilon$$

Clearly, by looking at the data in Figure 4, it appears that India has seen substantial growth in the agricultural sector over time. This is probably because better farming practices, policies, and technologies have been put in place. Using this pattern as a foundation, author projected future harvested areas for the following ten years using the trend function. It's crucial to keep in mind, though, that such forecasts might not account for all the variables that could affect agricultural output in the future, such as natural disasters, climate change, and market fluctuations. Therefore, author suggest that India should take a comprehensive approach to making predictions about the future that takes into consideration these possible uncertainties.

Table 11, prediction for the upcoming decade

Year	Area (Million Hectares)
2022	31.7798
2023	32.0452
2024	32.3106
2025	32.576
2026	32.8414
2027	33.1068
2028	33.3722
2029	33.6376

Source: own processing based on FAO

Based on the linear prediction, it is possible to suppose that the number of wheat area harvested will reach 33.63 million hectares by 2029. Yet, it is wise to say that this prediction seems rather optimistic as there are environmental issues with the global warming phenomenon all over the world and it is not yet certain how will the international situation in terms of supply chains and trade develop in the nearest future. All in all, after analyzing each essential component of wheat production, the author proceeds to the logarithmic dissolution of factors.

4.2. Logarithmic Dissolution of Factors

Now, it is essential to understand which agrarian factor of production is responsible for the annual change in the quantity of wheat produced in India. For this purpose, the author uses the so-called method of logarithmic dissolution of factors that will indicate the percentual change in the change in wheat production caused by the change in both area and yield, two main factors influencing the development of any agrarian production. The following table (Table 12) contains the input alongside the calculations.

Table 12, logarithmic dissolution of factors calculation

	2016	2017	2018	2019	2020
Production, mil.tons	92.29	98.51022	99.86952	103.59623	107.59
Yield, ton/ha	3.0339	3.1999	3.3682	3.5334	3.4311
Area, mil.ha	30.42	30.78523	29.65059	29.31879	31.357

	2017	2018	2019	2020
Production Change	6.22022	1.3593	3.72671	3.99377
Ip	1.06739863	1.01379857	1.03731579	1.03855131
Ia	1.01200625	0.96314336	0.98880967	1.0695189
Iy	1.05471505	1.05259539	1.04904697	0.97104772

Ln (a) / Ln (p)	18.30%	-274.02%	-30.72%	177.68%
Ln (y) / Ln (p)	81.67%	374.04%	130.70%	-77.67%
Total Percentage	100.0%	100.0%	100.0%	100.0%

Change caused by A	1.13817229	-3.72481943	-1.14471439	7.09595315
Change caused by Y	5.08022388	5.08428581	4.87063924	-3.10192109
Total Change	6.21839617	1.35946638	3.72592484	3.99403206

Source: own processing based on FAO

Consequently, based on the outcome of the analysis, the author is able to highlight the following information about the chosen factors and the role that they played in each year:

- In 2017, increase in area caused the increment of 18.30% (1.13 million tons) of the total change (+6.22 million tons) in the total production in India. Yield caused the increment of 81.67% (5.08 million tons) of the total change.

- In 2018, decrease in area caused the decrease of -274.02% (-3.72 million tons) of the total change (+1.35 million tons) in the total production in India. Yield caused the increment of 374.074% (5.08 million tons) of the total change.
- In 2019, decrease in area caused the decrease of 30.72% (-1.14 million tons) of the total change (+3.72 million tons) in the total production in India. Yield caused the increment of 130.70% (4.87 million tons) of the total change.
- In 2020, increase in area caused the increase of 177.68% (7.09 million tons) of the total change (3.99 million tons) in the total production in India. Yield change caused the decrease of 77.68% (-3.1 million tons) of the total change.

Thus, it is possible to say that India was constantly increasing its yield rather than area, the only year when the number of million ha used was increases was in 2020. Before that, the country was focused on increasing yield, and it is the main factor accountable for the increment in the total production.

4.3. Prices and Profitability

For the analysis of prices, the author first implements the technique of the calculation of the break-even point and for this purpose, the author calculates the break-even point for average farms in Punjab, one of the most important regions for the country's wheat production. In Table 13, the author presents the calculation of the break-even point for the Punjab state. Standard packaging size for India is quintals, which is equal to 100 kg and the author considers packages of 100 kilo as the main dimension of units, while hectares are taken as the main specification of area for the BEP calculation.

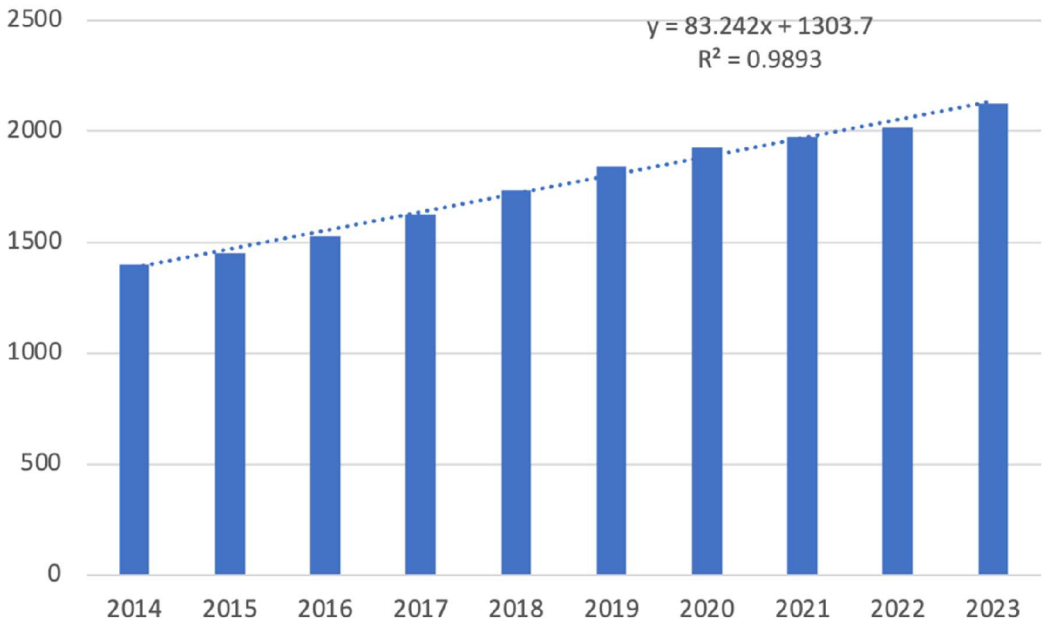
Table 13, break-even point calculation

Total Fixed	35314.860	Rupee
UVC	516.690	Rupee per 100 Kg
P	1624.610	Rupee
Yield	49.660	Per 100 Kg
BEP	31.875	100 Kg per HA

Source: own processing based on Indian Statistical Office

Effectively, it is suggested that Indian farmers from Punjab (as of 2016-2017) were experiencing a net loss without subsidies and help of the Indian government due to the fact that the actual yield was lower than the number of units needed to break even. Additionally, the author presents the average procurement price of wheat's development in India for all states based on available data from 2014 to 2023.

Figure 5, average procurement price's development in India per quintal



Source: own processing based on Statista

Indeed, it is visible that the prices of procurement hit the all-time high in 2023, which is quite anticipated due to the turbulence on the commodity market caused by the ongoing conflict in Ukraine. According to the trend estimation, which has an incredibly high quality, it can be said that with each year, the price of procurement of one quintal increases by 83.242 rupees, which is not a positive tendency.

4.4. Consumption

In this chapter, the author focuses on the analysis of the consumption of bread, which is the most fundamental commodity produced from wheat. In addition to the analysis of consumption in time, the author conducts a correlation analysis to find if there is any correlation between the consumption and price.

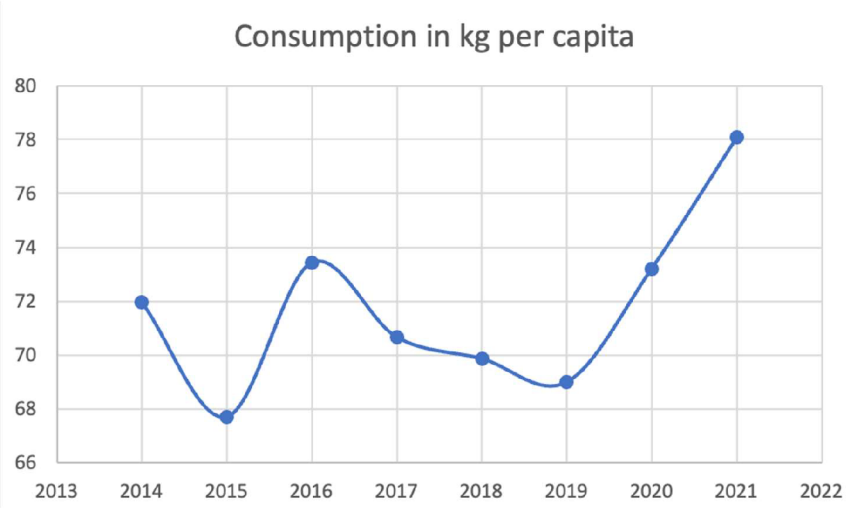
Table 14, consumption and prices

Year	Consumption in kg per capita	Price per kg
2014	71.96	0.5
2015	67.69	0.55
2016	73.41	0.62
2017	70.65	0.68
2018	69.85	0.69
2019	68.98	0.7
2020	73.2	0.74
2021	78.07	0.92

Source: Statista, 2023

Such a short period of time selected for the time series analysis is explained by the data availability of the study used by the author. In the next figure, she presents the development of the consumption variable over time.

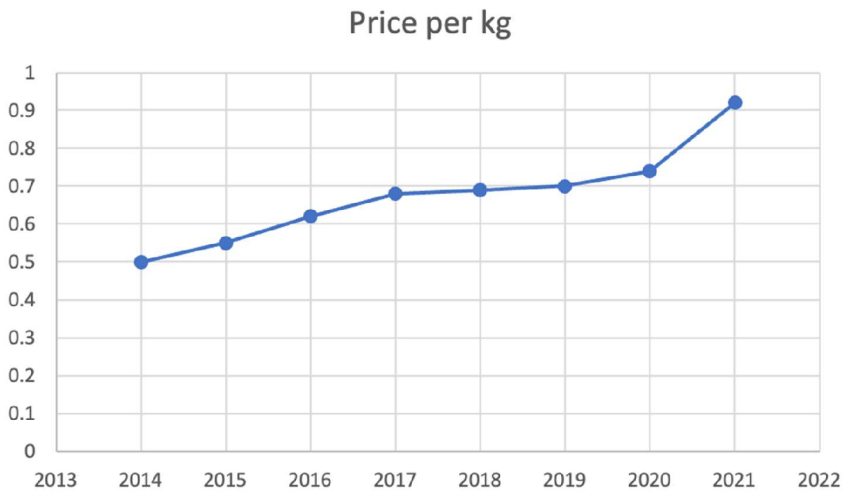
Figure 6, consumption per capita development over time



Source: own processing based on Statista

Effectively, it is visible that the consumption of bread increased over time and given the fact that these values are values per capita, it technically suggests that people started to consume bread more, which can be related to potential decline in the poverty rate of the country (Sengupta, 2022). In addition to that, the author presents the development of price per unit in the next figure.

Figure 7, price per kg of bread development over time



Source: own processing based on Statista

Clearly, it is visible that the price per unit of bread were increasing in India, which is explained by the ongoing inflation increase over time (Sengupta, 2022). Finally, the author presents the correlation coefficient computed in the next table.

Table 15, correlation coefficient

	Price per unit
Consumption per capita	0.66

Source: own processing based on Statista

It is visible that the correlation is positive, which is primarily underpinned by the fact that bread in general is a basic good for which elasticity is low since it is one of the most fundamental commodities. Effectively, this dependency proves the idea that bread remains

one of the most fundamental commodities for the country's population and a primary source of nutrition.

4.5. Self-Sufficiency

Now, the author will estimate the self-sufficiency index for the country, which indicates if the quantity of a given commodity is sufficient in the country or not based on the production, export and import indicators. Before starting the self-sufficiency author wanted to highlight the important factor here on Wheat Balance in India during FY 2021-2022.

Figure 8, Wheat Balance Sheet FY 2021-22 to FY 2022-23

Sl. No.	Item	2021-22 Wheat (Million Metric Tons)	2022-23 Wheat (Million Metric Tons)
1	Opening Balance	27.30	19.00
2	Procurement	43.30	19.50
3	**Total (1+2)**	**70.60**	**38.50**
4	Allocation / Distribution in NFSA / OWS / PMGKY	44.60	30.5*
		0.00	
5	Sale under Open Market Sale Scheme (OMSS)	7.00	0.00
			(Will depend on final procurement figures)
6	**Closing stock (3-4-5)**	**19.00**	**8.00**
			(Stocking norms on 1st April is 7.5 MMT)

Source: PIB May 2022

Early summer caused the production estimate to drop from 111 MMT to 105 MMT (PIB 2022)

19 MMT is the initial stock in the central pool. Estimated wheat procurement is 19.5 MMT, which is less than last year for the reasons listed below:

1. Farmers are selling to traders and exporters in MP, UP, Rajasthan, Gujarat, and other states for rates higher than the MSP (Maximum Selling Price) (PIB 2022)
2. Due to early heat and shrivel grain, production is lower in Punjab, Haryana, and Uttar Pradesh (PIB 2022)
3. Farmers and dealers are both holding back some wheat in anticipation of higher prices in the coming months.
4. 30.5 MMT of wheat is needed for NFSA, OWS, and six months of PMGKY.
5. 7.5 MMT of reserve stock must be with FCI on April 1; stock levels will be about 8 MMT (PIB 2022)

The formula was mentioned in the methodology, where P stands for the domestic production, while Z stands for the production plus imports minus exports and changes in stocks. For the self-sufficiency analysis, the author uses information about consumption per capita in India, from which the volume of total consumption can be derived by multiplying annual figures of consumption by the population of the country and then those figures are divided by 1000 due to. Effectively, the author comes to the following dataset indicated in Table 16.

The author uses the following dataset for the self-sufficiency ratio calculation.

Table 16, dataset for self-sufficiency ratio

Year	P	Z
2011	86874000	82084935
2012	94880000	84587716
2013	93510000	94769093
2014	95850000	94069459
2015	86530000	89544834
2016	92290000	98269294
2017	98510220	95673925
2018	99869520	95624881
2019	103596230	95407069
2020	107590000	102215538

Source: FAOSTAT, 2022

The findings of a calculation regarding the production and consumption of a specific good in a particular nation are discussed in the paragraph. According to the data, it appears that the nation can satisfy its consumption requirements for most years using its existing annual production level. The numbers that have been examined make this statement quite clear.

The author then uses a pertinent formula that was previously given to further explore the relationship between production and consumption. The author hopes to do this in order to obtain a deeper understanding of the situation and the specific factors that are at work.

In order to draw accurate conclusions regarding production and consumption trends, the paragraph emphasizes the significance of data analysis and the application of mathematical formulas. The use of a formula by the author shows a dedication to thorough investigation and a desire to present a complete and accurate picture of the current situation.

Table 17, Self-Sufficiency (S/S) ratio per year

Year	S/S (Self-Sufficiency)
2011	105.83%
2012	112.17%
2013	98.67%
2014	101.89%
2015	96.63%
2016	93.92%
2017	102.96%
2018	104.44%
2019	108.58%
2020	105.26%

Source: own processing based on FAO

Following the analysis, ratio fell below 100% in 2013, 2015, and 2016, indicating a lack of wheat brought on by poor meteorological conditions such heat waves and insufficient

rainfall. The Self-sufficiency ratio was larger than 100% in the other years, showing that India's production of wheat was sufficient to meet domestic demand.

Because of the yearly increase in overall production, Self-sufficiency ratio has been higher than 1. However, if production does not rise, the ratio can fall below 1, suggesting that more wheat is needed to satisfy India's rising demand for it as a result of population growth. This emphasizes the necessity for the Indian government to concentrate on boosting production in order to guarantee a consistent supply of wheat in the nation.

The data shows that India has been able to keep its Self-sufficiency ratio for wheat output largely steady, but the nation must be careful to keep the stability of its wheat supply given population increase and uncertain weather patterns.

Furthermore, this information emphasizes how crucial weather is to wheat production because it has a significant impact on the total amount of wheat that is produced. The information also highlights the necessity for the Indian government to make investments in the creation of technology and procedures that can help boost wheat output and guarantee the nation's supply will remain in future.

4.6. Terms of Trade

Now, it is essential to understand the current perspective of India on the international level. One of the best indicators to understand if the country is benefitting from the international trade of a given commodity of not would be calculating the so-called terms of trade ratio, that indicates whether the country is in a benefit position of trading or not. Its formula was described in the methodology of the master's thesis.

The author uses Comtrade data HS Code 1001 use for creating the dataset indicating the total quantity of wheat exported and imported over the course of 16 years – from 2006 to 2021. The following table presents the original dataset used for the calculation. The author incorporate four variables, where there are 2 variables of trade value indicating the total monetary unit of either import or exports and there are also 2 variables of total quantity either exported or imported from and to India. This dataset will help the author to draw insights on average prices per kilo exported and imported.

Table 18, Comtrade dataset

Year	Export		Import	
	Sum of Trade Value (US$)	Sum of Net weight (kg)	Sum of Trade Value (US$)	Sum of Net weight (kg)
2006	8,673,455	51,965,676	306,000,000	1,390,000,000
2007	120,392	545,052	1,300,000,000	5,080,000,000
2008	154,651	639,819	266,000,000	722,000,000
2009	168,300	519,075	2,634,880	9,125,666
2010	135,483	676,574	101,000,000	331,000,000
2011	145,000,000	500,000,000	7,331	24,980
2012	1,350,000,000	4,580,000,000	540,541	1,568,530
2013	1,260,000,000	4,300,000,000	4,233,078	10,247,060
2014	1,110,000,000	3,950,000,000	6,574,392	18,817,387
2015	156,000,000	603,000,000	135,000,000	512,000,000
2016	49,912,292	199,000,000	413,000,000	1,910,000,000
2017	55,217,921	202,000,000	1,220,000,000	5,350,000,000
2018	46,544,599	168,000,000	18,376,812	85,547,704
2019	54,009,036	190,000,000	588,848	1,665,568
2020	243,000,000	929,000,000	66,637	257,290
2021	1,720,000,000	6,090,000,000	24,842	56,229

Source: Comtrade, 2022

The table 18 displays the export and import data for a certain commodity during a 16 year period. The information is shown as the net weight in kilos and the total trade value in US dollars. At a simple glance at the table 18 reveals that the export and import numbers vary significantly from year to year. For instance, while the opposite is true in certain years, there are some where the export value is significantly more than the import amount. Additionally, some years have very low trade volume, while others see much larger trade volume.

It becomes clear from a closer look that there are some years where the export and import data are especially remarkable. For instance, both export and import values increased significantly in 2012, and export values significantly increased in 2021 along with correspondingly large increases in import values.

Overall, table 18 offers helpful insights on the commodity's trading dynamics, showing trends and patterns that can guide additional research and decision-making. To properly comprehend the underlying elements and implications of these trade figures, additional research and analysis may be necessary. It is crucial to keep in mind that the data offered is only a snapshot of a much bigger and more complex picture.

Following the calculation of average prices, the author was able to get the following table containing prices of export and import per 1 kg, which will be used for the terms of trade calculation.

Table 19, table of prices per kg

Year	Price of Export per kg	Price of Import per kg
2006	0.17 US$	0.22 US$
2007	0.22 US$	0.26 US$
2008	0.24 US$	0.37 US$
2009	0.32 US$	0.29 US$
2010	0.20 US$	0.31 US$
2011	0.29 US$	0.29 US$
2012	0.29 US$	0.34 US$
2013	0.29 US$	0.41 US$
2014	0.28 US$	0.35 US$
2015	0.26 US$	0.26 US$

2016	0.25 US$	0.22 US$
2017	0.27 US$	0.23 US$
2018	0.28 US$	0.21 US$
2019	0.28 US$	0.35 US$
2020	0.26 US$	0.26 US$
2021	0.28 US$	0.44 US$

Source: own processing based on Comtrade

As it can be seen on the previous table, the prices of exports and imports were constantly fluctuating, which is an obvious consequence of fluctuations in the world price of wheat, which is in its turn subject to various circumstances, such as droughts in especially productive regions, international conflicts and trade wars. Then, the author finally focuses on calculating the terms of trade ratio per each consecutive year and the output for the calculation is presented below.

Table 20, terms of trade ratio per each year

Year	Terms of Trade
2006	0.7582
2007	0.8631
2008	0.6561
2009	1.1229
2010	0.6563
2011	0.9882
2012	0.8553
2013	0.7093
2014	0.8043
2015	0.9812
2016	1.1599
2017	1.1987

2018	1.2897
2019	0.8040
2020	1.0099
2021	0.6393

Source: own processing based on Comtrade

Following the analysis, the terms of trade for Indian wheat from 2006 to 2021 are displayed in the table. The ratio of the price of exports to the price of imports is known as the terms of trade. In only 5 of the 16 years examined by the analysis, the terms of trade for Indian wheat were higher than 1. This shows that the nation does not gain much from the export of wheat. In some years, the cost of importing a kilogram of wheat was much more than the cost of exporting a kilogram. The information reveals that imports were low in some years and high in others. The results and discussion chapter will go into the causes of this variation.

The results suggest that the nation needs to investigate ways to enhance its wheat trade terms. Overall, the study offers insightful information about the dynamics of wheat trading in India. These results can be expanded upon by future research to create more thorough trade policies for the nation.

4.7. Linear Regression

Finally, the very last analysis that will be performed by the author is linear regression analysis where the author will be quantifying the effect of individual factors (agrarian, macroeconomic and social ones) on the total amount of wheat produced in India.

The author estimates the following linear regression model:

$$Y_t = ß_0 + ß_1 X_{1t} + ß_2 X_{2t} + ß_3 X_{3t} + ß_4 X_{4t} + ß_5 X_{5t} + ß_6 X_{6t} + \varepsilon_i$$

With the following set of variables:

- Y_t Production of wheat in India, million tons
- X_{1t} Yield of wheat in India, tons per ha

- X_{2t} Harvested area of wheat in India, million ha
- X_{3t} Exchange rate, rupee per USD
- X_{4t} Fertilizer consumption, kilograms per ha
- X_{5t} Terms of Trade, index
- X_{6t} Change in population, million people
- εi Error term

The author uses the following dataset for linear regression estimation:

Table 21, dataset for estimation

Year	Production, Million Tons	Yield, ton per hectare	Area, million hectares	Exchange rate, rupee per USD	Fertilizer consumption, kilograms per hectare of arable land	Terms of Trade	Change in population, million people
	y1	*x1t*	*x2t*	*x3t*	*x4t*	*x5t*	*x6t*
2006	69.354	2.619	26.484	45.307	136.404	0.758	12.000
2007	75.807	2.708	27.995	41.349	142.835	0.863	17.723
2008	78.570	2.802	28.039	43.505	153.349	0.656	17.460
2009	80.679	2.907	27.752	48.405	167.457	1.123	17.056
2010	80.804	2.840	28.457	45.726	179.036	0.656	16.555
2011	86.874	2.989	29.069	46.670	180.748	0.988	16.007
2012	94.880	3.178	29.860	53.437	163.122	0.855	15.492
2013	93.510	3.154	29.650	58.598	156.496	0.709	15.062
2014	95.850	3.146	30.470	61.030	163.498	0.804	14.759
2015	86.530	2.750	31.470	64.152	171.038	0.981	14.552
2016	92.290	3.034	30.420	67.195	166.003	1.160	14.365
2017	98.510	3.200	30.785	65.122	170.569	1.199	14.160
2018	99.870	3.368	29.651	68.389	176.071	1.290	13.966
2019	103.596	3.533	29.319	70.420	186.457	0.804	13.775
2020	107.590	3.431	31.357	74.100	209.408	1.010	13.587

Source: FAOSTAT, 2022 and World Bank, 2022

The dataset consists of 15 observations – from 2006 to 2020. The author uses Gretl to estimate parameters of exogeneous variables.

First, the author checks if there is a multicollinearity problem in the dataset (any $|r| > 0.8$ in independent variables). The following table contains the correlation matrix for the dataset.

Table 22, correlation matrix

```
Correlation Coefficients, using the observations 2006 - 2020
5% critical value (two-tailed) = 0.5140 for n = 15

   Yieldtonperha   Areamillionha Exhangeraterup~ Fertilizercons~
          1.0000          0.5573          0.7848          0.6896 Yieldtonperha
                          1.0000          0.7984          0.5977 Areamillionha
                                          1.0000          0.6355 Exhangeraterup~
                                                          1.0000 Fertilizercons~

    TermsofTrade Changeinpopula~
          0.3224         -0.3738 Yieldtonperha
          0.4032         -0.2884 Areamillionha
          0.4972         -0.6313 Exhangeraterup~
          0.3267         -0.1868 Fertilizercons~
          1.0000         -0.2300 TermsofTrade
                          1.0000 Changeinpopula~
```

Source: own processing based on The World Bank and FAO

There is no single correlation coefficient, whose absolute value would be greater than 0.8, so it is concluded that there is no multicollinearity occurring in the dataset.

Now, the author estimates the parameters of the model using the ordinary least squares. The output is presented below:

Table 23, parameters of variables

```
Model 1: OLS, using observations 2006-2020 (T = 15)
Dependent variable: Productionmillionton

                     coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------
  const              -82.9282      3.36716     -24.63     7.89e-09 ***
  Yieldtonperha       29.6365      0.720586     41.13     1.34e-10 ***
  Areamillionha        2.89972     0.144779     20.03     4.03e-08 ***
  Exhangeraterupee~   -0.0195819   0.0321571    -0.6089   0.5595
  Fertilizerconsum~    0.00364290  0.00850531    0.4283   0.6797
  TermsofTrade         0.0491847   0.592574      0.08300  0.9359
  Changeinpopulati~   -0.157903    0.102351     -1.543    0.1615

Mean dependent var   89.64762   S.D. dependent var   10.98513
Sum squared resid    1.142332   S.E. of regression   0.377878
R-squared            0.999324   Adjusted R-squared   0.998817
F(6, 8)              1970.566   P-value(F)           3.13e-12
Log-likelihood      -1.971737   Akaike criterion     17.94347
Schwarz criterion    22.89983   Hannan-Quinn         17.89068
rho                 -0.145289   Durbin-Watson        1.739407

Excluding the constant, p-value was highest for variable 6 (TermsofTrade)
```

Source: own processing based on The World Bank and FAO

Based on the output, the following model is estimated:

$$Y_t = -82.9 + 29.6X_{1t} + 2.89X_{2t} - 0.019X_{3t} + 0.003X_{4t} + 0.049X_{5t} - 0.15X_{6t} + \varepsilon_i$$

According to the estimated model, it can be concluded that:

- When yield in India increases by 1 ton/ha, the volume of wheat produced in India increases by 29.63 million tons.
- When harvested area in India increases by 1 million ha, the volume of wheat produced in India increases by 2.89 million tons.
- When exchange rate in India increases by 1 rupee per USD, the volume of wheat produced in India decreases by 0.019 million tons.
- When fertilizers consumption in India increases by 1 kg per hectare or 0.001 tons on average, the volume of wheat produced in India increases by 0.003 million tons.
- When terms of trade ratio increase by 1, the volume of wheat produced in India increases by 0.04 million tons.

- When change in population increases by 1 million people, the volume of wheat produced in India decreases by 0.15 million tons.

According to Durbin-Watson criterion, it is expected that there will be no issue of autocorrelation in this model, whilst for Akaike and Hannan, it is better to get lower values as the model would show a better precision. Now, after estimating parameters, the author continues to the verification of the model estimated starting with the statistical verification.

R square or coefficient of determination for the model estimated is equal to 0.99 and the adjusted R square is also equal to 0.99, meaning that 99% of variation in the wheat production is explained by the variation in independent variables. This is a very good result meaning that the model is pretty accurate.

Now, it is essential to test the significance of the model by doing F-test at the significance level of 5%. The testing procedure is presented in the table below:

Table 24, F-test

H_o: $ß_1 = ß_2 = ß_3 = ß_4 = ß_5 = ß_6 = 0$ (Model is not significant) H_a: One $ß \neq 0$ (Model is significant)
P = 0.001 0.001 < 0.05 => Ho is rejected. The model is significant.

Source: own processing based on The World Bank and FAO

After conducting F-test, the author will check which parameters are significant and which are not. The following table presents the testing procedure for each parameter.

Table 25, t-tests

H_o: $ß_1 = 0$ (parameter is not significant) H_a: $ß_1 \neq 0$ (parameter is significant)	H_o: $ß_2 = 0$ (parameter is not significant) H_a: $ß_2 \neq 0$ (parameter is significant)	H_o: $ß_3 = 0$ (parameter is not significant) H_a: $ß_3 \neq 0$ (parameter is significant)	H_o: $ß_4 = 0$ (parameter is not significant) H_a: $ß_4 \neq 0$ (parameter is significant)	H_o: $ß_5 = 0$ (parameter is not significant) H_a: $ß_5 \neq 0$ (parameter is significant)	H_o: $ß_6 = 0$ (parameter is not significant) H_a: $ß_6 \neq 0$ (parameter is significant)
P = 0.001 0.001 < 0.05 => Yield is significant	P = 0.001 0.001 < 0.05 => Area is significant	P = 0.55 0.55 > 0.05 => Exchange rate is not significant	P = 0.67 0.42 > 0.05 => Fertilizer is not significant	P = 0.93 0.93 > 0.05 => Terms of trade is not significant	P = 0.16 0.16 > 0.05 => Change in population is not significant

Source: own processing based on The World Bank and FAO

Effectively, there are just variables that significantly contribute to the wheat production in India: Yield in ton/ha and Area in million hectares. After quantifying the effect, it is essential to understand which factor contributes the most to the production of wheat in India. This will be determined by calculating elasticities for the year 2019, the last one from the pre-pandemic period. The calculation is performed according to the following formula mentioned in the methodology of the work.

Elasticities for 2019 are presented in the table below:

Table 26, elasticities for 2019

Elasticity		
Yield	1.011	*2019*
Area	6.670	

Source: own processing based on The World Bank and FAO

The author estimates elasticities for just 2 parameters based on the significance test performed earlier. The interpretation is presented below:

- When yield changes by 1%, it triggers 1.01% change in the wheat production in India.
- When area changes by 1%, it triggers 6.66% change in the wheat production in India.

It is visible after the analysis that the significance that area has on the wheat production in India is quite high.

5. Results and Discussion

5.1. Key Factors

It is important to begin the findings and discussion by stating that the author was only able to discover two parameters that substantially contribute to the growth of wheat output in India, and those factors are area and yield. It was determined that the area is significantly more essential than the yield when it comes to these two variables since a 1% change in the area causes a 6.66% rise in the total wheat output in the nation. This is a totally reasonable position to take; nevertheless, it turned out that the highest proportion of change in the country's output was due to a change in yield rather than an increase in area. This is an important distinction to make.

In conclusion, over the period of time that was chosen for the logarithmic dissolution of factors study (which was five years), the total harvested area grew only once, and that was in the year 2020. According to the author's assumptions, the overpopulation problem is the primary reason why India does not place as much of an emphasis on increasing the harvested area. India is already well on its way to becoming the most populous country in the world, and in some regions, especially the ones where wheat production is concentrated – the Northern part of the country – there is an obvious problem of overpopulation that puts an additional constraint on the wheat production – the same conclusion was obtained by a group of authors with Singh (2019), as well as by Garg (2020), Uniyal (2020) and Dutta (2019). The issue of overpopulation is likely to worsen, which means that India may be forced to deal with a significant challenge regarding the production of wheat. This is due to the fact that increasing yield by a significant number per each, and every year will require a certain level of technological advancement or an improvement in the quality of fertilizers.

Without a question, this is a distinct possibility; nevertheless, at some point in the future, the nation will hit its limit, and it will become necessary to expand the amount of land used for wheat production in order to maintain or achieve the same level of overall output, which is also highlighted by Viswanathan (2020). However, given how difficult it already is to do so, it is reasonable to assume that if the country does not find a way to reverse the trend of overpopulation and the effect it has had on the harvested area that is being used, the country

is likely to face a serious shortage. This is due to the fact that the domestic production will simply stop being sufficient to satisfy the rates of domestic consumption, which would result in an increased demand for imports despite unfavorable conditions of trade, as the country would be forced to.

5.2. Self-Sufficiency and Population Growth

The current scenario in India about the country's ability to produce its own wheat is another intriguing and important factor that should be mentioned in the context of this examination. The author of the study came to the conclusion that during the course of the investigated time period of ten years (from 2011 to 2020), the nation achieved self-sufficiency in every single year other than 2016 and 2017. However, the value of the index is rather slightly over 1, which has led the author to believe that the nation is functioning on the brink of both self-sufficiency and scarcity. This is primarily justified by the fact that the country is facing a huge increment in population each and every year; however, at the same time, the country is able to find a remedy for the growing rates of consumption by increasing wheat production for each and every year. This is a win-win situation. It is quite possible and even likely that the quantity of wheat in the country will cease to be sufficient and satisfy the ever-growing domestic population of India once there is a supply shock or an unexpected drop in production caused by unfavorable weather conditions. This is due to the fact that the quantity of wheat is just a little bit higher than the domestic consumption. Similar findings are made by Ramadas (2019) and Zaveri (2019) with the second author focusing specifically on the role of climate change.

However, it is quite interesting to note that according to one author who published his research in 1997, India was not a self-sufficient country when it came to main agrarian commodities; however, the country was extremely focused on becoming a self-sufficient country. This is a fact that deserves to be taken into consideration (Vijnana, 1997). The author of this diploma thesis adds to the findings of Vijnana's research by coming to the conclusion that, while it is true that the country was able to overcome technological problems with the production of main agrarian commodities in the 1990s and became self-sufficient in some of them (based on the outcome of the self-sufficiency analysis), the country is on the verge of returning to the situation in which the domestic production will not be able to catch up with the population growth and will therefore see it become Because the function

representing population increase is exponential in character, it is very probable that the second scenario will be playing out in India. This is due to the exponential nature of the population growth function. At the same time, Singh (2019) suggests that the country's main objective is focused on another type of commodity – pulses, so the main priority of the agrarian policy is to stabilize the situation with that group of commodities, which is also specified by Abraham (2021), who considers the situation to be critical.

After everything is said and done, it ultimately comes to the issue of whether or not our current population levels are sustainable. It is possible that India will be able to increase its potential, but this will lead to an intensification of factor use and the potential for damage to the environment. Therefore, even though it is possible that India will be able to catch up with the growth in population, this will invariably cause damage to the environment.

5.3. Impact of Terms of Trade

Then, it is wise to take a look at the alternatives that India has to the domestic production and satisfying domestic demand in a different way. Evidently, the most obvious solution in that case would be importing wheat from elsewhere thus diversifying the strategy of the country. Nevertheless, as it turned out, the country does not really have a good position in terms of international wheat trade as the terms of trade ratio was lower than one in most periods. However, the terms of trade started to improve in 2016 and in 3 consecutive years, the index was above 1 for the country that resulted in the increase of import – almost 2 million tons imported in 2016 compared to just 511 916 in 2015. Yet, when understanding the situation in the context, is also essential to highlight that in 2016, the amount of wheat was not sufficient in the country as the self-sufficiency ratio was below 1, so the need for importing was quite evident, as other authors agree with the author of the thesis in that regard (Ramadas, 2019). Nevertheless, it is still visible that the country is willing to import wheat and satisfy a portion of domestic consumption by imports but only in years when the country's terms of trade are beneficial. Nevertheless, the situation started deteriorating in 2019 and the country's terms of trade fluctuate, thus returning a ratio above 1 in some years and below 1 in other years after relatively successful period of time.

Of course, it is essential to understand that the country's desire to import depends on two main factors – the first one is the exchange rate and the second one is the price set by

trading partners. When it comes to the first aspect, it might be rather expensive to import millions of tons of wheat when the domestic currency is gradually depreciating, which rupee does compared to the US dollar. All in all, the problem of the country importing wheat is related to the increase in price and depreciation of the domestic currency but it is at that point possible to say that in the nearest future, it is unlikely that India will be able to avoid importing wheat from other countries because the population growth might not offer any chance to wheat production to catch up with its growth rate. Mottaleb and Bhoi, both publishing their articules in 2019 suggests that the situation with wheat production becomes even more complicated considering unfavorable situation with the trade of this commodity for India.

5.4. Recommendations

Following the completion of her investigation and the interpretation of its findings, the author would now like to provide a number of suggestions for more study to be carried out in the relevant field. To begin, it would be prudent to investigate the patterns and tendencies that are present in other products. For example, maize and rice are two of the most essential commodities for the Indian domestic population, therefore it would be beneficial to investigate these patterns and tendencies. As a consequence of this, the data may be compared in order to conduct an analysis of the agricultural situation in India as a whole and not only in a single specific sector, such as the production of wheat.

Then, it would be prudent to carry out the same research once again in ten years' time to determine how the wheat output in India evolved during the 20s. In addition to all of that, it is also recommended to carry out an analysis that will reflect the micro situation with wheat production, particularly with farms and farmers. One example of this type of analysis is a break-even point analysis, which can further determine whether or not farmers and farms are dependent on government subsidies for producing wheat. In the event that farmers are, in fact, dependent on government subsidies and are not independent, this would indicate that agriculture in general accounts for a significant portion of the federal budget, and it is quite possible that this expense will rise as a result of the consistently rising population at somewhat unbelievable rates of 17-20 millions of people per year. If the government is unable to bring everything into appropriate equilibrium, all of this may result in a rise in the budget deficit and cause the inflation rate in India to spike.

6. Conclusion

One of the most fundamental goals of the author's analysis was to answer the series of five research questions specified by her in the goals and objectives section of the diploma thesis. The first question was whether the country is self-sufficient in wheat with the answer that for the overwhelming majority of years on the selected time interval, the country is in fact sufficient having the figures slightly above 1. Contrary to that, the situation with the terms of trade, which was the author's interest for the second question is not so favorable as the price of export is lower than the price of import for the majority of periods. For the question about the most important factors influencing the country's production of wheat, it is wise to suggest that area and yield remain the most influential factors influencing the country's annual production of the selected commodity. Also, when considering the fourth question of whether the country's wheat production growth rate catches up with the quick growth of population, the answer is yes as the average growth rate for wheat production is slightly lower than for the population growth. For the fifth question about quantitative effect of selected factors, the author mentions just two that have a significant impact on the wheat production quantity: when yield in India increases by 1 ton/ha, the volume of wheat produced in India increases by 29.63 million tons and when harvested area in India increases by 1 million ha, the volume of wheat produced in India increases by 2.89 million tons.

Ultimately, to conclude it all, the author is able to highlight the most important findings of the practical part: the country is self-sufficient in India but the tendency is likely to change under the heavy burden of unbelievably high population growth rate; the country does not really have a good position in the international trade of wheat as the terms of trade index is primarily lower than 1; the most important factors influencing the production of wheat in India are area that accounts for over 6.66% increase in the total amount of wheat produced caused by 1% increase in million hectares and yield that accounts for over 1.01% increase in the total amount of wheat produced caused by 1% increase in ton/ha; the country was focused more on increasing its yield rather than area, which is primarily caused by the overpopulation problem and inability to increase the arable land area.

In addition to that, the author concludes that the country is likely to expect serious problems when the potential of the factors of production will be reached, since there will be no way to comply with the population growth using domestic production, so additional import from other countries will not be performed just when the terms of trade are favorable, but it will have to be done every single year thus putting an additional burden on the domestic budget.

7. References

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