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Bachelor Thesis

Evaluation of Wheat Commodity

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BACHELOR THESIS ASSIGNMENT

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Thesis title

Evaluation of wheat commodity

Objectives of thesis

The key objective is to examine the different factors leading to the identification and enhancement of wheat expenses, an integral part of the industry growth information, thus evaluating various major factors that influence wheat production and pricing. This analysis suggests that a range of factor policies take into account is traditional commodity costs, temperature and other unique influxes on the production of grain. Study in the international wheat industry is the main objective. A definition and study in particular of the export and import dimensions of international trading in wheat. The target is the overall impact for wheat-producing nations of the selected variables on regression calculations.

Methodology

The thesis is grouped into two areas. The principal component is theoretical, and the second component is the applied part of the first. The time-series investigation likewise covers the wheat-producing nations export figure. Critical figures and other significant highlights are gathered from the utilization of econometrics.

The linear regression is utilized to demonstrate associations between factors by applying a straight equation to the data investigated, which permits a more inside and out examination of the variables that influence wheat production.

The proposed extent of the thesis

40

Keywords

Wheat, consumption, production, export, analysis, price, yield,

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Recommended information sources

Benli, B., 2016. Yield Gap Analysis of Wheat Production in Central Asia.

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Declaration

I declare that I have worked on my bachelor thesis titled "Evaluation of Wheat Commodity" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 23.03.2020 _____

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Evaluation of Wheat Commodity

Abstract

The research is split into two major sections, theoretical and functional. The first component explains the usage of wheat. This also defines the wheat industry in terms of foreign exchange. The growth of foreign trade in wheat and its influence on world wheat exports have been researched.

The second portion is analytically focused, for which a linear regression study was carried out employing the regular least square approach to evaluate the reliance of wheat exports on chosen macro-economic indicators.

The export of wheat has been influenced by shifts in the variables selected. This implies that the model included important factors, both statistically and commercially. Estimated model studies have a major effect on the production of wheat. This indicates that exports are primarily influenced by shifts in demand, quality and export marketing. It highlights the value of export assistance programs.

On the basis of this research, the outlook for the production of wheat for the coming years is extracted. This forecasts that the production of wheat will grow in the years to come. Exports are expected to be 35 thousand metric tons in 2020. That would be the largest quantity exported since 2010. However, if the prediction is retained, China is projected to hold its role as the world's leading wheat exporter.

Keywords: wheat, consumption, production, export, analysis, price, yield.

Zhodnocení komodity Pšenice

Abstrakt

Výzkum je rozdělen do dvou hlavních částí, teoretické a funkční. První část vysvětluje použití pšenice. To také definuje pšeničný průmysl z pohledu devizového trhu. Byl zkoumán růst zahraničního obchodu s pšenicí a její vliv na světový vývoz. Druhá část je analyticky zaměřena, pro kterou byla provedena lineární regresní studie s využitím pravidelného přístupu s nejmenším dopadem pro vyhodnocení závislosti vývozu pšenice na vybraných makroekonomických ukazatelích.

Vývoz pšenice byl ovlivněn změnami vybraných kategoriích. To znamená, že model obsahoval důležité statistické a komerční faktory. Odhadované modelové studie mají hlavní vliv na produkci pšenice. Ukazuje se, že vývoz je primárně ovlivňován změnami poptávky, kvality a exportního marketingu. Zároveň to zdůrazňuje hodnotu programů pomoci s vývozem.

Na základě tohoto výzkumu je vytěžen výhled na produkci pšenice pro nadcházející roky. To předpovídá, že produkce pšenice poroste v následujících letech. Očekává se, že v roce 2020 bude vývoz činit 35 000 metrických tun. To by bylo největší množství vyvezené od roku 2010. Pokud bude predikce přesná, můžeme předpokládat, že si Čína zachová světové prvenství světového vývozce pšenice

Klíčová slova: pšenice, spotřeba, produkce, vývoz, analýza, cena, výtěžek.

Table of content

List of tables

List of abbreviations

CAGR- Compound Annual Growth Rate

ARIMA- Autoregressive integrated moving average (model)

BIC- Bayesian information criterion

RSME- Root mean square error

USDA- United States department of agriculture

GIS- Geographic information system

CV- Coefficient of variation

DLM- Dynamic Learning Maps

MAPE- Mean Absolute Portion Error

1 Introduction

Where acreage and tradable quality are involved and as an essential element of family diets, wheat is a significant world asset. A few variables influence the costs of wheat, for example, conditions, oil costs, costs slacked and imports. Such exchange powers affect world markets and, at last, on sanitation notwithstanding the developing overall necessity for wheat gradually and routinely (Asseng *et al.* 2015). A methodical audit of the writing with respect to the basics of the wheat business and pattern investigation care is done utilizing a restricted assortment of information to key wheat-producing regions to dissect how these elements impact wheat advertises in an unexpected way. Past examinations have indicated that, among different causes, trades, environmental change, oil costs and past qualities have a generous association with shifts in world wheat costs (Daryanto *et al.* 2016). For the term from 1998 to 2018, this investigation incorporates and differentiates similar principle factors in worldwide wheat sends out.

Wheat is the world's most generally rising crop. As a result of the decent variety in culinary applications, wheat has gotten a most loved decision. Wheat is one of the world's most broadly delivered and devoured grains. It is developed on more ground than some other rural agribusiness and gives off an impression of being the essential wellspring of grain food (Torriani *et al.* 2015). Among maize and wheat, the overall generation of wheat positions third in weight. The way that wheat can be developed in numerous zones, where the climate, stature or soil is heterogeneous, is most likely the explanation. It is fundamentally developed in territories with temperatures from 30 to 32 degree Celsius, in the scopes of 30 degrees N to 60 degrees N and in the scopes of 40 km. Wheat is adjusted from new and ocean side dampness to a wide scope of dampness (Shavrukov *et al.* 2017). While about three-fourths of the land secured by wheat is developed by normal yearly precipitation of 380 to 890 mm, it is workable for wheat to be developed in a more extensive scope of regions differing from 275 to 1800 mm. The yield of wheat involves more than 250 million hectares worldwide and the global absolute trade is higher than the consolidated measure of every other harvest (Crimp *et al.* 2016)

Wheat is a perfect yield in light of the agronomic flexibility of the wheat plant, quick grain protection, and the straightforwardness with which grain is prepared into flour for staple nourishment things. The eating regimen of individuals from numerous nations, including Australia, the greater part of Europe, North Asia and North Africa, depends on wheat. During the 1960s, wheat production gradually expanded, joined by a specialized change that in the long run called the green revolution, generally due to the better returns per hector (Masuda, 2016). During the green revolution, rustproof semi dwarf wheat could be developed and would utilize an extraordinary amount of nitrogen compost and would develop more. The complete world touching area for wheat has declined by 0.24% since 1998 and 2018, yet the arrival rose by 1.41%.

While very nearly one-fifth of the world's yearly creation is sent out, the larger part wheat is eaten within the country wherein it is developed. World wheat trade in 2018, the principle buy by producing nations was esteemed at 150 MTT. Regardless of the expansion in wheat creation over the most recent couple of decades, 65% of the world's wheat advertise has remained devoured by producing nations.

Two main considerations affecting wheat production are the ground and oil costs. Oil costs impact the expenses of the generation of wheat items, with a high relationship between the two proposing comparable examples of wheat and oil value instability (Maier *et al.* 2017). Atmosphere changes can have an assortment of impacts on nourishment creation, since significant generation districts ' claims will move with respect to the expanding regular period, as can modifications in normal temperatures and precipitation. A few universal innovative work bodies have made environmental change a key spotlight on horticulture and sanitation and have made more approach on how one of the essential nourishment staples can be influenced by endeavors to build the resilience of the nourishment framework. The probability of movements in precipitation patterns affecting world generation of wheat is explicitly identified with this examination (Benli, 2016).

Due to a great extent to the reasons talked about beforehand, varieties and patterns in wheat cost as of late have moved contrasted with earlier decades. Since world wheat costs have raised, inputs are getting all the more exorbitant, and in

this manner, costs have likewise expanded in nourishments which are generally made with input wheat. Wheat-based nourishments are a significant piece of household eats fewer crabs in many producing nations, with the goal that adjustments in wheat costs have noteworthy ramifications for nourishment expenses and sanitation (Hernandez-Ochoa *et al.* 2018).

Seeing how the world wheat advertises is influenced by various elements is basic due to its significance to an enormous piece of the worldwide populace as respects sanitation. Consequently, during a time of strengthened atmosphere concern, the article begins with a wide outline of worldwide nourishment security issues, and afterwards continuously decreases to the audit of key market factors for one specific division that is critical to worldwide sanitation (Franch *et al.* 2015). With wheat particularly powerless against environmental change impacts, it is essential to research the scope, especially in key improvement districts, of interest and supply factors influencing the worldwide wheat advertise.

This diploma thesis talks about key components driving interest and improvement to evaluate the overall significance of people so as to comprehend the errors between primary partners in the worldwide wheat industry. There is likewise related writing on the world market for grain, including oil costs, past rates, generation examples, yields and precipitation. The revelation of the key market is a specific core interest.

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2 Objectives and Methodology

2.1 Objectives

While a range of key factors impacting the output and pricing of wheat are being assessed, the key objective is to investigate the different factors that contribute to the identification and enhancement of wheat prices, an essential part of the market growth data. This analysis indicates that historical commodity prices, temperature and other particular influxes on the supply for wheat are a variety of considerations that policymakers will take into account. The main goals are to research the global wheat market. In particular, a description and analysis of the aspects of wheat international trade growth export and import. Examine the relation between wheat exporters and selected 1998-2018 macroeconomic indicators using both numerical and econometric processes. The goal is to determine the overall effect of the chosen variables on the regression analyzes on wheat-producing countries.

2.1.1 Hypothesis

1. A rise in Wheat would lead to an increase in the other commodity production.

2. Price increases do not affect the quantity of wheat for export.

3. Wheat exports will increase if the climate is stable.

4. Wheat exports often decline when the measure of currencies declines.

2.2 Methodology

In order to examine the subject in depth, the study will be separated between theory and practice. The thesis approach will, however, first provide a description of and use of wheat literature and philosophy. For this purpose, secondary data has been used from articles, transcripts, official documents, reports, interviews, quantitative newsletters, and other related materials.

Information are then gathered and analyzed about the wheat growing nations. The sales of wheat and selected indicators are shown graphically in graphs and tables throughout the period 1998-2018. The operational element is first and foremost concerned with changes of the chosen variables.

Two sections, theoretical and practical, are included in the dissertation. The conceptual portion focuses on recognizing the worldwide trend in wheat production and the commercial partnership between the countries. Tariffs on goods sold to the EU and other nations are also levied. Countries' partnership, investment strategies and exchange and tariff barriers are also taken into account.

The pragmatic chapter gives an overview of the world market for wheat. The increase in wheat exports in the last twenty years. The world's largest importers were wheat produced. The emphasis is on how wheat exporting countries have improved their wheat exports amount and price around the world. It also explores the evolution of a potential market across the globe as the food habits of people change.

The annual growth rate for the wheat output and cultivation in the world is estimated during the study. The compound growth rate is calculated. The formal used by Compound annual growth rate (CAGR) is Y= abt. 'a' is static, 'b' is the regression coefficient and 't' is the time parameter. To overcome the above Log solution, the equation to log Y= log an+ t log b is taken from both sides. The rate of CAGR was based on the equation CAGR= (anti-log b-1) x 100.

For the chosen duration, the international unit price is measured, and the retail price is equivalent. In order to predict importation and usage of wheat in future, the period pattern study was carried out.

The purpose of the analysis was to examine stochastic forecasts for wheat production worldwide, which required the use of various forecasting techniques. Created by Box and Jenkins, the ARIMA system was widely used to define the trend and predict future time series values. In AR (p), where p is finite and bound by the same integer the stationary time series. The "Univariate Box-Jenkins technique" is classified as ARIMA (p, d, q).

The ARIMA Stochastic Time Series models have been used widely for time series results with parsimonious, static, invertible, substantially approximate coefficients and statistically distinct residues typically circulated. If a sequence is

unstationary, it can often be static, i.e. by creating a new time series with successive variations ($Y_t - Y_{t-1}$). If you do not convert the first differences to a stationary form, you can create first differences. This is also the distinction of the second order. The second-order variations were described ($Y_t - Y_{t-2}$).

A number of researchers have used the Box-Jenkins approach to predict future usage and production requirements in order to take appropriate steps.

Stationarity Test

The stationarity criterion ensures that a mean, variability and ACF measurements can be produced from a test.

A variation in the mean and variability over time was checked for the stationarity of one sequence.

Potential ACF levels that should be quickly removed to zero

T-test has checked the importance of autocorrelation.

The standard error of autocorrelation was calculated as under

$$t_{r_k} = \frac{r_k - \rho_k}{S(r_k)} \; ; \; where \; S(r_k) = (1+2\sum_{j=1}^{k-1} r_j^2)^{1/2} n^{-1/2}, \; and \; k = 1, 2, 3, \ldots$$

The most common approach is to examine stationery series by graph or time.

For converting non-stop information into regular data, the Box-Ljung Q statistics are used to confirm residual property. A variety of performance metrics such as R2, Stationary R2, Root Mean Square Error (RMSE), Mean Absolute Portion Error (MAPE) or BIC are used to determine the suitability of AR, MAs and ARIMA systems. The statistics on reliability are.

RMSE, MAPE, BIC and Q statistics were computed as below:

$$RMSE = \left[\frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2\right]^{1/2} \; ; \; MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{(Y_i - \hat{Y}_i)}{Y_i}\right| \; and$$

$$BIC(p,q) = ln \; v^*(p,q) + (p+q)\left[\frac{ln(n)}{n}\right]$$

Here p and q are the order of AR and MA methods sequentially and n is the number of measurements in the time series, v* is an assessment of white noise variance σ^2.

$$Q = \frac{n(n+2)\sum_{i=1}^{k} rk^2}{(n-k)}$$

Where n is the residual number, and where *rk* is the residual autocorrelation at log k. In this analysis, a sufficiently large dataset was therefore used to define, approximate, diagnostic test and forecast four measures, including a sufficiently large number of details. Model parameters for the ARIMA models have been estimated.

Autoregressive process of order (p) is,

$$Y_t = \mu + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + \epsilon_t;$$

Moving Average process of order (q) is,

$$Y_t = \mu - \theta_1 \epsilon_{t-1} - \theta_2 \epsilon_{t-2} - \ldots - \theta_q \epsilon_{t-q} + \epsilon_t;$$

The general form of ARIMA model of order (p, d, q) is

$$Y_t = \mu_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + \mu - \theta_1 \epsilon_{t-1} - \theta_2 \epsilon_{t-2} - \ldots - \theta_q \epsilon_{t-q} + \epsilon_t$$

3 Literature Review

This part portrays and assesses the hypothetical foundation and utilization of wheat concentrated on the United States. It likewise remembers remote business wheat and subtleties for the world's driving verifiable and current wheat producers, exporters and merchants. Auxiliary records, essentially posts, books, official archives, studies and factual pamphlets, have been utilized for investigation. This will go about as a structure for the audit of the monetary hypothesis and the investigation of the financial model. The yearly developing territory of wheat, proportional to Greenland, stretches out from Scandinavia to South American and crosswise over Asia, is more typical than some other staple nourishment crop. The yield is 215 million hectares. Consistently around the planet, around 50 billion dollars of wheat is sold (Asseng *et al.* 2015).

In eight nations, wheat is eaten most importantly by 2.5 billion individuals. In low and medium-salary countries, maize or rice is defeated as a protein source and rice is second just to corn as a calorie source. Wheat is the most prevalent nourishment of all calories expended in North Africa, West and Central Asia. The expansion on the planet's wheat admission is guided by urbanization, expanding wages and working ladies. Models expect 60% more wheat than it is today by 2050 by shoppers. This need must be settled by opening new land and utilizing nourishment, vitality and assets proficiently (Daryanto *et al.* 2016).

Wheat is one of the most significant plants in Southwest Asia and in south-east Turkey. Wheat attributes Wheat is a typical name that applies to grass Tritium and oat grains, which incorporate a considerable number developed and reproducing species. Wheat was the primary tamed nourishment crop and has been major fundamental nourishment on the planet for a large number of years. Egyptians were developed and consumed in stoves around 5,000 years prior. Wheat was the main tamed nourishment crop. It has been improved by reproducing by ranchers consistently. Wheat was first developed as a recreational harvest in the United States toward the finish of the eighteenth century. The wheat is currently developed in almost 120 nations around the world (Ladha *et al.* 2016).

In every single calm atmosphere around the world, wheat can be developed. The planting of wheat depends on the climate, temperature and soil. Dry regions

where the nature of the dirt is poor are the most appropriate. Whereas wheat contains a few basic minerals and nutrients, it is nourishment for many individuals. The worldwide exchange of wheat is higher than in every single other yields. All nourishment and non-nourishment use have the local and national significance of wheat. Wheat flour is utilized to create baked goods, noodles and baked goods in the nourishment business. It is additionally a fundamental creature feed. The seed and crude material for mechanical creation, gas, tobacco, and starch can likewise be utilized with wheat. In the oil and restorative businesses, the item still has an impact (Torriani *et al.* 2015).

3.1 Top nations that produce wheat

Wheat has a staple of numerous weight control plans far and wide and is one of the most significant plants for mankind. FAOSTAT gauges that drove by India, Russia, the United States, China creates more wheat than some other area. Here is a rundown of the best ten nations on the planet that develop wheat.

As the world's leading wheat producer, China has a significant impact on building up a focused grain showcase around the globe. China creates around 126 million tons of wheat yearly more than 24 million hectares (practically identical to the size of Algeria all in all). Wheat goes about as one of the Chinese populace's staple nourishments, contributing 40% of the nation's grain admission. The Yellow River and Huai River Valleys, in China, are developed broadly and the harvest is turned with maize. Meanwhile, rice is all the more by and large reused in and around the Yangtze River Valley (Zhuo *et al.* 2016).

Wheat is India's second-biggest planted harvest of nourishment (after rice). This nourishment is especially significant in the north and north-west of the nation, for instance near the Pakistani outskirts. The world records for about 8.7 per cent of wheat generation and the developing of this product is consumed on 13 per cent of all developed land in India. The coming of the Green Revolution in India has to lead to an enormous ascent in wheat generation, with local wheat creation multiplying somewhere in the range of 1960 and 1970 in the range of that decade. The top wheat delivering nations on the planet are Uttar Pradesh, Punjab, Haryana and Madhya Pradesh.

Russia is the world's third-biggest maker of wheat. The two years from 2006 to 2011, Russia was one of the world's main five wheat trading nations. Winter wheat is the nation's fundamental wheat type. In the western piece of Russia close to Moscow, the plants are for the most part developed. The seed is developed from August to October and gathered from July to August of the year that pursues (Fantin *et al.* 2017).

The biggest US grain crop, wheat, is developed in the whole nation. In the US, which positions fourth on the planet in the measure of wheat developed, somewhere in the range of 47 million tons of wheat are delivered and are frequently positioned the third position between the United States and Russia as of late. As per the USDA order, the nation produces eight wheat assortments. Hard-red winter wheat, hard red spring wheat, delicate white wheat and hard-white wheat, in addition to other things, are the most widely recognized of these. In the USA 70-80 per cent of winter wheat is as Winter Wheat. As indicated by USDA measurements from handling, in 2014 the top wheat ranchers in the country were North Dakota, Kansas and Montana. The fare of half of the nation's wheat is 8.9 billion dollars for each annum.

The greatest maker of wheat in Europe is France with its harvest developed all through the nation. In the northern districts of France, it is basically developed. The French condition of the Center is the nation's driving wheat-delivering zone drove by Picardie. Winter wheat is the essential wheat assortment developed in this nation and planted in the fall and gathered the next year in August (Shavrukov *et al.* 2017).

3.2 Variables that impact the production of wheat

Two key variables forming the creation of wheat are temperature and oil costs. The nature of the contributions for wheat generation depends on oil costs, and a high relationship between the two is obvious in comparable examples in the fluctuation of the cost of wheat and oil. Atmosphere changes can affect nourishment creation, as the climate of the significant generation regions can alter in connection to the term of the developing season just as modifications in normal temperatures and precipitation. Various worldwide science and approach bodies have discovered the effect of environmental change on horticulture and

nourishment wellbeing a significant center, urging them to research all the more how one of the key staples can be influenced by endeavors to make the nourishment framework progressively vigorous. The likelihood of movements in precipitation patterns affecting worldwide wheat generation is explicitly identified with this examination.

Because of the elements recently examined, vacillations and examples in wheat cost have changed as of late contrasted with before decades. As overall wheat costs rising, imports have gotten progressively costly, and nourishment costs, for the most part created as wheat as info, have likewise risen. Wheat-based nourishment is a major portion of local eating regimens in many creating nations, which infers that changes in wheat costs are significantly affecting the expense of nourishment generation (Maier *et al.* 2017).

Realizing how various components sway the world wheat area is significant because of its nourishment security position for a huge extent of the total populace. The article along these lines begins with an extensive review of the worldwide nourishment security issues in a period of rising atmosphere difficulties and afterwards gradually limits itself in the examination of key market factors for a specific part of worldwide nourishment security premium, wheat.

With the impacts of environmental change getting especially delicate to wheat, the nature of interest and supply factors that affect the worldwide wheat advertise and specifically crosswise over key improvement districts must be analyzed. This paper examines key variables impacting request and improvement so as to distinguish the general significance of every one of the significant players in the worldwide wheat industry. Applicable writing is additionally given concerning factors influencing the worldwide market in wheat, including oil costs, past rates, generation examples, yields and precipitation. Specifically, a diagram of key market determinants in significant stockpile areas and exchanging accomplices that associate with atmosphere issues is focused. Numerous essential wellsprings of information were accumulated and broke down for designs so as to survey the basics of the wheat business (Masuda, 2016).

3.3 The fundamentals of the wheat market

Wheat is planted on more soil than some other harvest and is the fundamental wellspring of grain nourishment for human utilization. World generation of wheat, after maize and rice, positions third in weight. This is most likely the case, as wheat can be developed in numerous spots where the temperature, rise or soils are heterogeneous. Wheat is fit from dry climate and ocean mugginess to an assortment of temperature levels. While around seventy-five per cent of the land where wheat is developed has normal yearly precipitation of 380 to 850 mm, it is conceivable that wheat is developed in a bigger range where precipitation runs somewhere in the range of 275 and 1800 mm. The world's wheat generation involves in excess of 250 million hectares (ha) and is higher than different harvests together with its reality exchange. The agronomic flexibility of the wheat plant, the simplicity of grain maintenance and the office of changing over the grain into flour for the creation of staple nourishment items make wheat a principal nourishment staple. The eating routine of residents from numerous countries, including Australia, the greater part of Africa, Northern Asia and Northern Europe, is centered on the wellspring of starches from wheat (Wang *et al*. 2018).

During the 1960s and gradually later in an adjustment in innovation generally called' Green Revolution' the better returns per ha expanded strongly. With the green unrest, rustproof semi-dwarf wheat developed which could utilize countless nitrogen manure and had a better return. Most of what is eaten in the country where it is developed, while about one-fifth of world creation is sent out. World exchange wheat in 2011, the most noteworthy provided by creating countries, was esteemed at 150 million tons (MMT). Regardless of the expansion in wheat creation in ongoing decades, 65% of the world's exchange streams have still been devoured by creating nations.

3.4 Wheat production History

Antiquated wheat exchanging follows back to the old streets of exchange the Levant, enabling Greeks and Romans to get wheat from the Middle East. Wheat was delivered to China by means of another huge street, the Silk Road. The wheat

exchange was all the more firmly connected to browning in the medieval period. Sharecroppers needed to process their grain on the landowner's factory and the proprietor held one-sixteenth of the gather as a lease. In the late eighteenth century, the plan was stopped. Thereafter, mill operators were permitted to buy wheat based on their personal preference, become outside their very own region (Maier *et al.* 2017).

When workers came to America, they couldn't discover grain, anything extraordinary in Europe to do with it. You needed to import feast from the old landmass until you could develop wheat without anyone else. Sending wheat all around the globe around then was not esteemed rewarding. At the turn of the eighteenth century, the United States started to offer wheat to England. The U.S. at that point sent out record measures of wheat in European nations during Napoleonic Wars and World War II (Zhuo *et al.* 2016).

The universal exchange wheat in the last piece of the twentieth century was changed massively. Areas once focus of wheat generation depended on imports of wheat. First off, Turkey and the early exporters in the Middle East began bringing in a great many huge amounts of wheat consistently to nourish their developing populace. Be that as it may, throughout the years 1950-90.55, worldwide generation of wheat has expanded essentially since 1990. At the point when worldwide challenge expanded, the portion of the market in created nations declined impressively from 45% toward the start of the 1950s to 35% in the late 1990s.

3.5 Price of wheat

The cost of wheat relies upon the connection among organic market in the business sectors. The quality isn't steady and after some time changes. In the examination, the nature of wheat is normally unpredictable. The cost for wheat is the most noteworthy in the range of the year, particularly in March, May, July, September and December. Changes in the cost of fundamental and relevant factors happen in a more extensive comprehension and in a more extended term way.

The fundamental components cause the market equalization to move gradually and after some time. In the rising nations including Brazil, China and India,

always expanding challenge, financial development, urban advancement, and developing nearby dietary patterns are on the whole impacts. The costs of oil frequently assume a job as they sway fabricating input costs just as transportation costs. Presently, the interest for marginally affects the cost of wheat however this perspective can be developed and have significant ramifications for what's to come (Maier *et al.* 2017).

The brief variables affirm value inclines in course, pace and quality. The effect on wheat markets, for example, dry season and flooding, are significant to the extent ecological inconstancy and outrageous occasions are concerned. Costs do vary out of sight of money related markets, especially over the span of emergencies, bringing about the development of theoretical speculators who need to guard themselves against the probability of cost variations. Trade rates likewise have a critical market impact. Countries whose cash is legitimately associated with the US dollar have the most affected impact. The fare boycott actualized by the sending out nations is likewise impacted by wheat rates as well as a raise to trade tax. Both advances are intended to shield household markets from momentary vacillations or nourishment deficiencies. By the by, the merchants are harmed. Such activities would diminish household ranchers ' push to build creativity in the medium term.

Value vacillations have a wide scope of impacts. Creating nations, especially on the off chance that they are reliant on nourishment help, are the most in danger of negative effects. For the time being, it might prompt expanded hardship and introduction to potential outside stuns. The ascent all through nourishment costs may prompt fierce urban fights. In any case, provincial networks can likewise frequently get an opportunity to escape neediness. For nourishment retailers, significant expenses are increasingly gainful (Zhuo *et al.* 2016).

3.6 Exporters of Wheat

In 2016, global shipments of wheat contributed to US$ 36.3 billion. As of 2017, the top five exporters are classified as the Russian Federation (36.000 ton), the European Union (26.000 tons), the United States (25.855 tons), Canada (22.500 tons) and Ukraine (17.000 tons). The following countries are Canada, Chile, Russia, Turkey, and Mexico. Figure No. 5 highlights the rise of the world's

largest wheat exporters. Over the past decade, the European Union exported the highest volumes of wheat, but EU wheat exports dropped by 25% in 2017. France and Germany are the largest exporters in the EU. There is a significant decrease in EU wheat exports as a consequence of French output. The bad weather in Europe has affected its production of wheat badly. However, Russian exports of wheat have risen by 20%. Russia lists that among exporters for the first time. In the latter half of the 20th century, it was a major importer of the crop, however, with former countries selling wheat sharply increased since the collapse of the Soviet Union. The Russian wheat boom comes mainly from support from the government, low currency, and high returns. Russian wheat exports will continue to perform mainly due to the environment and currency fluctuations. Certain top wheat exporters are the United States, Canada and Australia. In 2016 the US produced the world's biggest volume of wheat. U.S. shipments of wheat have fallen by 3,577 metric tons in 2017 due to severe drought conditions in particular. When Canada grows production of wheat, it produces high-quality wheat, with more than 75% of its wheat shipped outside of Canada. The same trend is true of Australia, where the bulk of Australian wheat is exported to major export markets, especially in Asia.

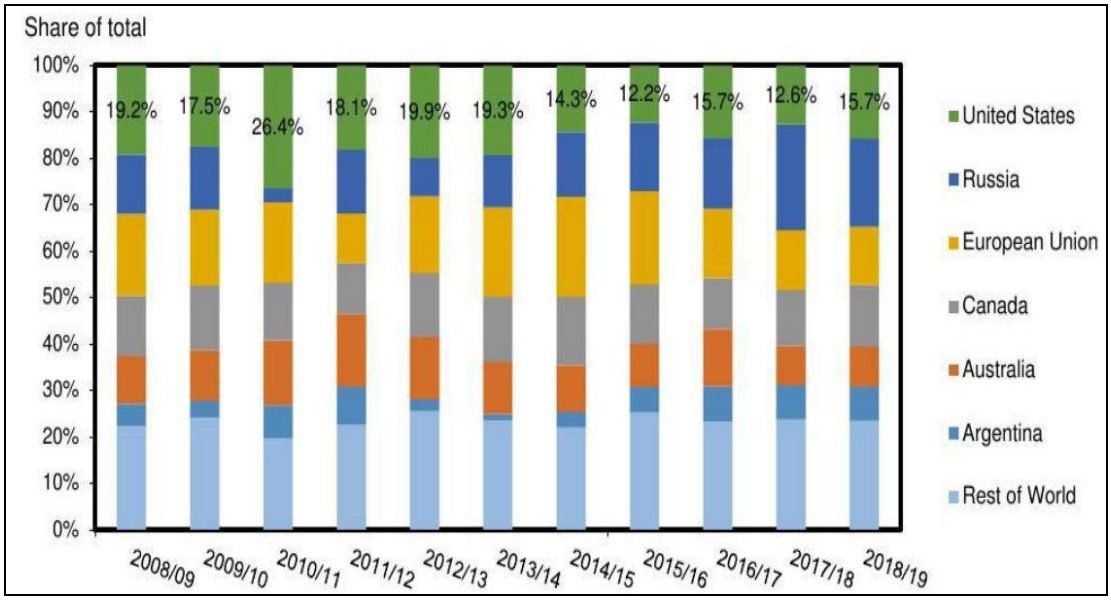

Figure 1: wheat export in the world

(Source: Economic Research Service calculations based on USDA, National Agricultural Statistics Service data.)

It is important to emphasize that for decades, the USA was the largest exporter. Russian Black Sea has always been the major supplier of the Arab world, but more and more nations are switching from the U.S. to Russia today, in the Middle East and North Africa. Also, Mexico, which was historically an importer of U.S. wheat, has imported Russian wheat because of cheap goods prices. Nevertheless, nearly half of the wheat farmers still expand in the United States, and the share is even higher in some states. About 80% of the Montana wheat, for example, is shipped to foreign countries. Shortly, the United States wants some market share to rebound.

It was a huge wheat importer in the latter half of the 20 century, but since the collapse of the Soviet Union, wheat exports from former members have risen sharply. The Russian wheat boom is caused mainly by government support, a weak currency and high yields. The future performance of Russian wheat exports relies mainly on the weather as well as currency fluctuations. The United States, Canada, and Australia are other prominent exporters of wheat. In the year 2016, the U.S. exported the largest amount of wheat worldwide. U.S. wheat exports were reduced by 3,577 metric tons in 2017, especially because of severe drought conditions. While Canada has increased wheat exports, it produces high-quality wheat, as more than 75% of their wheat is exported abroad. The same pattern applies to Australia; the majority of Australian wheat is exported into the major export markets, especially within the Asia continent.

It is important to underline that the United States was the largest exporter for decades until recently. Russia's Black Sea has always been the main supplier to the Arab world, but now, an increasing number of nations in the Middle East and North Africa are switching from the U.S. to Russia even more. The cheap freight rates caused that even countries such as Mexico, which has traditionally been a U.S. wheat importer, is buying Russian wheat. However, in the case of the United States, still, almost half of the wheat farmers grow is traded abroad, in some states, the portion is even higher. For example, around 80% of Montana wheat is exported overseas. The U.S. expects to regain some of the market shares shortly.

3.7 Importers of Wheat

In spite of the fact that most of wheat is eaten in the nation where it is developed, over a fifth of the yearly yield is imported from abroad. In 2017 the primary sourcing nations for the wheat business are as per the following, in 1,000 metric tons (12,500 tons), Indonesia (12,000 metric tons), the Arabian Republic of Egypt (12,500 meters), Brazil (7,800 meters), Algeria (7,700 meters tons) and Bangladesh (6,200 metric tons). The accompanying figure no. 6 shows imported products of wheat in US dollars in the year 2013.

Egypt is the greatest wheat merchant in the nation, and it has been driven for the most part by strategy. This has as of late changed, and Indonesia's status has moved. The Egyptian government expects to turn out to be less needy upon the stockpile of wheat, however, this will surely not add to any noteworthy changes later on. The admission of Indonesia has expanded incredibly and is relied upon to remain the biggest merchant of wheat in the long haul. Because of developing nourishment and nourishment supply request, the Indonesian imports of wheat rose. The creation of wheat from Bangladesh rose by 24 per cent contrasted with the past season in 2016–17. Algeria and Brazil are likewise the primary shippers of wheat. India, the quickest developing merchant of wheat, should likewise be recorded. India's import of wheat rose by 39.206 per cent somewhere in the range of 2011 and 2016.76 Egypt and Algeria are emphatically reliant on imported Wheat. In this manner, populace development and expanding riches would unmistakably escalate their reliance on wheat imports, later on, exploiting lower costs by the numerous Arab States that purchase wheat from Russia. The importation of wheat in Egypt is politically reasonable, in light of the fact that it is being utilized by the legislature for providing a program to help the sponsorship cards of a great many Egyptians at the hour of the vacillating. In the 2017/18 season, Egypt's wheat import is estimated at 12 million tons, about a similar level of import as a year ago and around 9 per cent over the five-year normal. In Indonesia, the admission of wheat in the developing white collar class, which has appreciated Western nourishment, is expanding quickly. Over the most recent 15 years, Indonesia has been the top Australian wheat buyer. In the most recent decade, Brazil has created the most elevated number. By and large, Brazil buys

the vast majority of its wheat from neighboring Argentina. With worldwide merchants having testing buying conditions, Bangladesh has become the biggest shipper of wheat to fare to the world. Because of flooding, interest for wheat developed, driving rice costs to record highs which drove individuals to transform into flour.

4 Practical Part

4.1 The Trend Analysis of Major Food Grains in China

For this analysis, the researcher listed the top five cereal (rice, wheat and maize) farming systems in Eastern and Middle China based on FAO systems classification in six emerging parts of China. The systems included the rice program, a mixed temperate system, system-intensive highland temperature systems, a subtropical system-intensive upland system, and a mixed irrigation system for the highlands. In consideration of the large range of latitudes and very complex climatic conditions encountered in this framework, there's a division between the upland intensive system of FAO into two subsystems, a subtropical-upland intensive system and a temperate-upland intensive system. Within those farming systems, about 93 per cent of total domestic production of wheat, rice and maize is produced. They are distinguished by large human populations, high economic growth and vigorous agriculture and other industries production strategies.

The details used in this paper were drawn from the annual farm statistics of the China Census Office for the period 1980 to 2010. Information was obtained by County from the National Agricultural Statistics from 1980 to 2003 and information from 2004 to 2010 is reported annually in the Provincial Statistical Yearbook. I tracked the production and processing of rice, wheat and maize throughout China's five cereal-dominated farms. In 2,463 nations, the report consisted of over 73,000 survey responses spanning 30 years. Both statistics have been translated into tests at three geographic component levels: area, province/district/municipalities, and agriculture network. If more than one farming system divides a county point, it broke up the agricultural region in the county into equivalent units that are weighted by arable land allocation. At the county level, the quality of census office data varies. In some counties and years, missing data values have been normal. Annual values for prior and subsequent years were combined and used to interpolate incomplete values for the lack of data within the 30-year dataset. The average pattern from a neighboring county was used for imputation for those who had lost data at the start or end of the period. In some counties, data outliers with unusually high or low yields (derived

from misreported details, deficiencies in survey results, weathers or infestation of the disease) were detected and removed from the dataset.

4.2 Trend analysis

The yield patterns were evaluated based on a study of the annual yields between the years 1980 and 2010 and were better balanced for regression models (an interception model, a linear model or a quadratic model) at each of the three levels of spatial unit for the cultivation. The parameters of model models and curve properties have led to the grading of yield trends in four categories which define the range of trends. The first form of pattern in production was in the 30-year era where performance had not changed (NI). Such form of the pattern was demonstrated by a positive slope and yield increase of just intercept and linear model below 0.5 t ha-1 during the time. In this scenario, the linear model displayed a positive slope; the quadratic term coefficients were negative for the quadratic model and the yield had a maximum value that remained stable or decreased. Thirdly, yield collapsed (CO), with yields raising or originally increasing to the point of the 1980s. This group revealed a regression model with a negative slope and the quadratic term coefficients were negative for the quadratic form and the parabola was in front of the center of the span. In the fourth form, an ever-increasing yield (SI), increased yields in a span that continued to increase at the end of the 30-year cycle were described. Positive slopes of the best fit linear model R squares suggest an increase in yield. This form was defined by a quadratic model with negative coefficients where maximal yield values (parabolic vertex) or positive coefficients with parabolic vertexes in the vicinity of the ordinates have not yet been achieved. The crop field of the SI class has been divided further into three regions, based on the growth rate of return over the period; the areas of "fast growth" (the maximum 25% rate of return growth in the improved yield regions), "fair growth" (the intermediate 50% rate of yield growth in the improved returns areas) and "slow growth".

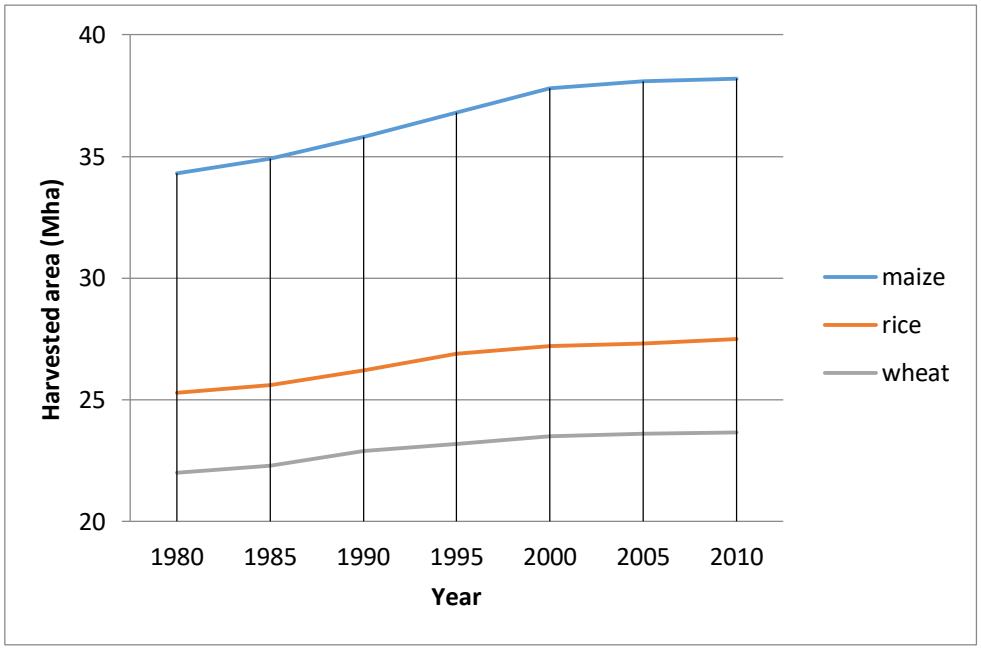

Figure 2: Tendency of harvested area of rice, maize and wheat in China.

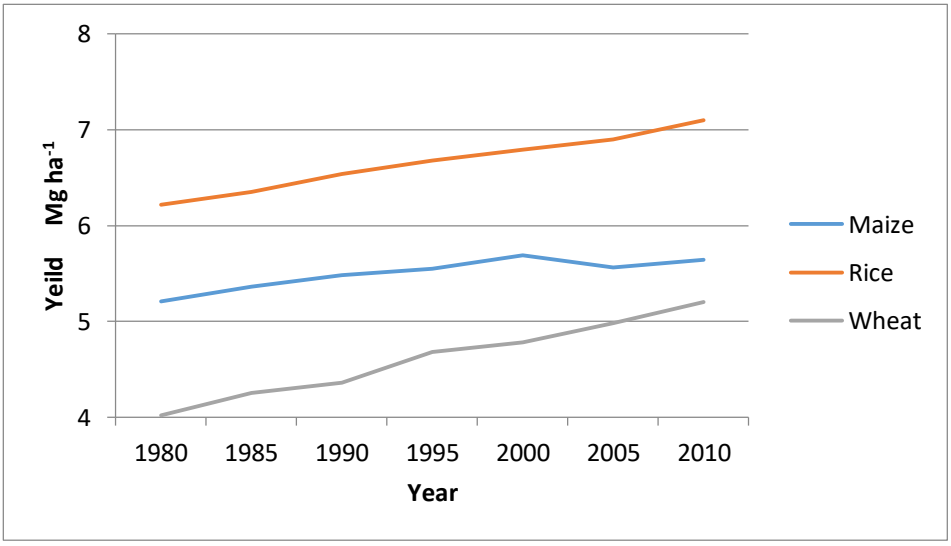

Figure 3: average yield of rice, maize and wheat in China.

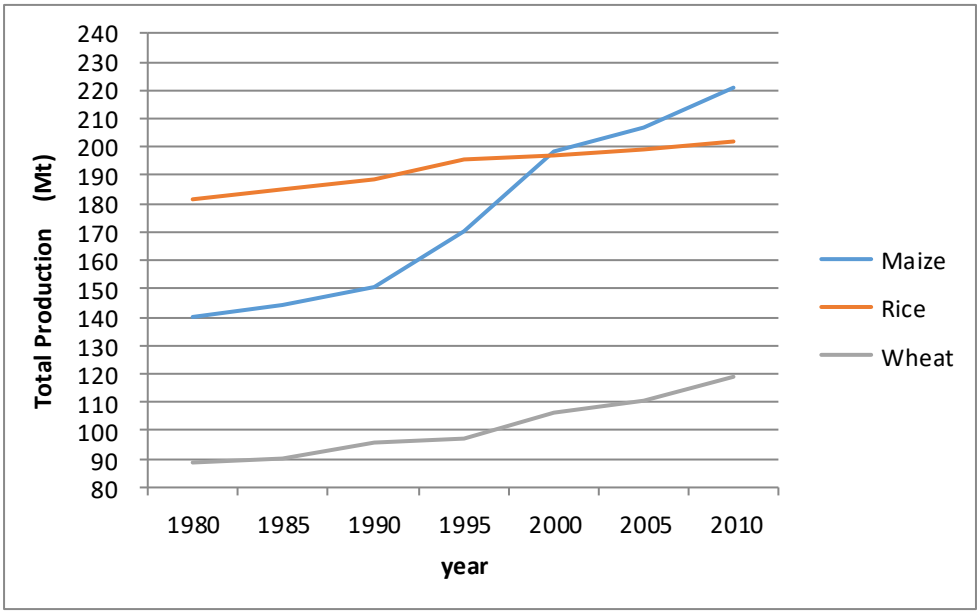

Figure 4: total production of rice, maize and wheat in China.

Four different types of patterns in cereal yield in China, 1980–2010. Y-axis in t / ha is grain production.

The region of yield pattern for each crop was compiled from the county level details in the farming system and province. Counties ' yield patterns have been introduced into the GIS dataset. This was linked to each of the grids in the GIS network (where each grid is a region), and the areas with district yield patterns were incorporated into provincial-and agricultural program units. Mapping allowed us to see where and how over time crop returns improved. A more comprehensive systematic study of the yield patterns for each crop in its 10 most significant production provinces was undertaken to help understand the situation of the cereal crops in large areas of China. Such findings for the most important grain areas led to an assessment of the likely future patterns in grain crop yields and their effect on national food health.

The analysis suggests that, between 1980 and 2010, China experienced significant yield increase, with a large proportion of this early-and mid-term, in the major cereal production areas in the five agricultural systems (which together produced 93 per cent of national cereal output). Recent years have recorded stagnating yields (approximately 14.7 million hectares of rice, and 15.5 m

hectares of maize) on more than half of the five farm systems. Rice production increased continuously on 12.3 m ha, i.e. 41.8% of the harvest area. Nevertheless, after a prolonged period of growing yield, about 50% of the rice harvest is now indicated yield deflation (about 14.7 m ha). Yields in less than 2.3 m ha or 7.8 per cent of the total rice field collapsed or increased (with a slight increase of 0.5 t ha-1) in recent decades.

The yield of wheat continued to rise by 13.8 m hectares, i.e. 58.2% of the estimated crop area (Table 1). Nearly 3.8 m ha (15.8% of arable land) indicates sluggish yields. In comparison, there has been no increase of wheat yields in 13.3 per cent of the harvest region over thirty years, whereas yields on a small area plummeted (1.8 per cent).

The most popular food crop in China has been maize since 2007, followed by rice. In the study, however, yields rose at only 17.7% of the area covered by maize harvest (5.3 m ha), stagnating in an area very wide (54.3% 16.3 m ha), after some early change in period (see Figure 2). However, the yield at 6.5 m hectares (21.7% of maize area) did not at all increase and fall at 0.5 m hectares (1.6%).

Just 7.8% of the rice areas produced has seen no improvement in yield over the last 30 years within the five farming systems. The regions contained in Shanxi, Shaanxi and Inner Mongolia was located in the lowland rice network, peripheral areas of the Sichuan Province and portions of the upland intensifier system. At 59.7 per cent of the national rice harvest region, the lowland rice network is of extreme importance for rice production. This method still generates 22.3 per cent more yields for the domestic rice market, but more has stagnated (32.5% for the national rice area). The temperate mixed system has 19% of the national rice harvest area, half of which are active (most of which is "rapid"), and 7.4% of the overall stagnating rice region. The subtropical uplands network has stagnated 16.9% of domestic rice production and a half (8.7%) of it.

Around 1980 and 2010 the yields of wheat did not improve in 13.3% of the agriculture systems ' harvest regions. 7.7% of the region was located in the Low Country rice zone, the largest wheat-growing field with a wheat-growing area of 51.6%. The lowland rice program accounted for 37.3% of national wheat yields, although 6.3% remained stagnant. The second-largest region for the wheat harvest is the temperate mixed system (23.3% of the nation's total). More than two, with

6.7 per cent stable, here (14.4 per cent of the country's total) had raised returns. Wheat yields in the highly productive wheat production regions in Huabei plain, Hebei Province, Henan Province, Anhui Province and Shandong, continue to increase rapidly. They are the most productive areas of wheat.

Maize yields in the large remote upland areas of Shanxi, Shaanxi and Sichuan provinces, covering 21.7% of maize growing regions in China, have not increased from 1980 to 2010. In China's main maize crop (62.9 per cent of the maize crop area in the temperate mixed system), yields were spaced by 65 per cent. This accounted for 41.3% of the country's stagnant maize sector. There was a continuing rise in yields of only 11.5% (7.2% of national maize) for the maize region. In lowland rice and highland-intensive-temperate schemes sustainable yields have stagnated, where 46.4% (7.3% of 15.7%) and 44.7% (4.2% of 9.4%) have stagnated yields. In comparison, maize yields have continued to rise in the southern production systems, even those that generate a small portion of maize. 70.8% (3,4% out of 4,8%) and 64,9% (1.4% out of 2,1%) of maize-growing areas in the tropical and highland mixed highland intensive systems were subject to an improvement in production. In the Provinces of Hunan, Guangxi, Sichuan and Yunnan, massive and modest rises in maize yields were noticed.

4.3 The Trend Analysis of Major Food Grains in France

France is the leading producer of crops with an estimated share of output in the European Union, 20 per cent. Nevertheless, recently a discussion began on the deflation of French yields. Although previous findings on wheat point to recent deflation overwhelmingly, there are conflicting data for maize and few or no observations from other crops. The researcher examines a set of information comprising over 120,000 yield observations for ten crops (barley, durum and soft wheat, corn, peas, rice, rapeseed, sugar beet and wine), from 1900 to 2016. Across time and space, we examine the history of return rates, evaluate the variability in yield and determine if yield development slowed across recent years. The yields increased by four in the course of the 20th century on average throughout all crops. The adjustment relative to the average has halved while there is an uptick in actual yield volatility–mean yields have grown more than their variability. Nevertheless, since the 1990s, yield rises have stagnated in at least 25 per cent of

its areas with regard to winter wheat, barley, peas, hard wheat, sunflower and wine. As a source of inflation, hitting production capacity is impossible. In comparison, maize displays no signs of inflation.

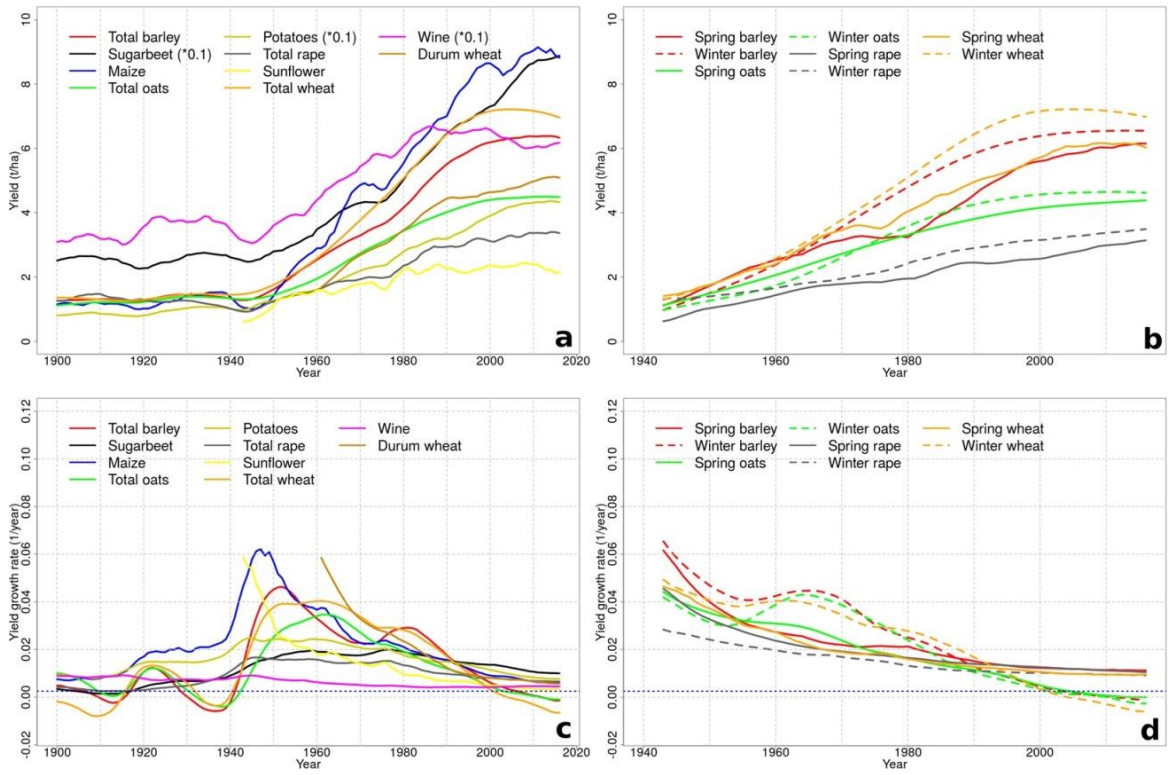

Figure 5: Trends and growth rates for national yields of staple French crops in the 20th and 21st century.

(a) Yield trends, for one-season and season-aggregated crop species (1900–2016).

(b) Yield trends, for spring and winter crop types (1943–2016).

(c) Annual relative yield growth rates, for one-season and aggregated crop species.

(d) Yield growth rates, for spring and winter crop types

Preliminary studies on the availability of foodstuffs need an exact description of yield patterns and annual fluctuations, especially in the case of key producers. France is one of the largest producers of agriculture and foodstuffs in the nation, ranking 6th in 2016, based on the total production of wheat. France has produced 5%, 2%, 8%, 14%, 4%, and 8% of the 2014 world wheat, maize, barley, sugar

beet, sunflower and rapeseed output, respectively. Evaluations of French agricultural productivity have already been carried out over time. Patterns in wheat yields in selected departments and field trials and noticed a turning point between 1996 and 1996 wheat yield increase. Based on regression simulations, there were no significant yield increases for wheat between 1900 and 1950, then fast growth until 1990, and no further rise in yields since then. Researchers have observed wheat renderings which have just stagnated in 80% of the crop area, utilizing departmental values from 1961 to 2008. Like maize, yields have been observed to increase moderately or rapidly. In 1996, in both northern and southern France, the researcher verified the decline of wheat yields. During the mid-1990s a decrease or steady plateau in growth rates for wheat yields based on different types of statistical models from 1950 to 2011, with few regional differences. From 1961 to 2010, researcher analyzed French maize yields nationwide and noticed slowing the technical changes towards the end of the period. Each of these articles examines potential deflation causes and describes one or more of the following as relevant: genetic advancement insufficient, improvements in farm management or legitimate fertilizers constraints. In the main French areas of development, but a rising variation for maize was observed. Wheat yield development in France was stagnating at the end of the 20th century, but that maize has contrasted. The inter-annual yield variation findings for wheat are unclear, but indicate a significant decrease for maize. Maize and wheat are the only plant species in France to research such issues.

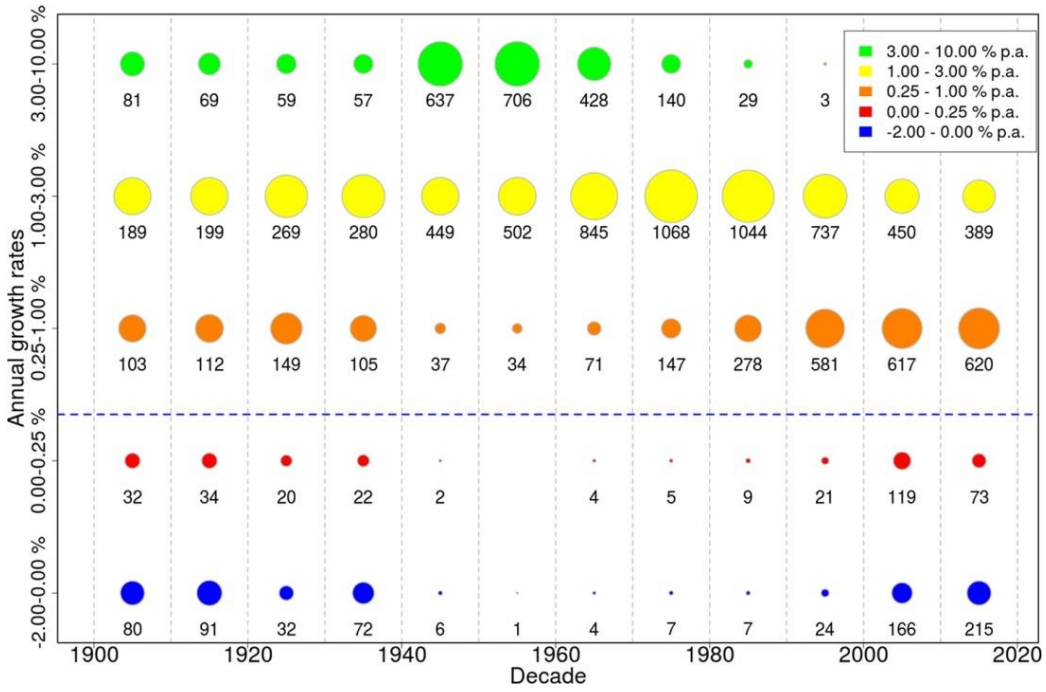

Figure 6: Normalized decadal relative yield growth rates over time across all crops

Several crops outside the period of 1940-2000 are subject to concentrations. In total, between 1950 and 1980 the pace of continued growth of barley, peas, soft wheat, durum wheat, and corn was at least 2% and up to 6% a year. But after the year 2000 such rates have dropped to almost zero or even negative values for soft winter wheat, winter barley and spring oats, wine and sunflowers; they have declined for maize, yet they remain positive.

Decadal uniform growth rates of relative yields are listed in the Figure for all crops and all starts. When all instances in the agricultural sector are taken together, the growth rate reveals a bell-shaped sequence over the period of records: low growth at the beginning of the 20th century and rapid growth from the 1940s to around the 1980s, with a decline in that development contributing gradually to inflation or even to negative growth levels after 2000.

The yield patterns are highly related to changes in the supply from mineral nitrogen (N). It refers to all plant species. Trends in potassium (K2O) correspond with yields, but there is a slight association between potassium (r= 0.34) and strong weeds. The application of phosphate (P2O5) is not linked to yield levels, by comparison.

For several cultivars, spatial clustering of yields is apparent: winter and spring barley, all oat forms, carrots, rice, and whole wheat, and hard wheat. It has grown limitedly over time, with four successive cycles roughly. With the passage of time, the number of clusters is growing and the variations in average yield between regions are rising. For the other species, there can be no effective spatial clustering. Higher average yield clusters for all communities with the exception of maize and wine are found in Northern France. Higher rates of demand for fertilizer in that area in the north are associated with higher rates of production. Intensive development environments are considered to comprise of the northern region of France. The clusters show large productivity disparities among the major farming regions in France, indicating a rise in productivity discrepancies over time.

4.4 Variability of inter-annual production

If compared to the decadal mean yields, a declining pattern over the course of time for a large part of combinations from the crop departments (like CV, Coefficient of Variation, described as standard deviation over average) is shown. It indicates the decrease in market share in the categories of moderate to strong CV (i.e. CV > 20%), categories 3-5 after the mid-20th century, and an increase in value in lower categories. Such a decrease in CV is not due to a reduction of the period variance in yield norm. The standard yield variations for all crops except rice, winter rape and wine have significantly increased over time; nevertheless, the rise in standard deviations was less than the change in mean production, illustrating why the CVs have declined in the long run. The rate of growth has declined in recent times for both average rates and standard deviation, as shown by the denser volume aggregations of most crops in the later years.

A significant increase in the minimum result after 1900 is supporting evidence of a decreased relative volatility that significantly decreases production variance as output errors have become less common or less extreme. Nevertheless, the upper volumes for spring barley, corn, winter oats and hard wheat rose a little between 1990 and 2010; i.e. several divisions have recently experienced a relatively high degree of change.

Rest yields appear to be weighted to more negative values than positive ones, i.e. to the left (mean skewedness= −0.2). It means that major negatives are more popular than large positive variations from expected returns. Residual results for all crops and divisions, following pattern elimination, are below 0.05 t / ha for 93 per cent, and in all situations below 0.66 t / ha. The renderings of residues are not linked to differences in the input of fertilizers nitrogen, potassium and phosphate associations are all greater than 0.15 and are negligible. For some species, the yield variability is associated, but not reliably, with (national, not plant-based), irrigated areas.

Of mild to high yields, the temperature trends crop variation is associated between plants. There are no significant negative associations between any crop pair. Of oats and rye, but not barley and rape, the winter and spring forms differ. In 8 out of 9 instances (mean and extreme), the inter-annual fluctuations of winter cereals (barley, oats and wheat) correspond with each other in excess of 0.6 (Pearson's r), suggesting comparable (meteorological) conditions for such crops in both normal and extreme yield years. High associations with other crops are observed in sunflower, sugar beet, maize and wine.

4.5 Detection of the trend

Dynamic models have established patterns as a good tool for the trend analysis of crops. DLMs allow patterns to be changed over time and provide an annual increase without heavy hypothesizing how the yield trends work. Furthermore, variables at the level of yield underlying the yield trend and the yearly growth rate were specified both as time-variable stochastic dependent and calculated by a Kalman smoother algorithm for their values and variances. For every crop and branch, and for nationwide aggregated time series, the independent DLM was calculated. Through dividing it by the expected yield rates, the growth rate was converted from absolute into relative values. The intervals in confidence for growth rates of 90 per cent were calculated based on the Kalman smoother variances. Only if at least 30 outcomes findings were possible to have patterns and growth rates been predicted.

Return growth rates were graphically represented overtime throughout all crops and departments using a bubbling plot. The average growth rate per decade

was estimated for each crop and branch. Bubbling areas represent the number of varieties per field between crop divisions, multiplied by the total value of the five categories over decades. That means the total number of areas in each group is equivalent.

4.6 Stagnating yield identification

In this analysis, levels of returns as stagnating within a certain span, if annual rates of growth remain mainly below a specified threshold, are described. This also means a reduction in yield, i.e. negative growth, which here aren't distinguished further from deflation. "Mainly" implies that not all growth rates will stay below the defined growth rate level. Alternatively, an equivalency, with the relative values of 90% confidence for annual yield growth rates and a growth rate interval described as representative of static yields, was used. In the latter scenario, 0.25% annual rate of yield increase between 0.0 and 0.5% was chosen. A ranking was given for each of these roles from 0 to 1, with 0 representing distinctly growth rates over inflation and 1 suggesting apparent deflation. The findings for each year are summed up and split into the trial period by the number of years, contributing to a complete deflation. These ratings vary from 0 (no deflation, of course) to 1 (some stagnation or decrease). The study's checked time frame included the past 20 years, 1997-2016. The ranking can be viewed as a likelihood of inflation in yield. The yield time series in one department for the study of the affected national regions is described as "probable stadium swimming" if the overall score was at least 0.5 (50 per cent or more in the span suggested by stagnation). For deflation, the beginning year was described as the first year in which the rates of growth of the stagnation measure were below the upper range (0.5 per cent annually). Results were sensitive with winter wheat as an iconic crop in accordance with the identification threshold and time frame.

4.7 Spatial departmental clustering

Clustering departments investigated the spatial coherence between departments as regards mean yield, utilizing dissimilarity as an indicator of the difference between mean yields (averaged over the time periods) over four successive years,

namely (1900-1929, 1930–1959, 1960-1989 and 1990-2016). A UPGMA (Unweighted Pair Group Model of the Arithmetic mean) hierarchical clustering has been used, grouping such divisions at medium yields with minimal unequal Euclidean distance. Upon clustering, 1% of the data is separated to the left and to the right to avoid outliers being controlled. The optimum cluster number for each crop and time was determined separately, using the cluster efficiency metric of Calinski-Harabasz (CH-index), which maximizes inter-cluster variance and decreases internal variance 35.

Departments of limited planted areas are susceptible to exclusion. All studies listed above were conducted with the full data set and then a limited data set, in order to test the sensitivity of the findings, excluded departments with a weak crop identified crop region (mean area under the mean 10% quintile area for a particular crop for each department). As a review consequence of this sensitivity check, the findings are very close to those without deletion and none of the assumptions in the report altered if the 10 per cent smallest cultivation units are excluded. Due to space limitations, tests are not shown.

5 Results and Discussion

In 2017 the main wheat-producing countries were the European Union (151,600 tons), China (130,000 tons), India (98,380 tons), the Russian Federation (85,000 tons) and the United States (47,371 tons of grain). The following countries are Malaysia, Australia and Turkey. The European Union is the largest European nation, a blend of 28 European nations. China is the largest producer of wheat in the world.

India grows enough wheat to sustain 1,324 billion people and even sell millions of tons of wheat to other countries. The production of Russian wheat is still on the rise, beginning in 2013. About 50% of global wheat production in 2014 was restricted to four nations, the Russian Federation, China, India and the United States.

Global wheat exports totaled the US $36.3 billion in 2016. Top five exporters in 2017 are listed as follows (in 1,000 metric tons): Russian Federation (36.000), the European Union (26.000), the United States (25.855), Canada (22.500), and Ukraine (17.000). They are followed by Australia, Argentina, Kazakhstan, Turkey, and Mexico. The European Union had been exporting the largest quantity of wheat over the past decade, but in the year 2017, EU wheat exports have dropped by 25%. The largest EU's exporters are France and Germany. A decline in the EU wheat exports is due to a significant fall in French production. Europe's bad weather has severely hit its wheat production. Besides, Russian wheat exports have gone up by 20%. This is the first time when Russia ranks that position among exporters.

Although most wheat is eaten in the country in which it is grown, more or less a fifth of its annual production is imported from outside the world. Indonesia (12,500 tons), the Arab Republic of Egypt (12,000 tonnes), Brazil (7,800 tonnes, Algeria (7,700 tonnes), and Bangladesh (6,200 metric tons), the major countries importing wheat in 2017, were as follows. The exceptions are China, Indonesia, the UK, Mexico and Nigeria. In the past, Egypt was the biggest importer of wheat in the world and has mainly been politically motivated. This has recently changed and this role has been filled by Indonesia. The Egyptian government plans to decrease its dependence on wheat imports, but this will not trigger any drastic

changes in the future. The intake of Indonesia has increased greatly and will be, in the longer term, the largest importer of wheat. Due to the growing demand for food and fibre, Indonesian wheat imports have increased.

Wheat is the most produced grain in the world and is eaten around the globe. Moreover, at any point in time, most countries will import wheat. Wheat is the largest proportion of world grain exchange. Four fifths are domestically purchased while one fifth is the product of international trade. About 90 per cent of global wheat exports belong to the United States, Canada, the European Union, Russia, Australia, Ukraine, Argentina, and Kazakhstan. These major wheat exporters are utilizing various exchange promotion schemes to protect their market share. Culture is an extremely important part of the programs.

In the Chinese agriculture sector, wheat has a vital role. After only maize, it named the second most important crop. China is a leading wheat producer in the world. It is the unique producer to deliver all six major classes of wheat in massive, comfortable quantities and at the highest quality every year. It's the only commodity that has the potential to provide all six main types of wheat. Although the Chinese share has diminished as other exporters have become more dominant on the world wheat market.

6 Conclusion

The aim of this research was to examine the factors impacting wheat production in the international market, which may have catalyzed rapid world wheat growth in 2016 and volatility in the following years.

Knowing such variables and how they affect global wheat prices can be helpful if economist, market analysts, consultancies, and politicians find influences that are important for predicting future market trends, or if new trade and development strategies are implemented if the welfare consequences are to be taken into consideration. For this purpose, a linear regression experiment was performed to analyze the variables expected to have an effect on the determination of wheat price. The global crisis in the previous years may lead to changes in the wheat price levels, oil shock and the associated fiscal policies across the world economy which were not expressed in the model design at the beginning of the 1980s.

In reaction to the occupation of Afghanistan, the United States prohibited food and equipment from supplying to the Soviet Union. The restriction was removed a couple of years later. As a result, trading habits shifted when the embargo came into effect, with product shortages in the Soviet Union confronting substitute suppliers of wheat. More political measures have initiated in the United States owing to the resulting fall in the world price of wheat.

Findings in this analysis show that import volumes, oil price trends, precipitation grades in the United States, the weather quality and current year concentrations in Canada, China and France are key variables that have important consequences for wheat prices around the world. In this research, the linear regression review discusses the variables that have a fairly strong impact on the world wheat price.

The results show that import rates affect the world price of wheat significantly. This becomes clear if the market price is taken into account by the equilibrium of supply and demand. The volume of imports is expected to be indicative of the demand side in this study. Many other considerations that are not taken into account in this analysis can also affect global demand. The factors which influence demand in imports and how these factors may influence the world wheat price may be the subject of further study.

This is consistent with earlier studies and shows a strong connection between oil prices and wheat. A fair argument could be that wheat output is explicitly and indirectly influenced by oil and energy demand by the usage of fuel and chemical fertilizers in wheat production, as well as indirectly, by the decision to use the land base of bio fuels for farm crops produced in the same region.

Typically speaking, there are no major impacts of precipitation on wheat prices however the result should be cautiously interpreted. Less rain might imply more sunshine 54 days in more northern Latitudes or higher temperatures that usually lead to the growth of wheat and seeds. The United States is an exception among the five major wheat exporters included, as precipitation in Kansas has been associated with strong wheat prices. The reality that Chinese wheat exports are the strongest over time shows that the U.S. is the main driver of the international market. But this strong and unique significance to the United States degree of rainfall deserves more research to understand what other variables may lead to this association and to equate it more closely with other areas not linked to it.

This study analyzes the connection between precipitation and wheat prices in the exporting regions, although precipitation can also influence the market prices of any world balance. Precipitation in countries which import wheat, for example, may influence wheat prices by changing the equilibrium between the rates of produced, output and use in these countries. Provided that the volume of wheat imports has a significant impact on world wheat markets, this is another outcome requiring more exploration.

The findings for yields indicate a greater effect on wheat prices, as compared to the results for precipitation. In general, the relationship between the yield and the global wheat price is negative. The calculated yield coefficient for France is negative yet negligible, as predicted. The calculated coefficient for E.U. wheat yield, on the other side, is optimistic but marginal. Since yields in all the countries except Australia where yields fluctuated, especially after 2000, have steadily increased over the time period considered, this might explain why the forecast on the global wheat prices of yields in Australia was negligible.

While it is the second-largest exporting sector in the duration analyzed, the returns have been recorded by the E.U. No major impact on the world price of wheat. This negligible consequence could be that the reporting yield data is for

only one French zone, which represents a small subset of the overall E.U. sector. There is a need for more study to see why E.U. The projected model has a marginal relation between yields and world wheat prices.

As described in the previous chapter, the prices of the preceding year will have a major impact on the wheat price of the current year. Agricultural commodities output is inevitably delayed between decisions on supply and demand. In reality, last year's prices reflect the results of other variables that have affected the wheat market in the previous year and are primarily consumer representatives. Variables such as the substitute crop markets may also influence decisions on the output of wheat, and since these ties are fairly consistent, the price of the previous year may constitute a proxy for continuity of such variables.

Climate change is a very complex phenomenon and does not fully match the simple economic model used in this research. This analysis has other drawbacks. In a long-term analysis, this deficiency is becoming more important. However, the economic modeling of wheat prices is complex with other factors affecting wheat markets and shifts in the global economy. This research simplifies the real-world economy and explores the relationship between the main factors, utilizing key economic concepts and climate details, influencing the wheat price worldwide. Apart from the economic model's inherent limitations, the lack of access to empirical data from various nations often restricts the scope and precision of the analysis.

6.1 Limitations of the Research

The downside of this work is the variability in data collection. The weather station, for example, also moved positions during the time frame, limiting access to time-frames for weather data.

Knowing how environmental and economic factors affect wheat prices will lead to the knowledge of market dynamics by international organizations and policy. In an environment of strong food security concern, this research allows leaders to plan more efficiently and brace for potential shortages or disruptions that might occur from evolving conditions and market shocks. Furthermore, it may lead to a better understanding of international trade in wheat that is related to

demand and other exchange factors that recognizes how all countries engage within the global wheat sector.

6.2 The future prospects

For future global studies of the wheat industry, the collaboration between world-wide researchers is needed to compile more detailed information and perform thorough market analysis of supply and demand factors on the global wheat sector. This study did not investigate causes of demand beyond the volumes of imports, but may be important for future studies. A valuable contribution would also be a potential analysis that explores in depth the conditions that affect exporting and importing nations.

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