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Bachelor Thesis

Maize Production in China

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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Maize production in China

Objectives of thesis

The goal of the author's thesis is to analyze the production of maize in China and to provide a relevant prognosis for the upcoming decade that will be based on the results of the empirical analysis conducted by the author.

Methodology

The author incorporates primarily numeric methods that involve regression analysis, trend analysis, self-sufficiency and break-even point evaluations. Selected methods will help the author to get a good overview of both micro and macro aspects of the corn production in China. The author uses secondary data as a numeric basis for the empirical analysis with information collected from FAO, World Bank and Chinese Statistical Office.

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40 – 50 pages

Keywords

China, revenue, self-sufficiency, export, import, production, consumption, planned economy, hunger

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Li, S., Zhao, J., Dong, S., Zhao, M., Li, C., Cui, Y., ... & Wang, Z. (2017). Advances and prospects of maize cultivation in China. Scientia Agricultura Sinica, 50(11), 1941-1959.

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Declaration

I declare that I have worked on my bachelor thesis titled "Maize Production in China" 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 any copyrights.

In Prague on 15.03.2024 _____

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Maize Production in China

Abstract

The goal of the author's thesis is to analyze the production of maize in China and to provide a relevant prognosis for the upcoming decade that will be based on the results of the empirical analysis conducted by the author. The author incorporates primarily numeric methods that involve regression analysis, trend analysis, self-sufficiency and terms of trade analyses. The author uses secondary data as a numeric basis for the empirical analysis with information collected from FAO, World Bank and Chinese Statistical Office.

In the end, it is identified that China is not self-sufficient in maize, but the country managed to make a huge effort to get closer to the goal of becoming self-sufficient in the next decade. Yield is categorized as the most important factor influencing the total production function. It is suggested that the development of maize production in the short-term perspective is likely to be optimistic, but it can be obscured by a potential demographic boom and deteriorating environment in the country and in the world.

Keywords: China, revenue, self-sufficiency, export, import, production, consumption, planned economy, hunger

Produkce kukuřice v Číně

Abstrakt

Cílem autorovy práce je analyzovat produkci kukuřice v Číně a poskytnout relevantní prognózu pro nadcházející desetiletí, která bude založena na výsledcích empirické analýzy provedené autorem. Autor zahrnuje především numerické metody, které zahrnují regresní analýzu, analýzu trendů, soběstačnost, obchodní podmínky a techniky faktorové analýzy. Autor používá sekundární data jako numerický základ pro empirickou analýzu s informacemi shromážděnými od FAO, Světové banky a čínského statistického úřadu.

Nakonec se zjistilo, že Čína není v kukuřici soběstačná, ale zemi se podařilo vyvinout obrovské úsilí, aby se přiblížila cíli stát se soběstačnou v příštím desetiletí. Výnos je kategorizován jako nejdůležitější faktor ovlivňující celkovou produkční funkci. Předpokládá se, že vývoj produkce kukuřice v krátkodobém horizontu bude pravděpodobně optimistický, ale může být zakrytý potenciálním demografickým rozmachem a zhoršujícím se prostředím v zemi a ve světě.

Klíčová slova: Čína, příjmy, soběstačnost, export, import, výroba, spotřeba, plánovaná ekonomika, hlad

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FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
COVID	Coronavirus
PLA	Polylactic Acid

1 Introduction

China until quite recent times – 2023, to be more specific, was the country that was called home by the biggest number of people on the planet hosting a population of over 1.4 billion people. In fact, the country's strong manufacturing sector, unique culture and hybrid economic regime are usually the most well-known and talked about aspects of the country, while one of the very important questions is often overlooked by people interested in China. How does a country that has such a tremendous population manage to feed all those people and does it actually do so quite successfully?

Due to the fact that the author had a feeling that this side of the Chinese economy was often overlooked, he seeks to understand the way how the Chinese agrarian sector functions and develops over time based on the example of maize, which is a very popular agrarian commodity in China, alongside the rice and wheat. Apart from being driven out of motivation to take an insight into something that is not often mentioned, the author himself comes from the country and he is definitely concerned with its future. Based on the series of aforementioned circumstances, the author was prompted to take an insight into the subject as an independent researcher planning to assess the maize industry in an unbiased, comprehensive and sophisticated way. Apart from aiming to do it in a detailed manner, the author believes that the best way for addressing the subject is by conducting empirical research since the world of numbers is not subjective but purely objective. The subjectiveness of the interpretation will partially be tackled with the help of a comparison of the results of the author with the results of academists.

In addition to the circumstances addressed earlier, the world has recently been shocked by a huge war that has already been happening for more than two years, and that had direct implications on agriculture all over the world. Therefore, in such turbulent and complicated times, when nothing about the future state of agrarian markets is certain, countries need to ensure their self-sufficiency in order to decrease the risk of facing shortages and other problems that inevitably lead to food insecurity and hunger, which can even become the case of China, despite its economic might and development. The bachelor thesis' results will be correlated with the results of other scholars and scientists in order to build a better foundation

for further research and generally understand the main contradictions between the results of the bachelor thesis and other journals and studies.

2 Objectives and Methodology

2.1 Objectives

The bachelor thesis has a few sub-objectives that together contribute to the major objective – analyzing the situation with maize production in China and identifying the main problems, tendencies and perspectives of producing corn in the selected country. Alternatively, the sub-objectives mentioned earlier are mainly related to the identification of whether the country is self-sufficient or not, identifying the most important factors influencing the production, comparing the size of the production to other countries and also quantifying the effect of area and yield on the country's production.

The thesis also seeks to answer specific research questions linked to the objective and the sub-objectives.

1) Is China self-sufficient in maize production?
2) Is China capable of maintaining a steady growth in per capita production given the development of the total population?
3) What are the terms of trade for maize in China?
4) What is the future of maize production in China?

2.2 Methodology

The methodology of the work is made up of techniques that will help to achieve the main objective of the work and the sub-objectives, and also to answer the research questions that were formulated on the basis of the thesis aims. The first part of the analysis is traditionally represented by a literature review, which will help to understand the specificity of maize production and the main tendencies related to it, present an overview of the Chinese agrarian sector and understand the importance of maize as a source of nutrients. In this part, the author uses solely secondary data, which will be analyzed with the help of the document analysis technique.

The second part presents the author's own contribution to the subject, where he will address the stated issues with the help of quantitative techniques from both statistics and

agrarian economics. From the agrarian economics dimension, the author is concerned with the calculation of the self-sufficiency index, which is used to describe the degree of being able to satisfy the domestic consumption of a particular good in a given country. The index's calculation is composed of 2 elements – the value of domestic production (P) and the value of domestic consumption (Z). Whenever the index is above 1 or 100%, it implies that a country is able to maintain a level of production that is able to satisfy domestic consumption without causing significant distortions in the market of the commodity. The calculation of the self-sufficiency index was applied by Kotyza & Slaboch (Kotyza & Slaboch, 2015) in their article dedicated to the calculation of self-sufficiency indices for selected commodities in the Czech Republic and Poland.

$$Self - Sufficiency\ Index = \frac{P}{Z} = \frac{P}{Production + Import - Export - Changes\ in\ Stocks} \quad (1)$$

In the analysis, the technique of the terms of trade is applied, which is a very common framework used in foreign trade to understand the position that a country has in the international trade of a particular commodity. Whenever the terms of the trade index are above 1 or 100%, it implies that a country is selling a good at a price higher than it imports, which suggests that a country creates profit for it, which is a good sign (Schmitt-Grohé & Uribe, 2018).

$$Terms\ of\ Trade\ Index = \frac{P_e/unit}{P_i/unit} \quad (2)$$

For the time series analysis, which is performed based on the interval containing 11 years (2010-2020), three different techniques are utilized – trend analysis, descriptive analysis and regression estimation. The selection of the time period is explained by data availability and fundamental changes in Chinese economy that occurred after the global financial crisis of 2007-2008. Trend and regression analyses rely on the same formula, which is used in the estimation of the parameters of models. Models created through this kind of estimation and the ones used in the thesis are traditional of the linear nature, thus they follow the structure of a simple linear function, where coefficients *a* and *b* are estimated (Blackburn & Neumark, 1995).

$$b = \frac{\sum(x-\bar{\bar{x}})*(y-\bar{\bar{y}})}{\sum(x-\bar{\bar{x}})^2} \quad (3)$$

$$a = \bar{\bar{y}} - b\bar{\bar{x}} \quad (4)$$

The descriptive analysis considers very simple measures, which will help to understand the situation in the context of the production of maize in a slightly better way. Those measures are *base index*, *minimum*, *maximum*, *median* and *mean*. The data is collected with the help of FAO (agrarian indicators), the World Bank (economic indicators) and the Chinese Statistical Office (additional information and indicators). The utilization of FAO is preferred to the rest of statistical platforms due to its user-friendly interface. The application used in the analysis is Microsoft Excel, which offers a perfect pool of functions that will ensure that the methodology of the thesis can be applied. The thesis also uses the formula for calculating elasticities which presents the percentual change in the response variable rather than a unitary one (Blackburn & Neumark, 1995). It is calculated as follows:

$$E\ (\%) = a_i * \frac{x_i}{\hat{y}} \quad (5)$$

For the final analysis, which is the correlation analysis, the author observes the correlation between the total production of maize and selected macroeconomic and socioeconomic indicators, where correlation coefficients and subsequent t-values are calculated. Correlation analysis is a universal tool that will help to analyze the degree to which the production of maize is associated with the economic and demographic performance of the country. The correlation coefficient used in the study is the Pearson correlation coefficient, which is usually the best fit for variables assumed to be correlated linearly (Cohen et al., 2009).

$$r = \frac{\sum(x_i-\bar{x})(y-\bar{y})}{\sqrt{\sum(x_i-\bar{x})^2 \sum(y_i-\bar{y})^2}} \quad (6)$$

$$t - ratio = \frac{r_{xy}\sqrt{n-2}}{\sqrt{1-r^2}} \quad (7)$$

In the analysis, various graphs, histograms and other tools of visualization are used in order to ensure that the reader will be able to grasp all presented data and perfectly understand the empirical foundation based on which the author will eventually proceed to the formulation of recommendation and evaluation of the current performance of the maize production in China.

3 Literature Review

3.1 Nutritional Information and Importance of Maize

Maize belongs to the family of crops that are called cereals or grains and this type of good is often regarded as one of the most important for consumers all over the world due to the fact that those commodities provide a series of fundamental nutrients and elements that account for healthy daily ration of individuals. Maize, which is sometimes referred to as maize, is a type of cereal grain that is extensively produced and has been a staple diet for people all around the world for many years. Because of its adaptability, high nutritional content, and significant economic importance, it is an important crop for both human consumption and the feeding of animals (Goodman & Galinat, 1988).

Maize is extremely nutrient-dense and supplies a wide variety of necessary vitamins, minerals, and dietary fibre. Furthermore, it is an excellent source of carbohydrates, most of which are present in the form of starch, which may be used as a source of easily accessible energy. In addition to carbohydrates, maize is a source of proteins, however, its protein content comprises a lower proportion of important amino acids when compared to that of animal sources. However, when maize is ingested in conjunction with other sources of protein, it can help contribute to a profile of amino acids that is more balanced. According to scientists, maize is one of the most beneficial alternatives to wheat, which is traditionally regarded as the most important and widely harvested commodity (Nuss & Tanumihardjo, 2010).

In addition, the presence of fibre in maize slows down the absorption of glucose, which results in a more consistent release of energy and increases feelings of fullness. In addition, maize provides a source of a number of minerals, including magnesium, phosphorus, and potassium, all of which play important roles in a variety of physiological processes, including the maintenance of healthy bones and the proper functioning of muscles. Vitamins are yet another essential component that may be found in maize. It is rich in B vitamins, especially B1 (thiamine) and B3 (niacin), which are necessary for the functioning of the neurological system and the metabolic process of generating energy. Additionally, maize

has tiny amounts of vitamin E, which is an antioxidant that helps protect cells from the effects of oxidative damage (Huma, 2019).

Although maize contains a wide array of important nutrients, the bioavailability of those elements can be altered by a number of circumstances, including the processing and cooking methods used. The unprocessed form of maize contains phytic acid, which is an anti-nutrient that prevents minerals from being absorbed by the body by binding to them. To improve the bioavailability of maize's nutrients, however, traditional processing procedures such as nixtamalization have been employed successfully for generations. Nixtamalization is accomplished by first soaking maize in an alkaline solution, which is often lime or wood ash, and then boiling the mixture. In addition to enhancing the flavour and consistency of the corn, this procedure also makes the mineral content, particularly that of calcium and iron, more accessible. In the process of nixtamalization, the phytic acid is also broken down, which makes it easier for the body to absorb other nutrients (Graham et al., 1980).

Because it can be used for such a diverse set of purposes and is so adaptable, maize is an extremely important component of the food system on a worldwide scale. Millions of people rely on it as their primary source of nutrition, particularly in areas where it has long been cultivated as a crop. It is possible to produce bread, tortillas, and a variety of other baked foods from maize that has been crushed into flour. It is also possible to process corn into cornmeal, grits and corn flour, all of which are ingredients that can be used in a wide range of culinary recipes. In addition, the manufacture of animal feed relies heavily on maize as an essential ingredient. Because of its high energy content and the ease with which it can be digested, it is a great feedstock for cattle, poultry, and aquaculture. The increasing demand for meat, eggs, and dairy products throughout the world is being met in part by the sustainable production of maize-based feed, which in turn contributes to satisfying the demand for protein among the world's expanding population (Ranum et al., 2014).

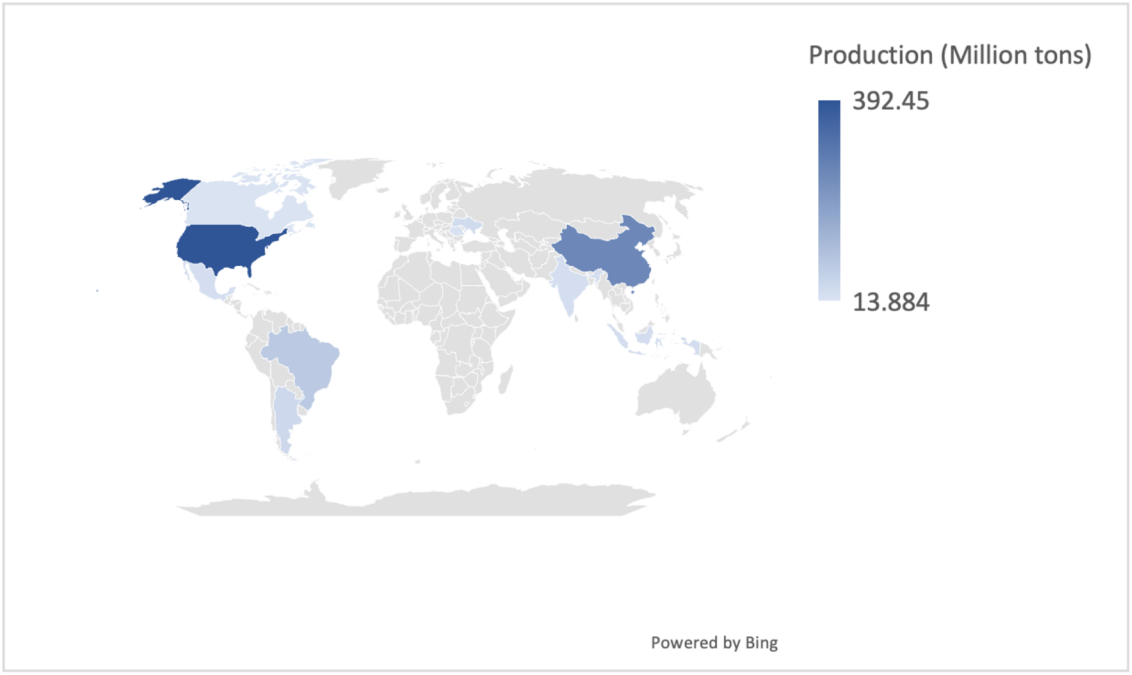
The growing of maize also provides farmers with prospects for economic growth and makes a contribution to the improvement of rural areas. Maize cultivation is essential to the livelihood of small-scale farmers, particularly in developing nations, as well as to the provision of adequate food supplies. Due to the crop's hardiness and flexibility, it may thrive in a variety of environments and growing circumstances, making it a desirable alternative

for farmers in a number of different places. In addition, maize has potential applications that extend beyond the production of food. It is used as a raw ingredient in the manufacturing of biofuels, which helps to contribute to the development of renewable energy sources and reduces dependency on fossil fuels. The by-products of processing maize, such as corn oil and corn flour, make their way into a variety of different industrial sectors, such as the pharmaceutical industry, the textile industry, and the paper-making industry (Erenstein et al., 2022).

3.2 Maize Production in the World

As it has been mentioned in the previous sub-chapter, maize is actively harvested all around the globe and depending on the culture, traditions and specificities of local cuisine, corn can be preferred as the best alternative to wheat, which is the world's most harvested commodity. Figure 1 presents the map of the top ten biggest producers of corn in million tons as of 2018.

Figure 1, the world map of maize production in 2018



Source: AtlasBig, 2018

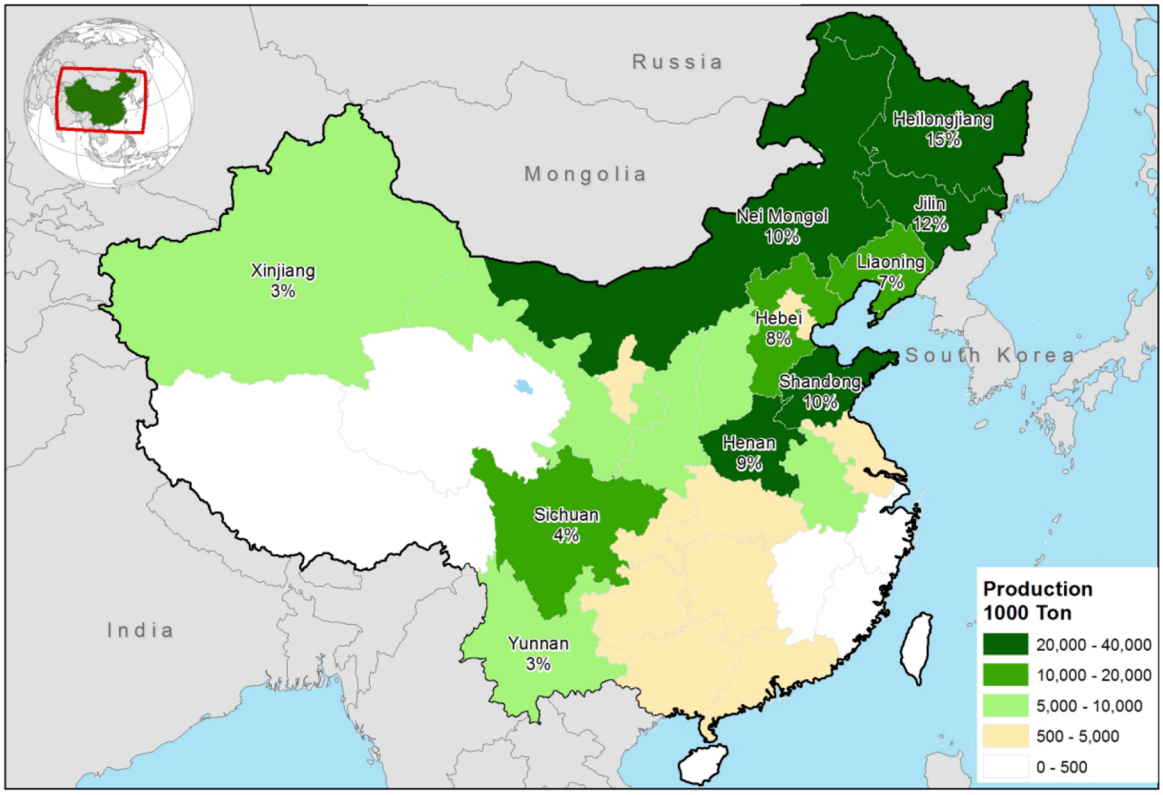
Based on the world map of maize production, it is possible to say that the absolute leader in the production of maize is the United States, which produced an entirety of 392.45 million

tons. Of course, this particular phenomenon is explained by the culture of consuming maize that exists in the United States. The country located in North America was significantly influenced by the culture of numerous immigrants coming to the country from South America and other parts of the world, where corn is preferred to wheat thus making corn the main commodity from which the bread is made. Apart from that, corn flour has a huge number of applications that are found among the residents of the United States thus increasing the importance that the commodity has for the country (Klopfenstein et al., 2013).

The country that is in the spotlight of the thesis is in second place with approximately 250 million tons produced in 2018. There are many areas in China that are appropriate for growing maize, which has led to extensive cultivation of the crop. Because of the favourable climate and fertile soil in the northern and northeastern areas of the nation, these regions are collectively referred to as the "Corn Belt." Some of the provinces that fall within this region include Heilongjiang, Jilin, and Inner Mongolia. These locations provide important contributions to China's overall maize output, which is measured in tonnes. In China, the majority of people and animals rely on maize as their primary source of nutrition. It is put to use in a wide range of culinary preparations, including maize that has been steamed or boiled, corn porridge and snacks that are based on corn (Z. Li & Sun, 2016).

In addition, maize is processed into a number of other food items, such as corn oil, corn starch, and corn syrup. In addition to its use as a grain for human consumption, maize is an essential ingredient in the production of animal and poultry feed in China. Because of its high energy content and the ease with which it can be digested, maize is a suitable feedstock for the rapidly expanding meat, egg, and dairy industries in this country. In recent years, there has been a rise in the demand for maize to be used as animal feed, which is a direct reflection of the increasing consumption of animal products in China (You et al., 2011). The map of Chinese corn production, according to USDA, is presented in Figure 2.

Figure 2, China corn production map in 2021



Source: USDA, 2021

The third-biggest producer of corn is Brazil, which is generally one of the biggest agriculture-exporting countries in the world. Brazil harvests a large variety of goods and the country is an absolute leader in the production of soybeans, for which the country is famous. As for the corn, the application of the culture is pretty similar to the case of the United States of America (Meade, 2016).

3.3 General Application

Maize, as it was mentioned earlier, is an important source of starch, which in turn has a series of important applications in the food industry and also in the production of specific durable and non-durable goods. One of the widest applications of corn is its utilization in the production of biofuels or bioethanol. This specific type of fuel is categorized as an environmentally friendly and renewable one being extremely important for sustainable development and a shift from fossil fuels. Bioethanol is traditionally produced from corn by

first converting starch into sugars and then fermenting it and distilling it to produce ethanol (Chen et al., 2013).

Another application of corn is the production of industrial starch, which is used in the production of adhesives, paper, textiles, and some of the most important and widely used pharmaceuticals. On the other hand, maize and notably the sugar derived from it is used not only for industrial purposes but also for the production of sweeteners and syrups. Corn syrup is a common sweetener used in soft drinks, baked goods and processed foods, and also serves as an ingredient in confectionery (Rouf Shah et al., 2016).

In the pharmaceutical sector, there is a need for both substances derived from maize and derivatives of maize. Tablet formulations often include maize starch as a filler, which plays an important role in protecting the medication's overall quality. In addition, several medicinal formulations utilise maize oil as a carrier for the active ingredient. Additionally, components generated from maize are utilised in the manufacturing of biodegradable plastics and packaging products. It is possible to create the bioplastic known as polylactic acid (PLA) using maize starch. As a more environmentally friendly and sustainable alternative to conventional plastics derived from petroleum, goods based on PLA have enjoyed a surge in popularity in recent years (Ramessar et al., 2008).

Last but not least – corn, just like wheat and other goods from the family of cereals is used as a very common animal feed in the livestock industry. To be more specific, corn plays a huge role in livestock and especially in the poultry feed industry. Thanks to the high energy content and abundance of other beneficial nutrients, corn is one of the most advantageous and balanced feeds for livestock. Maize is processed into various forms, such as cornmeal and feed pellets, thus providing balanced nutrition for animals consequently ensuring a sustainable production of meat, eggs and dairy products which form the basis of human alimentation (Gwirtz & Garcia-Casal, 2014). The corn milling process, which is the basis of the majority of productions involving maize is shown in Figure 3.

Figure 3, corn milling procedure

Source: Sterk, 2018

With the emphasis on China specifically, the wide utilization of maize is not much different in China from the rest of the world, where the country mainly uses maize and its derivatives as a fundamental source of the expansion of livestock production, where maize stands out as one of the most prominent feed (Spoor, 2012).

3.4 Chinese Agriculture

The agricultural industry in China is of tremendous significance due to the influence it has on China's economy, historical legacy, and the nation's ability to ensure its own food supply. Agriculture has been the foundation of Chinese civilisation throughout the ages, and despite the enormous industrialisation and urbanisation that has taken place in China over the past few decades, agriculture continues to play an essential role in the country. Above all else, considering that the nation has an astounding population of 1.4 billion people, the importance of the agrarian sector becomes even more significant given that it is something that guarantees all of those people will be fed and that they will be provided with sufficient quantities of food at the right time in the right place (Spoor, 2012).

As a result of the wide variety of crops that may be grown on China's enormous land mass, the country now holds the title of being the greatest agricultural producer on the planet. A reliable supply of essential crops including rice, wheat, maize, and soybeans is maintained by the agricultural sector, which is a significant contributor to the overall goal of achieving and sustaining food security. In addition, China is able to satisfy the dietary requirements of its enormous population by producing an extensive range of fruits, vegetables, and animal products, as well as a large variety of tea. The country runs from Central Asia all the way up to the Pacific coast, and as a result, it has a great variety of distinct temperature zones, each of which has its own unique geographical circumstances. This is the primary explanation for the enormous range of cultures that are harvested in the country (Q. F. Zhang & Donaldson, 2008).

The agricultural sector in China is made up of both smaller-scale family farms and major agricultural corporations. property in China is owned by the state in its entirety, although individual farmers are granted rights to utilise the property for an extended period of time. In recent years, there has been a trend towards combining smaller-scale farms into bigger agricultural operations in order to increase the sector's overall efficiency, productivity, and competitiveness. This movement was brought about in order to take advantage of the economies of scale that larger operations provide. Actually, the increase in productivity within the agricultural sector was one of the most significant forces that were responsible for laying the foundation for a middle class that was both highly robust and very numerous. Deng Xiaoping, who came to power in 1978 shortly after Mao Zedong passed away, made a significant effort to modernise the economy by allowing a greater degree of authority to farmers and enterprises over their outputs, which resulted in an increase in productivity. He came to office in 1978 shortly after Mao Zedong passed away. Since that time, the agricultural sector has not really been subjected to any major reforms that would significantly alter the way that things are currently going in terms of the conceptual policy, but the government has been continually supporting domestic producers and small-scale farmers in order to guarantee that they will be able to make a profit for themselves (D. W. Chang, 1991). His picture during one of the meetings he had with Jimmy Carter is presented in Figure 4.

Figure 4, Deng Xiaoping and Jimmy Carter

Source: Britannica, 2023

The government of China has placed a great emphasis on the modernisation of agriculture as well as technical breakthroughs in this sector. This involves making investments in genetic advancements, boosting mechanisation, building improved irrigation systems, and supporting the implementation of precision agriculture practices. The combination of technological advancement and creative thinking has been an essential factor in the rise in agricultural output, the enhancement of crop quality, and the lessening of the negative effects agricultural practices have on the surrounding environment. The Chinese government has put into effect a variety of policies with the intention of bolstering and developing the agricultural industry in the country. Subsidies, price supports, crop insurance programmes, and investments in rural infrastructure are all examples of these types of government programmes. In addition, the government supports the use of sustainable agricultural practices, such as organic farming and the use of technology that is favourable

to the environment, in order to address issues pertaining to the long-term viability of the ecosystem (Lele & Goswami, 2020).

On the other hand, the current environmental situation has considerable repercussions for the agricultural industry, and these repercussions continue to be a concern. The agricultural industry in China has a number of issues, some of which include limited arable land, a lack of available water, soil erosion, and the destruction of the environment. The high population density and growing urbanisation have both contributed to the transformation of farmland into land used for purposes other than agriculture. As a reaction to these issues, a number of different measures have been put into place, including projects for the reclamation of land, efforts for the conservation of water, and the promotion of sustainable land management practices. In the context of urbanisation, one additional thing that has to be noted is the increasing migration of people from rural regions to more industrialised and urbanised places. This is an important issue to bring up. In China, the rural-to-urban migration that has occurred as a result of people looking for better economic prospects in urban regions has significantly impacted the agricultural industry. This tendency creates difficulties for those working in agriculture, which ultimately results in labour shortages in certain locations. The Chinese government has instituted poverty alleviation programmes with the goals of raising the standard of living in rural communities and narrowing the economic gap between urban and rural areas (Cao & Birchenall, 2013).

4 Practical Part

4.1 Descriptive and Trend Analysis

In order to provide a comprehensive overview of maize production in China, it would be logical to start with a description of the main tendencies related to the production of the commodity in the country. For this purpose, the author believes that starting with a descriptive analysis, as well as with a trend will provide itself to be highly reliable in order to understand the current context of maize production and the development of the main indicators associated with the production. The dataset with the main indicators is presented in Table 1.

Table 1, the dataset for the descriptive analysis (2010-2020)

Observed Year	**Production**	**Production per Capita**	**Yield**	**Area**
	million tons	*kg/person/year*	*t/ha*	*million tons*
2010	177.54	132.72	5.46	32.52
2011	192.90	143.42	5.75	33.56
2012	205.72	151.91	5.87	35.05
2013	218.62	160.37	6.02	36.34
2014	215.81	157.31	5.81	37.15
2015	265.16	192.16	5.89	45.00
2016	263.78	190.07	5.97	44.21
2017	259.26	185.69	6.11	42.43
2018	257.35	183.46	6.10	42.16
2019	260.96	185.37	6.32	41.31
2020	260.88	184.87	6.32	41.29

Source: FAO, 2023

The dataset containing 4 indicators is expected to provide a comprehensive first overview that will build the basis for the future analysis of the subject. The first indicator that is analyzed in the sub-chapter is the total production of maize in China with quantities expressed in million tons. Undeniably, it is already pretty evident that the production of corn in China has been increasing in the previous decade at a rapid pace.

On the other hand, when judging the self-sufficiency and satisfaction of domestic consumption, it is essential to focus not entirely on the total production quantities, but on the

production per capita. Of course, it is always essential to compare the growth in production with the growth in population since the goal of every agrarian policy is to ensure that people will be fed, which can be rather complicated when the magnitude of the increase in the total production is significantly lower than the growth in population. Over the past decade, China's population was not increasing in the same manner as it had been at the end of the 20th century, which resulted in a positive effect on the production per capita indicator. The production per capita was seemingly increasing over the course of the previous decade even despite the presence of drawbacks, when the production per capita was dropping.

Yield is another crucial aspect that is needed to be considered since it is one of the two factors that directly contribute to the total production quantity, so increasing yield is something that agrarian policymakers constantly try to achieve. Undeniably, China's yield of maize has increased, but the magnitude is not so high, which might prompt to consider that China was mainly increasing the production by increasing the area, which is the second earlier mentioned factor.

In fact, the country increased its area by a significant figure, which is definitely an option for China thanks to its large surface and not fully developed regions, which were not in the spotlight of agrarian policymakers in the previous decade. Yet, this very phenomenon offers modern policymakers and agrarian specialists a good foundation that they can process and turn into the area, where maize can be harvested. Thanks to the geographical position and weather conditions of China, the country has a very good chance to produce maize in most parts of the country, which is definitely a good sign. After briefly discussing the situation with each indicator, it is essential to continue to the descriptive analysis presented in Table 2 which will provide a larger number of quantitative insights about those indicators.

Table 2, the descriptive analysis of maize production in China (2010-2020)

	Production	**Production per Capita**	**Yield**	**Area**
	million tons	*kg/person/year*	*t/ha*	*million tons*
Mean	234.36	169.76	5.96	39.18
Median	257.35	183.46	5.97	41.29
Min	177.54	132.72	5.46	32.52
Max	265.16	192.16	6.32	45.00
Base Index	47%	39%	16%	27%

Source: own analysis based on FAO, 2023

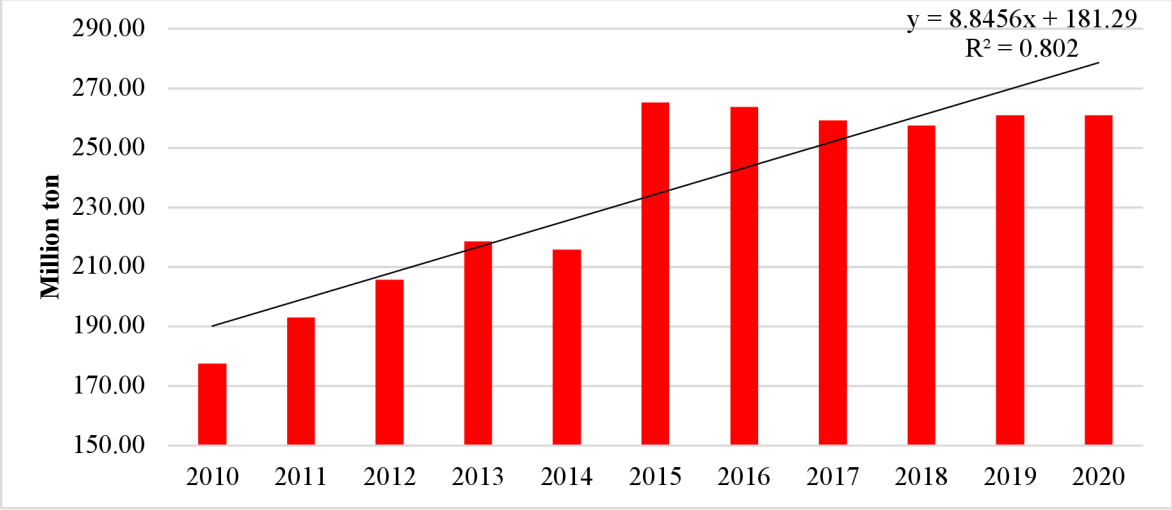
The mean figures do not really provide any important information without knowing the same figures for another country, but it is still vital to mention that the production of China has tremendous figures far exceeding millions for the production and area, and also having really good indicators for the production per capita and yield, which is a sign that China has a very strong industry related to the corn production. After all, this might also be the consequence of the centrally planned economy, which can quickly correct various market failures that can be found in agriculture.

The lowest values for the majority of indicators are identified in 2010, which is the first year from the dataset thus concluding that the country managed to make a huge leap forward when judging solely by numbers. On the other hand, the maximum values are not necessarily identified for the year of 2020, which is fully justified by the presence of the pandemic of COVID-19, which started in China and the country was the very first one in the world to take the blow from the uncontrollable spread of the disease. In addition to that, it is essential to note that the Chinese policy of zero COVID with excessive restrictions that were far stricter than the ones imposed in other parts of the world might have significantly stalled the development of maize production in the country. Therefore, it is fair to assume that future development is likely to follow in the footsteps of the previous decade.

The base index does also provide a number of important insights. Based on the base index, it is possible to say that the variable that increased the most was the total production, but it is essential to apply a vital discount factor to the variable by mentioning that what matters the most is the production per capita. However, the country also managed to increase

the production per capita, but the magnitude is slightly lower – just a 39% increase compared to 47% identified for the total production. As it was mentioned earlier, the country made more effort in increasing the total area harvested rather than yield – 27% for the area compared to 16% for the yield. This is a pretty traditional situation for countries possessing a lot of land that had been intact earlier. Yet, in the long run, it is essential to find ways to increase the yield in a more effective way because increasing the amount of harvested area will not always be possible, so preparing the ground for improvements in technology is seen as a crucial aspect on the agenda of China in relation to the maize production in the country. On the other hand, another important consideration that might impact the yield of maize in China is climate change. According to the CARD project, the yields are expected to diminish dramatically under the impact of the climate change, so it is wise to bear this consideration in mind (International Fund for Agricultural Development (IFAD), n.d.). Now, after briefly commenting on every piece of descriptive statistics for the selected indicators, the author will continue to the time series analysis, which will be expressed in 4 individual graphs for every variable. The first one is the total production, which is presented in Figure 5.

Figure 5, maize production over time (2010-2020)

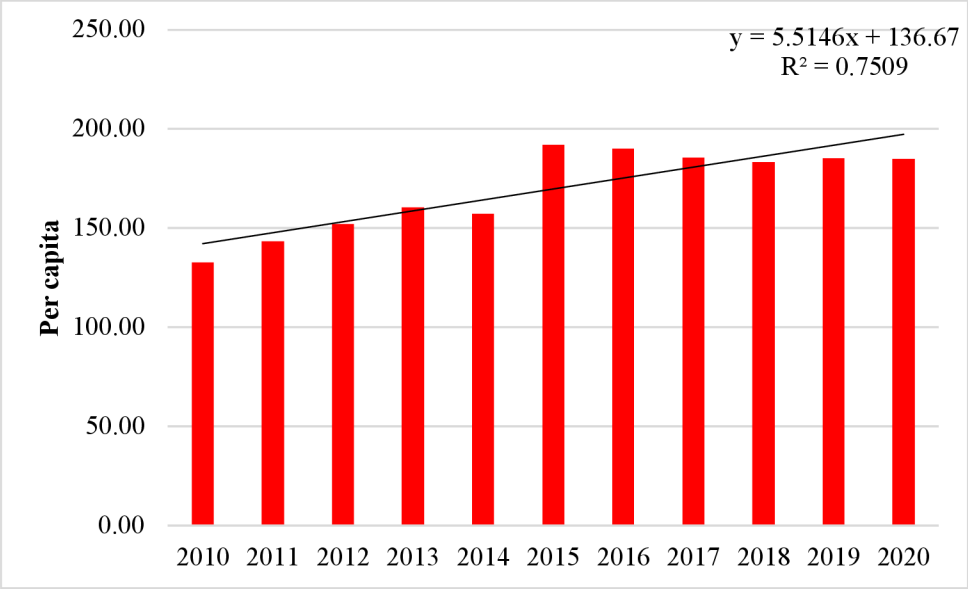


Source: own analysis based on FAO, 2023

Based on the time series plot, what has been said by the author about the maize production can fully be justified since it is pretty visible that the dynamic is an upward pointed one, which is a good sign. The production, however, faced a period of stagnation between 2015 and 2018, when it was gradually declining. On the other hand, the pandemic did not worsen the situation but almost certainly prevented the country from recovering from

the stagnation in production and breaking the frontier of 265.16 million tons produced in 2015, which was the all-time maximum. When judging by the trend, which is of pretty decent quality (80% of the variation is explained), it can be concluded that the country annually increases its production by 8.85 million tons, which is surely a huge value. The drop happened in 2014-2015 is explained by the stock market losses and small financial setback in China that led to the drop in all types of production with the subsequent devaluation of the yuan. The same kind of analysis is applied to the second indicator – the production per capita, which can be found in Figure 6.

Figure 6, production of maize per capita over time (2010-2020)

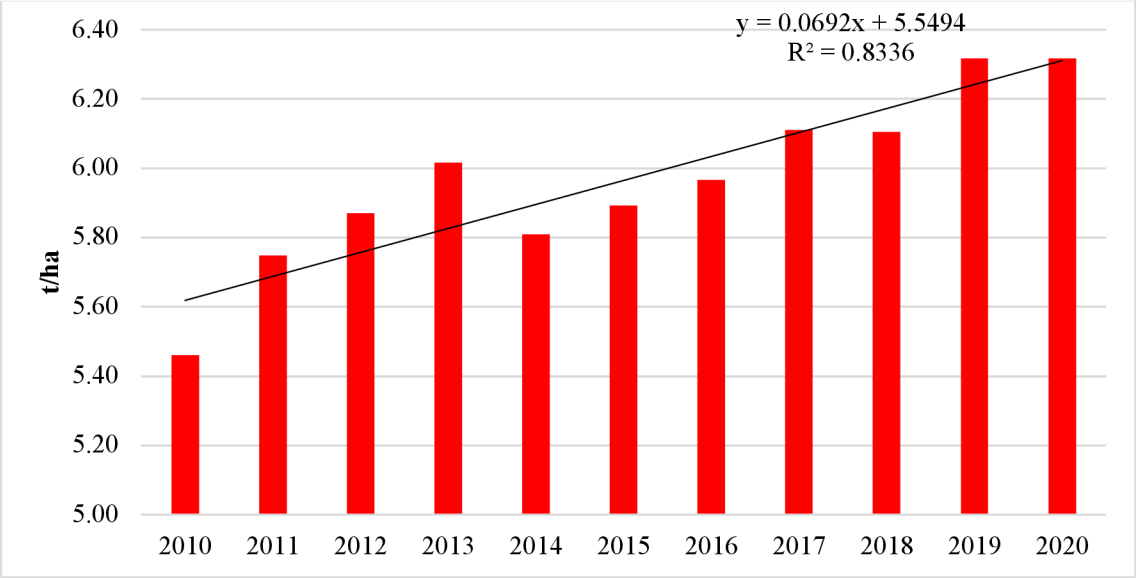


Source: own analysis based on FAO, 2023

A quite similar situation is observed in the development of the complex variable incorporating two indicators at the same time – the population of China and the production of maize. In fact, the observed phenomenon that the production per capita was increasing over time is a very good result, but it is still essential to note that the indicator faced a period of stagnation between 2015 and 2020, which can result in a series of problems if the population will start increasing at even a larger pace resulting in potential vulnerability to food insecurity and related problems. According to the trend, which is of slightly worse quality than the one for the production, the annual increase in the production per capita is 5.51 kg/year/person, which is quite a good result but can surely be improved. The third

indicator to which the time series analysis is applied is yield, which can be found in Figure 7.

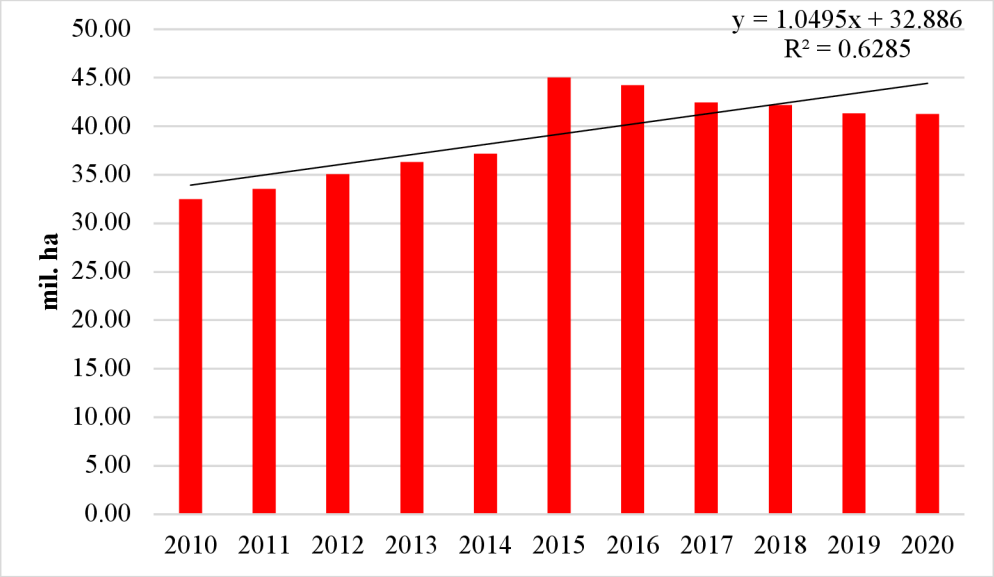
Figure 7, the yield of maize over time (2010-2020)



Source: own analysis based on FAO, 2023

Yield in China, compared to previous indicators, was not really in stagnation between 2015 and 2020 as the first two indicators. This might suggest that the main reason behind the country's inability to significantly increase its production of maize between 2015 and 2020 can be adverse weather conditions and other potential problems related to the harvested area or farmers. According to the trend, the annual increase in yield of maize in China was 0.0692 tons/hectare or 69 kilograms from one hectare per year, which is definitely not an astonishing figure but when realizing that the country has over 40 million hectares harvested annually, this leads to the suggestion that the result is rather outstanding. The final variable to be discussed in the context of the time series analysis is harvested area, which can be found in Figure 8.

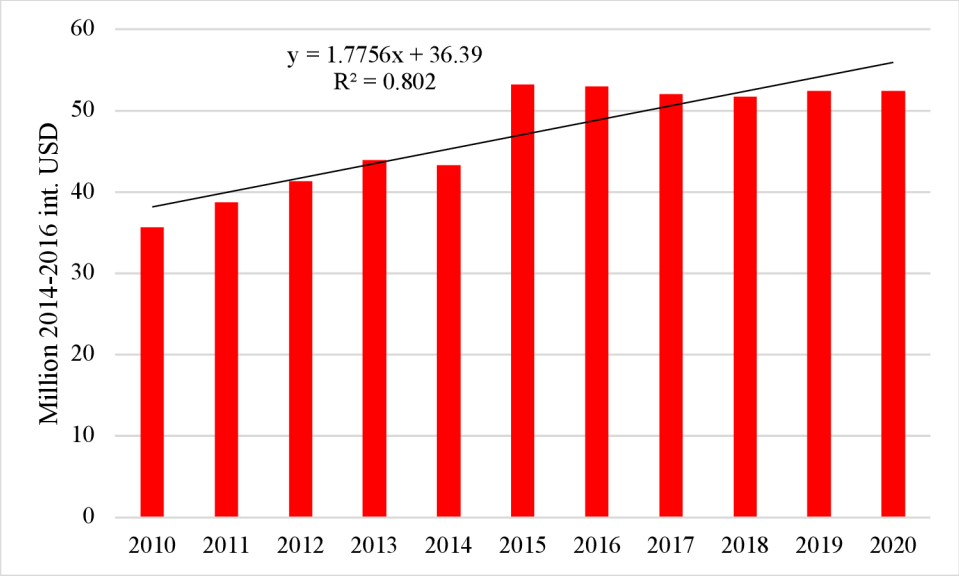
Figure 8, harvested area over time (2010-2020)



Source: own analysis based on FAO, 2023

In fact, the area is quite likely to be the main factor behind the stagnation in the production of maize between 2015 and 2020. Despite the constant increment in yield, the area was diminishing between 2015 and 2020, which can be the consequence of bad weather conditions or other micro problems from the farm level. As it stands as of 2020, the number of hectares harvested was rapidly diminishing from 2015 and if the situation will not be improved, constantly increasing yield will not help because the total production function is the result of the multiplication between the yield and harvested area. Henceforth, it is identified that the most troubled aspect of China's maize production is the situation with the harvested area that needs to be solved. Figure 9 presents the chart indicating the total value of maize production in China.

Figure 9, the value of production (2010-2020)



Source: own analysis based on FAO, 2023

As a matter of fact, it is visible that the graph almost perfectly replicates the production chart indicated in Figure 5. The trend function highlights that the annual increment accounted for 1.775 million 2014-2016 international USD, which is a decent value.

4.2 Correlation Analysis

This specific kind of analysis takes a slightly different perspective on the subject and instead of looking at the agrarian sector, it helps to understand the situation in the context of the whole country. In the correlation analysis, the correlation between selected socioeconomic indicators and the total production of maize in China will be assessed and then verified, which can help to find other important drivers of the production function apart from yield and area, whose contribution is pretty self-explanatory and evident. The table with calculated Pearson correlation coefficients is in Table 3. Alternatively, the table containing the dataset used in the correlation analysis is presented in the list of appendices to the bachelor thesis – Table 9.

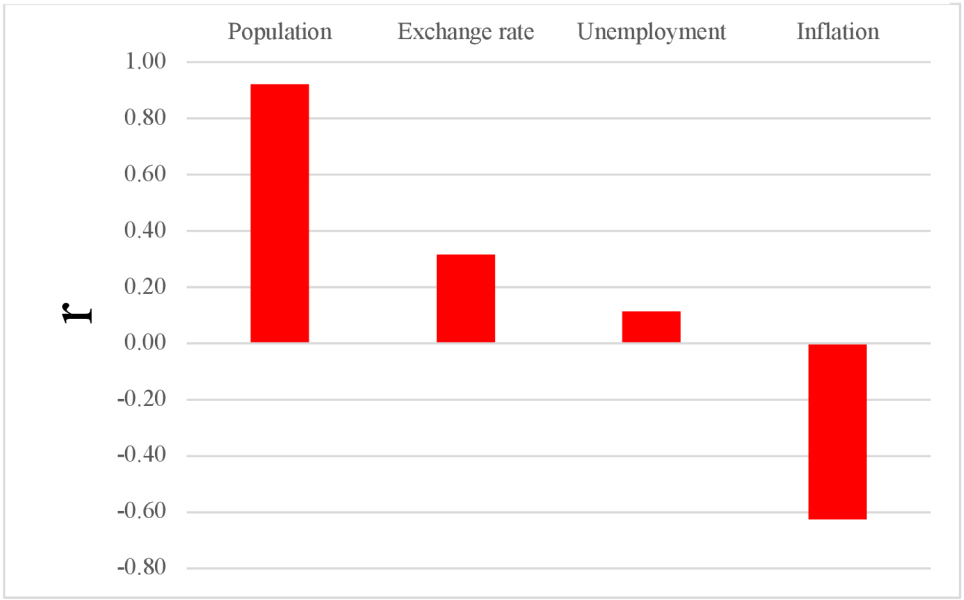
Table 3, correlation analysis (2010-2020)

	Production	
	r	t
Population	0.92	7.06
Exchange rate	0.32	1.00
Unemployment	0.11	0.34
Inflation	-0.63	-2.41

Source: own analysis based on The World Bank, 2023

Before interpreting the results of the correlation analysis, the author generates a visual representation of the correlation analysis, which will prepare a more facilitated ground for the description of the situation identified. Consequently, for instances with the t value roughly smaller than 2, it is wise to indicate the absence of statistical significance, notably for unemployment and exchange rate. Alternative, population and inflation's correlation are significant. The bar chart with the framework is presented in Figure 10.

Figure 10, the correlation analysis bar chart (2010-2020)



Source: own analysis based on The World Bank, 2023

It becomes quite obvious after looking at Figure 9 that the strongest correlation between the selected indicators for the analysis is identified between the population and production, which has already been mentioned earlier by the author. Effectively, the production of maize in China has tremendous importance and it is quite natural and logical that the country will

be increasing the total production volume thus catching up with the population growth. The exchange rate is also positively correlated with the total production, but this correlation is not significant when judging by the t-value from Table 3. The same applies to unemployment, which has the lowest magnitude of the correlation with the production of maize in China. However, the correlation between inflation and total production is statistically significant and not it just significant, but it is also negative, meaning that once one variable increases, the other goes down and vice versa. Based on the economic theory, it is quite logical to assume that it is the inflation rate that influences the production and not vice versa – once inflation soars, it results in a higher cost of production, which cannot be covered by some farmers who will significantly limit their production of the culture.

4.3 Self-Sufficiency Analysis

The self-sufficiency analysis is definitely one of the most important techniques used in the bachelor thesis since the question of self-sufficiency has been a central motive in China in relation to almost all essential agrarian products starting from the 60s and 70s of the previous century. In fact, it is important to note that the centrally planned economy to some extent provides a solid fundament for ensuring self-sufficiency in the country since with a higher degree of control and intervention, market failures in agriculture can be corrected quite quickly given that the government implements the right measures. For the self-sufficiency analysis, it is essential to know 2 indicators, as has already been mentioned earlier – the domestic production quantity, which is usually represented by the total production and the domestic consumption. However, in the context of the framework, domestic consumption is far more important because every production is usually based and projected according to the volume of the domestic production.

Undeniably, countries can still produce agrarian products and export them overseas, but this is traditionally done by least developed countries, who have the highest share of their value added from the primary sector, while highly industrialized countries like China will definitely not be seeking to become a huge exporter of agrarian products for the sake of earning revenue. Alternatively, the country can focus on this specialization in order to strengthen the cooperation between specific countries, such as the case of China with least developed countries, but it is still essential to consider that Chinese maize production is

almost fully driven by domestic consumption rather than a desire to export the product overseas.

Domestic consumption is a complex indicator which in fact involves 4 individual indicators – the production quantity, the export volume, the import volume and the change in stocks. Undeniably, it is essential to note that during some years, countries face the situation when some of their stock is still left, so it will be used in the next year and because of this it is essential to incorporate the index into the calculation as well. Nevertheless, the author presents the result of the implementation of the formula from the methodology of the work in Table 4.

Table 4, the self-sufficiency calculation (2010-2020)

Observed Year	**Production**	**Domestic Consumption**	**Self-Sufficiency**
	million tons	*million tons*	*%*
2010	177.54	183.224	**96.90%**
2011	192.9	186.099	**103.65%**
2012	205.72	189.966	**108.29%**
2013	218.62	183.306	**119.27%**
2014	215.81	173.53	**124.36%**
2015	265.16	235.108	**112.78%**
2016	263.78	260.29	**101.34%**
2017	259.26	266.895	**97.14%**
2018	257.35	276.934	**92.93%**
2019	260.96	279.481	**93.37%**
2020	260.88	270.896	**96.30%**

Source: own analysis based on FAO, 2023

For sure, it is important to start the interpretation by saying that the country is rather not self-sufficient and facing difficulties with supplying the domestic population with sufficient quantities of maize, according to the result of the self-sufficiency analysis. On the other hand, it is important to mention that Chinese self-sufficiency in maize might not be far away and the country can in fact reach a constant self-sufficiency since over time, it managed to approach the desired figure of 100% - notably in 2011-2016. On the other hand, one of the most important characteristics of a strong agrarian sector is its consistency. Yet, the crisis that happened in China in 2014-2015 seems to have left a serious toll on the country's

agriculture given the absence of self-sufficiency in one of the most crucial commodities for the domestic use.

That trait from the previous paragraph is related to one of the four pillars of food security (availability, stability, access and utilization), notably to the stability pillar. The stability pillar of food security is all about decreasing the degree of uncertainty in agriculture, but there arises a logical question – how can consumers be certain of the future and supply of maize in China when the country's self-sufficiency was constantly changing and not always for the best? Undeniably, despite a relatively pessimistic tone and the unfavourable result of the self-sufficiency analysis, it is still vital to note that the country can definitely reach the goal of being self-sufficient in the nearest future since it has a solid ground for accomplishing this goal in the nearest future.

4.4 Terms of Trade Analysis

The terms of trade analysis, compared to the previously implemented techniques, are concerned mainly with the way how the country interacts with other players in the international arena rather than with the way how the country manages its domestic production affairs. For this purpose, the terms of trade analysis are implemented, where the price per 1 unit of export is divided by the price per 1 unit of imports thus providing a ratio indicating by how much the price of exports exceeds the price of imports.

The importance of this indicator is high since countries having rather favourable terms of trade can fully profit from the situation by importing huge quantities of a particular commodity and exporting some quantities of the domestic production thus generating revenue for the country and also satisfying the local demand. All in all, the calculation of the terms of the trade index is also based on FAO data and the results of the analysis are presented in Table 5.

Table 5, the terms of trade analysis (2010-2020)

Observed Year	**Exports**	**Exports**	**Imports**	**Imports**	**Terms of Trade**
	million tons	*million USD*	*million tons*	*million USD*	*%*
2010	0.78	33.38	6.72	1601.30	17.88%
2011	0.54	46.59	6.00	1972.79	26.14%
2012	0.45	101.23	9.63	3106.74	70.16%
2013	0.25	33.24	7.39	2123.73	45.92%
2014	0.11	7.83	6.89	1766.06	27.27%
2015	0.13	5.91	9.03	1984.57	20.51%
2016	0.23	4.63	7.49	1428.10	10.79%
2017	0.48	18.54	7.36	1456.49	19.68%
2018	0.84	6.02	7.85	1647.18	3.42%
2019	1.15	9.83	9.79	2046.46	4.10%
2020	1.00	4.36	15.91	3384.57	2.06%

Source: own analysis based on FAO, 2023

Based on the results of the calculated terms of trade for each year from 2010-2020, it is possible to say that the position of China in trade in maize cannot anyhow be classified as strong due to the fact that the price of export is significantly lower than the price of import – the situation was especially critical in 2018, 2019 and 2020. On the other hand, the author believes that such low figures in terms of trade analysis can be justified by two aspects – the first one is that the country is in a desperate situation with the constant pursuit of self-sufficiency status, so it exports really low quantities and imports high quantities, or that the country exports the low quality maize mainly to world's least developed countries that get the commodity at a really good price for them. (Siméon et al., 2022; Ya & Pei, 2022)

All in all, the country's situation with the commodity does not definitely look quite good when considering that the country is not self-sufficient as well. Yet, as it can be the case with self-sufficiency, the same can be said about the terms of trade – once the country will improve its stance with self-sufficiency, it is possible to expect that the terms of trade of the country will be improving as well due to the fact that the country will possess a

production that is fully able to support the domestic consumption with just little intervention and help from international partners.

4.5 Regression Analysis

The regression analysis, instead of being focused on just specific years, is concerned with the whole study's time period, where the average contribution of 1 unit change in the selected factors to the change in the total production of maize in China will be studied. The implementation of the linear regression technique is done in Excel and the reduced output with unnecessary information cut is presented in Table 6.

Table 6, the regression output (2010-2020)

Regression Statistics	
Multiple R	99.97%
R Square	99.95%
Adjusted R Square	99.93%
Standard Error	0.86
Observations	11

	df	**F**	**Significance F**
Regression	2	7.30E+03	8.97E-14
Residual	8		
Total	10		

	Coefficients	**Standard Error**	**t Stat**	**P-value**
Intercept	-223.13	6.82	-32.73	0.01
Yield	38.22	1.41	27.11	0.01
Area	5.86	0.08	72.54	0.01

Source: own analysis based on FAO, 2023

The estimated model is a multiple linear regression, meaning that it has two independent variables and 3 regressors, including a constant. Based on the result of the analysis, it is possible to create the following model:

$$Q = -223.13 + 38.22Y + 5.86A + Error$$

Therefore, it is also possible to provide a sophisticated interpretation of the regression coefficients:

- If yield and area are both equal to zero, the average production will be -223.13 million tons. Despite the fact that the sign does not make sense at all, the constant is significant, and the author believes that the described relationship does make sense. After all, if both elements of the production function are equal to zero, there will be no production at all, so it will be zero. However, the framework of the linear regression analysis does not bear the original production function in mind, so it returns a negative value.
- When yield increases by 1 t/ha, the production of maize in China will increase by 38.22 million tons, if other regressors remain constant. The regressor is significant because the P-value is almost equal to zero.
- When the area increases by 1 million tons, the production of maize in China will increase by 5.86 million tons, if other regressors remain constant. The regressor is significant because the P-value is almost equal to zero.

The model is significant, according to its F-value and also to its P-value and a very huge proportion of the variation in the total production is explained – 99%, when judging by the adjusted and normal coefficients of determination, which is a very good result.

In fact, it might become evident that the yield is much more influential than area, but it is important to understand one important aspect – yield and area have different units and they depict absolutely different things, so comparing the absolute values of different units is definitely not sensible, so for this purpose, elasticities will be calculated for every single year and then the average elasticity per factor will be calculated. The complete table with elasticities is presented in Table 7 with the average percentual contribution of each factor shown in the very last row.

Table 7, Elasticities of yield and area (2010-2020)

Observed Year	**Yield**	**Area**
2010	1.19	1.08
2011	1.14	1.02
2012	1.09	0.99
2013	1.05	0.97
2014	1.03	1.01
2015	0.85	0.99
2016	0.86	0.98
2017	0.90	0.96
2018	0.91	0.96
2019	0.93	0.93
2020	0.93	0.93
Average	***0.99***	***0.98***

Source: own analysis based on FAO, 2023

Based on the calculation, it is possible to say that the average contribution of a 1% change in yield to the change in the total production was 0.99% - almost unit elastic. In turn, the average contribution of a 1% change in the area to the change in the total production was 0.98%. Therefore, there is enough evidence to highlight that yield is a more influential factor for maize production in China. With this final piece of the puzzle, it is possible to finally proceed to the interpretation of the results in a more sophisticated way, where it will be compared to what scholars and academists have been saying about the maize production and agrarian sector in China as a whole.

5 Results

5.1 The State of Chinese Maize Production

The Chinese maize sector, according to the author's analysis is in a very dynamic state. According to the identified tendencies and results of individual quantitative techniques applied by the author, he was able to provide a comprehensive overview of the current state of one of the most important industries from the Chinese primary sector. To begin with, it is essential to start by saying that the country managed to significantly increase its production volume, which has increased by 47% in 2020 compared to 2011. At the same time, it is important to note that the increase in the production per capita, which is an important indicator not just of the well-being of the industry but also of food security, was slightly lower – just 39%. However, this is still good when realizing that the country hosts a domestic population of more than 1.4 billion people that constantly increases and even despite the fact that the times of uncontrollable population growth have long past, it is still essential to keep the production up with the population growth, especially when considering that the analysed culture has tremendous importance for the country. On the other hand, the phenomenon described by the author is not seen as something special by Chang (G. G. Chang, 2015), who believes that China is facing a serious demographic problem with a rapidly ageing population and a younger generation that was significantly influenced by the "one-child policy" and its long-lasting repercussions, so Chinese agriculture does not really face a similar kind of problem as India, whose population growth can be categorized as uncontrollable, according to some scholars, James (James, 2011). Therefore, the process of increasing the production per capita is not obscured by an uncontrollable population growth thus giving the country a good foundation to host their agrarian policies. On the other hand, despite the evident focus put on the production per capita, it is viable to mention that maize, despite wheat and rice, is largely used as a catalyser of the expansion of the country's massive livestock production, where maize is the main feed used. In that regard, in order to ensure stable and rapid expansion of the country's livestock production, it is undeniably crucial to address the issues of the maize production in more detail. (J. Li, 2009; *Maize in China: Production Systems, Constraints, and Research Priorities*, n.d.)

However, the question of whether the agrarian policy of China in relation to maize is effective or not can have different answers as the situation with the self-sufficiency in the

commodity in China is ambiguous. On one hand, the country has figures quite close to being classified as a self-sufficient country but on the other hand, the country is still not self-sufficient. Scholars suggest that the goal of becoming self-sufficient by 2030 is quite attainable, but the author believes that it depends necessarily on the way how the country will be willing to encourage farmers to remain productive and how will the situation with global warming and pollution evolve in the nearest future (Cline, 2007). China, as it might not come as a big surprise, is one of the world's leading manufacturers, which almost entirely generates its value added from the secondary sector of the economy, which is usually accompanied by high pollution and emission of greenhouse gases. Therefore, the author believes that the self-sufficiency objective might not be attained by 2030 and it might be caused not by domestic issues but actually by global warming and the projected negative effect that it would have on agriculture if nothing will be done on the part of the world's biggest industrial countries, such as China and India. The same thought is shared by Anderson et al. (Anderson et al., 2020).

Additionally, it is important to mention that the production of maize in China might be also influenced by socioeconomic factors. The impact of population growth is pretty self-explanatory and obvious, which was underpinned in the correlation analysis, but it is important to mention the effect that inflation has on production. The correlation between the total production and inflation was statistically significant and negative, which implies that whenever inflation rises, farmers are presumably not so willing to increase their production, which might be explained by a relatively low degree of assistance from the government to farmers facing difficulties. However, this finding might be a consequence of sampling just 11 observations, which is surely not enough to consider it a solid ground for such an assumption. The same applies to the terms of trade analysis, which proved that the country has a very unfavourable situation in the trade of maize with other countries – the country never had a price of 1 unit of exports higher than the unit of imports, which is definitely not a good sign at all.

During the final stages of the practical part, the author was interested in the contribution that yield and area provide to the production of maize in China. Both indicators were developing in a very dynamic way, where yield was constantly being increased over the studied period and the area went through a period of increase but then started to gradually

fall. Some scholars and the author is no exception, blame adverse weather conditions for the phenomenon since agriculture is a practice that requires fixation on land, which is in turn highly influenced by the weather.

All in all, it was identified by the author that the two factors almost fully explain the development of the total production of maize in China, but the yield was a more influential factor, according to the result of the elasticity analysis, where the effect of a 1% change in yield resulted in a 0.99% change in the total production, and the effect of a 1% change in the area resulted in a 0.98% change in the total production. The author believes that this particular tendency of increasing the importance of yield will become more and more common in the future, especially for developing countries that will manage to utilize all suitable land that they have thus having no further room for increasing harvested area, so increasing yield with new techniques, practices and fertilizers is likely to be the main option. There might be some evidence that China has already managed to use all of its available and suitable for harvesting fertile land, so the country might face difficulties in the future if yield will not be constantly increased - as it was highlighted by Zhang et al. (Q. Zhang et al., 2020).

5.2 Future Development and Recommendations

As was already mentioned, scholars coincide with the suggestion that China is likely to become fully self-sufficient in maize by 2030. The author will not be so optimistic with his prognosis because self-sufficiency does not only depend on domestic production, but it also depends on domestic consumption. In light of the circumstances, when the state is not fully happy with the current demographic situation, it is fair to assume that China will make a huge effort to turn the tide and prompt younger generations to consider the idea of having children more actively, which will have its direct implications on the self-sufficiency. In other words, the author believes that if the policy will work out and younger generations will be more fertile than their parents, it is likely that the country will always remain on the verge of being self-sufficient in maize at approximately 95-97% in index terms.

Another problem with eventually becoming self-sufficient is not just the domestic consumption that might quite soon surge but also the drop in yield that can happen once global warming will not stop. China will surely be no exception when it will come to facing

consequences from the increase in the average temperature in the world, so the situation might become even worse if both the deterioration of the environment will continue and the demographic boom in China will happen.

Based on this, it is essential to provide a series of recommendations, which will consist of just one important recommendation. Undeniably, China has been in the spotlight of the whole world for a very long time – the country was increasing its presence in distinctive parts of the world, notably in Latin America, Oceania and Africa and it is still the powerhouse of the world's economy and business world. However, all that China is currently doing is surely ambitious and beneficial for the country's international position and credibility, but it is essential to ensure that future generations will be able to profit from this international credibility that is being earned by the country.

Clearly, one of the best ways to ensure that the future generation will fully be able to profit from what the current Chinese government is creating and doing would be switching to sustainable growth rather than just ordinary economic growth. Only a sustainable kind of growth can help China to achieve development without compromising the needs of future generations and almost certainly, it will secure a peaceful and safe future not just for maize production, but also for other agrarian industries that can one day face a serious problem because of uncontrollable pollution and greenhouse emissions that are generated by the secondary sector of the country.

Of course, shifting to sustainable growth will imply that the country should let go of the ambition of overpassing the United States and becoming the biggest economy in the world, but the author believes that this will definitely be worth it since the economic hegemony is not likely to save agriculture from diminishing yields and production, and neither it will be possible to save the population from constantly facing shortages with specific commodities. Therefore, it is suggested that the country should not just focus on renewable energy sources, as it has been doing over the past 2 decades, but it should also focus on limiting the emission of greenhouse gases that can only be achieved with the help of either shutting down a part of production concentrated in the country or by introducing specific legislation that will limit the amounts of pollution produced by those companies.

Based on the suggestion, it is expected that such measures can secure a stable future not just for one agrarian industry but for all agrarian commodities produced in the country. Thus, the country will not be self-sufficient just by 2030, but it will be able to remain in the same way in 2040, 2050 and onwards, which should be regarded as a far more important issue than just becoming self-sufficient in 2030.

6 Conclusion and Discussion

The bachelor thesis was concerned with the analysis of maize production in China, where the main objective of the thesis was formulated with the help of 5 equally important research questions, which could eventually be answered thanks to the methodology selected by the author. Answers to those research questions will be specified in paragraphs, each dedicated to one question.

1) Is China self-sufficient in maize production or not?

It was identified that out of the eleven analyzed years (2010-2020), China was self-sufficient in maize in just 2018 and 2019, but it is projected by the majority of scholars that the country can attain the objective to become self-sufficient by 2030. Despite the fact that the country has the index of self-sufficiently in maize fluctuating around 100% but being slightly lower, the author is not so optimistic about the prognosis because of 2 important factors – the potential demographic boom that can emerge as a result of a new demographic policy of China (Cai, 2020) and a potential deterioration of yields because of the global warming and pollution (International Fund for Agricultural Development (IFAD), n.d.).

2) Is China capable of maintaining a steady growth in per capita production given the development of the total population?

Despite not being self-sufficient, the country manages to constantly increase the number of kilograms of maize produced per person per year, and according to the descriptive analysis, the increase in the indicator in 2020 compared to 2010 was 39%, which suggests that the country was able to keep the production growth up with the population growth. On the other hand, the population growth of China in the 21st century cannot anyhow be compared to what is experienced by other countries, such as India, where keeping up with the population growth is much tougher than China which had seen better days of demographic boom a long ago in the past. Therefore, technological progress can positively contribute to the improvement of yield thus partially offsetting the negative effect of the climate change.

3) What are the terms of trade for maize in China?

The situation with the terms of trade in maize trade in China is not favourable at all since the country sells its maize for a very cheap price compared to the price of import resulting in very low figures for the terms of trade. Therefore, it is possible to suggest that the country does not have a strong trading position in maize, which arises from the constant need for importing the commodity due to the absence of autarky in the commodity. On the other hand, this complex situation is likely to negatively impact the livestock production as well as the cost of production, given the unfavorable development of the import price of maize, is inevitably likely to impact the whole livestock sector given the role that maize plays for feed (J. Li, 2009).

4) What is the future of maize production in China?

The future of maize production in China in the short-term perspective (3-5 years) is likely to be bright as the country will quickly increase its production after facing a period of stagnation during the pandemic. On the other hand, the future development of maize production, as well as other agrarian products depends on the attitude of the Chinese government towards sustainable development. Despite the fact that the government has recently recognized a huge potential in renewable energy sources, the country is still one of the world's biggest producers of CO_2 emissions in the atmosphere thus accelerating global warming. Therefore, if no movement towards sustainable growth will be made, the development of maize production is likely to be unfavourable and the country will even become farther from the objective of attaining self-sufficiency than before. Alternatively, if the country will be able to seize the opportunity and prioritize the paradigm of sustainable development over economic hegemony, it can be suggested that the future of the industry is bright, as well as the future of the whole country, because the sustainable development paradigm offers benefits not just to the environmental sector, but also to the economic and social ones, thus forming the triangular of three pillars of sustainable growth – the environmental pillar, the social pillar and the economic pillar. China, with all its resources, economic might and perfectly functioning economic system is surely able to change the way how matters stand now and bring boundless prosperity to the country that is called home by 1.4 billion people today.

At last, according to the own calculations made, the negative sentiment in the previous chapter might seem as an exaggeration as the linear trend plots created indicate a stable increase over time, but not a rapid one. On the other hand, this is perceived as a limitation of the bachelor thesis that did not take into account other complex methods of evaluation that might yield more robust results considering the effect of climate change and other unfavourable aspects.

7 References

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Appendix

Appendix 1, the dataset for the correlation analysis (2010-2020)

Observed Year	**Production**	**Population**	**Exchange rate**	**Unemployment**	**Inflation**
	million tons	*million people*	*CNY/USD*	*%*	*%*
2010	177.54	1337.71	6.77	4.53	3.18
2011	192.90	1345.04	6.46	4.55	5.55
2012	205.72	1354.19	6.31	4.58	2.62
2013	218.62	1363.24	6.20	4.60	2.62
2014	215.81	1371.86	6.14	4.63	1.92
2015	265.16	1379.86	6.23	4.65	1.44
2016	263.78	1387.79	6.64	4.56	2.00
2017	259.26	1396.22	6.76	4.47	1.59
2018	257.35	1402.76	6.62	4.31	2.07
2019	260.96	1407.75	6.91	4.56	2.90
2020	260.88	1411.10	6.90	5.00	2.42

Source: The World Bank, 2023