

Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics



Bachelor Thesis

Economic analysis of rice commodity

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Objectives of thesis

The key goals of the thesis will be to analyze the global rice industry. In particular, the definition and evaluation of the aspects of international rice trade production, exports and imports. Lists and lists the most important players. To use both statistical and econometric mechanisms to examine linkages between rice exporters and selected macroeconomic indicators for 1999-2019. The goal is to determine the overall impact of the chosen variables on the regeneration study for the rice-producing countries.

Methodology

The thesis of diplomas is divided into two sections. The first element is hypothetical, the second the conceptual component is evaluated. To use primarily quantitative and empirical methods to achieve the purpose of the dissertation. The time-series analysis also covers rice-producing countries' exports. Export forecast and signify figures and other important features. Also the use of econometric.

The linear regression is used to model connections between variables by applying a linear formula to the information analyzed, which allows a more in-depth analysis of the factors that affect rice exports. The design derives from economic theory and is an idea condensed. The interconnections between its components are quite difficult in the real economic process. In other terms, explaining economic reality in its maximum scope which is not always feasible and efficient.

The proposed extent of the thesis

40

Keywords

Rice, Production classification, Export, Limitations, Domestic Support, Yield, Milling, Green Revolution

Recommended information sources

Horgan, F.G., Ramal, A.F., Bernal, C.C., Villegas, J.M., Stuart, A.M. and Almazan, M.L., 2016. **Applying ecological engineering for sustainable and resilient rice production systems**. *Procedia food science*, 6, pp.7-15.

Chauhan, B.S., Jabran, K. and Mahajan, G. eds., 2017. **Rice production worldwide (Vol. 247)**. Springer.

Chitawo, M.L. and Chimphango, A.F., 2017. **A synergetic integration of bioenergy and rice production in rice farms**. *Renewable and Sustainable Energy Reviews*, 75, pp.58-67.

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Declaration

I declare that I have worked on my bachelor thesis titled “Economic analysis of rice 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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I would like to express my greatest gratitude to Ing. Petr Procházka, Ph.D., MSc for all his tremendous support towards me while I was writing my thesis. I would also like to thank to my girlfriend and her mother for their support at every step of my thesis. And special thanks to my parents and family of CZU who guided me and motivated me during my thesis.

Economic analysis of rice commodity

Abstract

The thesis depicts the study on rice which is Asia's key source of the meal and a significant source of jobs and livelihood in rural areas. The research is divided into two fragments; the first part discusses the application of rice and its international trade, also the rise of global trade in rice and its effect on global rice exports have been studied. The second section is numerically focused, for which a linear regression analysis was performed using the least square method to determine the dependency of rice exports on selected macro-economic indicators.

The primary target of the examination will be to figure the mechanical yield of rice creation on the planet. To satisfy increasing food demands, rice production needs to be expanded which can be done with a proper capacity of rice for irrigated systems, to close the yield gaps in rainfed systems by improving tolerance of high yielding crops to abiotic stress, and lastly to examine the connections between genotypes and the climate, so as to improve sustainable tolerance to pests and diseases. As more escalation of rice creation is up and coming, researchers will consider the negative natural results of developing rice yield and set up enough moderation choices.

Keywords: Rice, Production classification, Export, Limitations, Domestic Support, Yield, Milling, Green Revolution

Hodnocení rýžového produktu

Abstrakt

Diplomová práce zachycuje studium rýže, která je klíčovým zdrojem obživy v Asii a hlavním zdrojem práce a živobytí ve venkovských oblastech. Výzkum je rozdělen do dvou částí; První část se zabývá výzkumem rýže a jejím mezinárodním obchodem. Rovněž byl studován růst světového obchodu komodity rýže a jeho dopad na světový vývoz. Druhá část je numericky zaměřena, a její součástí je lineární regresní analýza k určení závislosti vývozu rýže na vybraných makroekonomických ukazatelích.

Primárním cílem je zobrazení mechanického výnosu produkce rýže na planetě. K uspokojení rostoucí poptávky po jídle je třeba rozšířit produkci rýže se správnou kapacitou pro zavlažované systémy, minimalizovat ztráty ve výnosech systémů zavlažovaných deštěm zlepšením tolerance vysoko výtěžkových plodin vůči abiotickému stresu a v neposlední řadě prozkoumat souvislost mezi genotypy a podnebím a podpořit tak rozvoj udržitelné odolnosti vůči škůdcům a chorobám. Jak se produkce rýže zvyšuje, vědci zvažují negativní přirozené výsledky vývoje výnosů rýže a určí závažnost dopadů na životní prostředí.

Klíčová slova: Rýže, Klasifikace produkce, Export, Omezení, Domácí podpora, Výnos, Frézování, Zelená revoluce

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List of abbreviations

WTO:	World Trade Organisation
FAO:	Food and Agriculture Organisation
OLS:	Ordinary Least Squares
HYV:	High Yielding Variety
MMT:	Million Metric Ton
MT:	Metric Ton
IR8:	Hight Yielding Semi-Dwarf
CGIAR:	Consultative Group from International Agricultural Research
ANOVA:	Analysis of Variance
URAA:	Uruguay Round Agriculture Agreement
EC:	European Commission
AMS:	Aggregate Measure of Support
FAIR:	Forced Arbitration Injustice Repeal
VMD:	Vitamin and Mineral Deficiency
FAPRI:	Food and Agricultural Policy Research Institute
FOB:	Free on Board
PPP:	Public Private Partnerships

1 INTRODUCTION

Oryza Sativa is possibly a descendant of wild grass that commonly cultivated on the foothills of the far Eastern Himalayas. Some suggest the rice crop might have originated from southern India, then migrated to the north of the country and then to China. It was subsequently founded in Korea, the Philippines and then in Japan and Indonesia. It's brought to Tunisia, Morocco, and Spain through Arab tourists, and so they flew all over Europe. Portugal and the Netherlands took rice to their West African colonies, and then traveled to America through the 'Columbian Natural Resources Exchange'. As is traditionally known, however, rice is a slow start, and that is also true because rice took root in America almost two centuries after the trips of Columbus (Chauhan *et al.* 2017). Afterward, the rice starts on the road to Spain by the Arabs in 700 A. D. And then at the beginning of the 17th century, the Spanish brought rice to South America.

Rice has spread steadily throughout the nation, and it has taken root in every corner of the world, it has remained a major agricultural and economic commodity for the citizens. More than a third of the agricultural land is granted rice in the world. For most people in the world, it's a very important part of daily meals. Rice is owned and cooked every day, as well as in celebrations and special events, along with wheat and maize. For more than half the world's population, rice is the staple food. Annual production is about 480 million metric tons.

The rice produced and eaten in China and India alone account for 50%. To millions of Asians living in poverty, rice provides up to 50 percent of the dietary caloric supply and is therefore essential to food security. In both Latin America and Africa, it becomes an essential food staple. Since the emergence of the green revolution, massive rises in rice cultivation have been seen. Rice remains, though, one of world trade's most secure food resources. Vitamins and minerals are poorly supplied by rice and losses are observed during breaking (Espeet *al.* 2016). Vitamin and mineral deficiencies are extremely at risk of communities subsisting on rice. Improved rice-fortification systems have the ability and the related negative health effects to cope with these deficiencies.

In many countries, the rice industry is growing and there is a chance to strengthen a considerable share of rice for distribution or use in government security network programs aimed at the neediest, particularly women and children. For promoting and implementing

rice fortification in countries, multispectral approaches are necessary. There is a high level of volatility in the global rice market because there are relatively large changes in total trade as a result of the small changes in production or consumption.

Rice, which is only treated with husks called brown rice, contains around 8% protein and small quantities of fats and is a source of thiamine, niacin, riboflavin, iron, and calcium. The rice which is milled to remove the bran is also known as white rice and nutrients have been greatly reduced. If white rice is a significant component of the diet, beriberi, a disorder arising from thiamine and mineral shortages, are at risk. Before milling, parboiled white rice is treated to retain most of the nutrients, and the fortified rice includes iron and B vitamins. Boiling rice is cooked. It is eaten alone and in a wide range of soups, side dishes and main dishes in the South, Middle East, and many other countries (Marxen *et al.* 2016).

Rice is mostly produced, consumed and traded, Thailand, Vietnam, India, Pakistan, and China are the principal exporters of Asian countries. International trade is now free from statistical constraints under the World Trade Organization (WTO) law. The economy of a country is largely based on its relative and efficient international trade advantage. Every country faces tough international competition and not only tries to maintain but also to increase their market share (Ziska *et al.* 2015).

In contrast to other agricultural commodities, the global rice market is much conservative, restricting production. Concurrence in no way is a new problem, as it seems to be a few days now. This concept has become trendier due to the liberalization of the markets and the emphasis on a more global economy. The competition was historically based in more areas and nations but is now relevant everywhere with growing international exchange. Concurrent rivals are not thoroughly known and may now be from a remote location, which was historically not the case (Mohammadi *et al.* 2015).

The rice sector's policy on government policy is a continual phenomenon. These strategies were placed on national, economic and social grounds. The rise in the import bill will negatively impact the balance of trade. It fits forecasts as policies on exports and imports of rice are not symmetrical, and in recent years India has continued to be sold at a lower level at home than international prices. Rice trade deformations occur worldwide. The rice market, mostly in China, Indonesia, India, Japan, Vietnam, and the USA, is controlled by state trading firms (Liu *et al.* 2016).

Trends in State exchange contribute to the lack of price stability and competition of trade. All of India is ready to export Basmati to China because both sides have managed to resolve regulatory problems that block exports. Liberalization will have important implications for the redistribution within countries of the benefits of rice production. Thailand is an obvious exception because rice is managed by a very competitive export group. Protection changes in the world rice market are expected to increase economic welfare by more than 7.4 billion dollars per annum (Horgan *et al.* 2016).

2 OBJECTIVE AND METHODOLOGY

2.1 Objectives

The main objectives of the thesis are to examine the international trade of rice. In specific, the description and analysis of the growth, export and import aspects of international trade in rice. The most important players are listed and described. To examine the connections between Rice exporting countries and selected macroeconomic indicators for the period 1999–2019 by using statistical as well as econometric processes. The aim is to assess the overall effect on the rice-producing countries of the selected variables based on the regression analysis.

2.1.1 Hypothesis:

- Increased rice production will prompt an expansion in the fare of rice.
- To analyze the structure of rice productions and its effects.
- Identify rice production and supply to the market.
- When the Index of currencies decreases, the exports of Rice also diminish.

2.2 Methodology

The thesis will be subdivided into theory and practice to analyze the subject in detail. Therefore, the dissertation approach should first provide a summary of the literature and philosophy of rice and its use. Secondary information which will be used for this thesis will be from papers, texts, official documents, journals, surveys, and analytical newsletters as well as other relevant materials on the topic.

Then the data on rice-producing nations are collected and processed. Throughout the period 1999–2019, rice exports and selected indicators are displayed graphically using charts and tables. First, the functional component concerns the evolutions of the variables selected. All information will then be examined using the Gretl software linear regression analysis to determine the variable relationship's dependence and validity. Of financial, numerical and economic verifications, the findings obtained will be checked. The last section of the economic analysis would include the implementation of the method for forecasting.

An econometric study begins with several proposals on certain economic aspects. The linear regression method is the most important tool of econometrics. The linear regression method seeks to analyze the connection between a variable dependent and one or more

independent variables. This assesses whether the different variables describe the variable dependent. Regression has these main hypotheses:

- Linear association
- Multivariate normality
- Very little multicollinearity
- No autocorrelation

The assumption is extremely important because the failure of any one of them would make the method unstable.

2.3 Economic Model Formulation

All economic research will originate from an economic model. The method follows deductive principles. The first step is the formulation of logical theories and ties between macroeconomic indicators. The economic model that correlates to the presumptions is then recommended. The economic model is nevertheless only a logical description of what is believed to be true by the researcher. Besides, the correct selection and classification of variables, including units for measurement, should be emphasized. It is necessary to formulate the model:

Define the subject

Choose the relevant parameters

Identify the working shape

The economical template may be written as follows:

$$y = f(x_{1t}, x_{2t}, x_{3t}) + u$$

Where:

y= Explanted variable

X_{1t-3t}= Explanatory variables

u= Random factor

The variable described is the topic that should be clarified. Indicators are the explanatory variables that are to be related to improvements in the parameter mentioned.

The random variable is the substance that affects the described parameter, not in the model.

Therefore, it is believed that the described and explicatory variables or the explanatory variables do not have overlapping relationships. The economic model that is defined serves to face economic theory with reality.

2.4 Formulation of the Econometric Model

It is important to define an economic model to confirm that the assumptions made are realistic. The economic model is one of the tools for predicting the future. The econometric model differs fundamentally from the economic model:

- It includes a stochastic variable.
- Contains criteria
- Has a functional shape

The specification of the econometric model consists mostly of determination and description of all variables in the equations. Assumption of the expected values of projected parameters choosing a model's numerical form the econometric system may be written mathematical:

$$y_t = \beta_1 x_{1t} + \alpha_2 x_{3t} + u_t$$

Where:

y_t = Endogenous variable at time t

γ_{1-3} = Parameters of exogenous variables

x_{1t-3t} = Exogenous variables at time t

u_t = Stochastic variable

The described factor can be defined by the endogenous variable usually called y_t . The significance of the described variable is then developed by the model. Thus, on the left side of the equation is always the explicit variable. The explanatory variables can be described in the named x_t , which denotes the t-time variables. Real data are used to illustrate the meanings of these parameters. There are explanatory variables on the right side of the equation.

In the economic model, the stochastic function plays an important role. Above all, these influences are not specific to the model since they include all other influences which affect the described variable and for several reasons. The stochastic factor also called the random variable is named u_t and is part of each formula in stochastic models. This represents the random variable at time t .

2.5 Time series analysis for export

Export prediction helps governments to schedule more effectively, thus boosting trade balance. Traditionally, econometric approaches are used for exports. The emphasis of this analysis is on comparing different simple time-series systems and an econometric method. The results demonstrate that simple time series methods can better predict exports than an econometric model can predict. Complementary modeling methods, cautious information analyzes and parameters, and a predicted climate should be given greater importance in the future.

The econometric framework would also exist in the matrix form:

$$\beta y_t + \Gamma x_t = u_t \quad t = 1, 2 \dots T$$

Where,

β = Endogenous variable

y_t structural parameter = Endogenous variable vector

y_t = Function vector

T = Fixed factor structural parameters

x_t = Vector of the fixed variables

T = Appendix time series observer

The usual least quadratic method (OLS) is the most prevalent one. It's the standard way to fit linear models. The downside is that there is no difficulty with small sample tests over other approaches. The essence of OLS is to search for parameters minimizing the sum of the squares of the deviations between the values observed of the dependent variable and the values predicted of the dependency variable.

3 LITERATURE REVIEW

3.1 Rice-producing nations in the world

The world's main rice-producing zone is the tropical part of Asia called Monsoon Asia. Together, the countries from this area generate 90% of the world's rice production. China, India, Indonesia, Malaysia, Thailand, Myanmar, Cambodia, Vietnam, Philippines, and Japan are significant rice-producing countries. Rice is also grown in Mexico, the United States, France, Argentina, Ecuador, Algeria, Italy, etc. (Truong *et al.* 2017)

❖ China

China is the world's largest rice manufacturer. China produces 130 million metric tons of rice annually or about 36 percent of global production. There is, therefore, a traditional rice-producing country in China that has been developed at an early stage of civilization. Today China is several times more successful than ever, and it can supply nutrition for its large population by planting many HYV rice seeds (He *et al.* 2018).

China's most significant rice-producing regions are

- Szechuan region
- South-West China
- Kwantung Region
- Szechuan-Hunan Region
- Lower Yangtze Basin

❖ India

India is the world's second-largest rice manufacturer. The average annual output is 95 million tons, which accounts for approximately 20% of the global total. Rice is the main food that is cultivated and produced in most of the Indian states. The Valley of Ganga-Brahmaputra regions is preceded by coastal regions that yield the maximum amount of rice (Sann *et al.* 2018).

West Bengal, Bihar, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, Karnataka, Assam, and Odisha are India's largest rice-production nations. Rice production increases, but its average yields are still small composed of other significant rice-producing

countries with the assistance of irrigation, improved crops, fertilizer use and multi-cultivation (Chitawo and Chimphango, 2017).

❖ **Indonesia**

It is the 3rd biggest country in the world to grow rice. Since 1980, Indonesia's national rice yield has been the most noteworthy in tropical Asia. Indonesians are likewise huge customers of rice, averaging in excess of 200 kg for every head every year. Indonesia grows a total of 37 million tons of rice per year. Rice is cultivated on many islands in Indonesia, though Java, Sumatra, and Borneo are the major rice production regions (Oo *et al.* 2016).

❖ **Bangladesh**

Bangladesh is the world's leading rice producer because of its overall rice average of nearly 10 million hectares and its annual yield of almost 30 million metric tons. In Ganges Delta, where annual precipitation above 250 cm and the soil is thick and muddy, rice fields are mostly irrigated (Klotzbücher *et al.* 2015).

❖ **Japan**

Japan is not only the nation that has grown rice under adverse topographical conditions, but is also a leading rice grower. It is the tenth-largest producer of rice in the world. The deep alluvial valleys and the coastal plains of Japan were covered by rice. The Plain of Kanto is Japan's largest rice area. The Japanese have introduced high-performance paddy hybrids 'Japonica' that greatly increase their production. The Japanese agronomists also produced some of the quickly mature plants to be collected within 95 days. In the southern areas of Japan, double rice production is also done (MazidMiah *et al.* 2016).

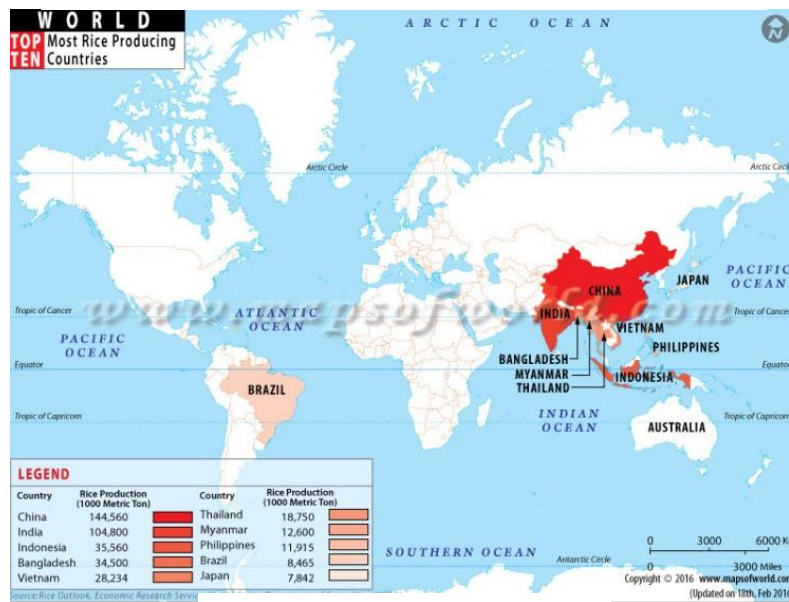
In addition to the countries mentioned above, Southeast Asia is also the leading rice producer. Indeed, rice is produced by every country in Southeast Asia. Vietnam, Thailand, Myanmar and the Philippines are, however, the primary states. In world rice production, the countries ranked fifth, sixth, seventh and eighth. The "Rice Bowl of Asia" is seen as Thailand and Myanmar. Cambodia, Laos, and Malaysia are also rice-producing countries in South-East Asia. Among rice-producing countries worldwide, Pakistan also grows rice and ranks 12th. The West Coast of Taiwan produces paddy (Brand *et al.* 2018).

Relatively little rice is grown beyond Monsoon Asia. In Egypt, both the delta of the Nile and the valley are cultivated rice. The basin drainage system was originally designed to use seasonal floodwater from the Nile River. Rice is cultivated today in the Canal irrigated Aswan dam region, apart from basin irrigation.

In the southern continents, Brazil is a big rice-growing region. Paddy is primarily cultivated in south-east Brazil and is ideally suited for the growing of wet paddy with high rain, swampy coastal lowlands and ample sunshine (Yodkhum *et al.* 2017).

Rice is also grown in the United States, mostly in the coastal regions of the Mexican Gulf. Louisiana, California, Texas, and South Carolina are the most important rice states. Paddy production is carried out in Europe on the Italian Plain in the East, the Spanish Ebro Valley, the French Rhone River and the Balkan regions of dispersion.

Figure 1: Rice producing nations



Source: Maps of world

3.2 Productivity Classification of rice

Rice has developed in over a century nation, producing more than 470 million tons of processed rice every year, with a gross developed area of roughly 158 million hectares. Asia delivers nearly 640 million tons of rice, which represents 90% of the worldwide generation. Around 19 million tons of sub-Saharan Africa and around 25 million tons of Latin America

are delivered. Most rice is developed on little ranches of 0.5–3 ha in Asia and Sub-Saharan Africa (Uphoff and Dazzo, 2016).

The yield scope in broad calm water system frameworks ranges from under 1 t/ha in amazingly poor rainfed conditions to more than 10 t/ha. The low salary of rice rancher families is because of little homesteads and contracting in numerous regions. Rice is effective much of the time where different harvests may battle and develops in a wide scope of conditions.

In high scope regions with taxing day and serious development practice, or in low scopes of desert territories of high sun-oriented vitality, the biggest yield is truly created from plantings. It is expected to incorporate Southwest Australia, Hokkaido in Japan, Spain, Italy and the Nile Delta in north California (Guo *et al.* 2015).

3.3 The development and utilization of global grain

Global rice yield controls horticulture (estimated by the extent of cropland reaped from grains) and by and large nourishment admission (estimated by the extent of grain altogether caloric utilization) in rice creation Asia instead of somewhere else on the planet.

China and India are by a long shot the world's greatest rice makers. Even though its developed area is littler than that of India, the yield of rice in China is higher since rice in practically all of China is watered, while not exactly half Indian rice is inundated. Indonesia, Bangladesh, Vietnam, Myanmar, and Thailand are the following greatest rice makers after China and India. In 2006-08, these seven nations delivered more than 30 million tons of paddies all things considered and together make up more than 80 percent of world generation (Hu *et al.* 2016).

In different pieces of the world, rice is likewise pertinent given Asia's authority of rice generation and utilization. In Africa, for instance, rice has been the most significant staple nourishment in West Africa—characterized as nourishment by the three chief harvests, giving the best measure of calories—and for certain nations in the Indian Ocean for at any rate 50 years. The extent of rice calories, for the most part, didn't increment altogether with time in these nations. By and by, in other African nations, the development of less expensive imports from Asia and the simpler planning of rice, particularly significant in urban zones, have supplanted other staple nourishments.

In general, Africa developed quickly; anyway, rice utilization rose significantly more rapidly, with rising import volumes keeping up the parity. West Africa, which represents over 40% of African creation in 2006-08, is the significant maker sub-region. For every district, Egypt (7.0 million tons; Nigeria (3.8 million tons) and Madagascar (3.2 million tons; 2006-08) are the main makers of paddy (Godwin, 2017).

In numerous Latin American nations, these days, rice is the most significant wellspring of the calories, for example, Ecuador and Peru, Costa Rica and Panama, Guyana, Suriname and Cuba, Dominican Republic and Haiti as the Caribbean countries. All things considered, the estimation of wheat, maize, and beans in national weight control plans is less common in utilization than in Asia. Brazil is by a long shot the biggest maker of paddy yield on the planet, representing practically half (46% in 2006-08). Following Brazil, Peru and Colombia (2.5 million tons each in 2006-08), are the biggest makers, drove by Ecuador (1.6 million tons), and (11.6 million tons).

In the USA (California and the southern states besides the Mississippi River) the most significant generation offices are somewhere else, delivering 9.0 million tons of paddies in 2006-08 by and large (HUANG *et al.* 2017). In the previous two decades, rice utilization on the islands of the Pacific has expanded quickly. Rice, all imported in Papua New Guinea separated from the modest quantity developed, is the principle staple of customary starchy root crops, because of evolving tastes, simple stockpiling and planning, and once in awhile costly.

3.4 Practices of yield upgrade

The Green upset is named after drastically expanding the yields of grains by methods for the current rural pay water system, manures, improved seeds, and pesticides—during the 1960 s. With the presentation of the high yielding semi-dwarf style IR8 in 1966, the insurgency began for rice. The normal yield of rice in 1960 was around 2 t/ha, the aftereffect of thousands of long stretches of understanding. Shockingly, this significantly increased, hitting 4 t/ha in 2000, in only 40 years as the Green Revolution extended. The continuous dry season and starvation in Asia specifically have clarified that wheat and rice generation must be improved to anticipate starvation. The downturn drove legitimately to the formation of the International Agricultural Research Advisory Group (CGIAR) in 1960, and in this way to its sister associations (Kazemi *et al.* 2015).

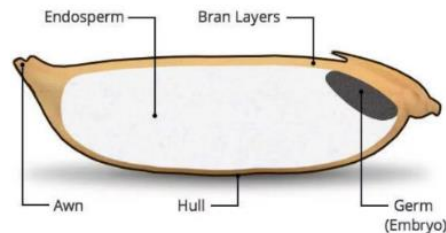
3.5 Adjusting technical Innovations

Water system and manure prompted grain yields, yet simply after high-yielding assortments (HYV) developed was their full impacts comprehended. The semi-predominate rice was increasingly open to plant supplements and had a shorter, harder straw than the heavier heads of wheat. They could likewise develop quicker and couldn't be delicate to light and could in this way enable more yields to be developed on a similar land every year.

In 1966, the first of the HYVs were propelled, named IR8. HYV was presented rapidly, and by 1980 almost 40 % of the complete territory of Asian grains was planted in new assortments. In 2000, it rose to about 80 % of the area planted (Zheng *et al.* 2017).

Although various unique HYV rice species had drastically expanded returns, they were vulnerable to vermin and maladies and had less customer benevolent cooking qualities. The creation of second and third era assortments, which successfully offset high return limit with solid resistance to pesticides and maladies and preferred consumables, has brought about further development in the farming examination.

Figure 2: Structure of Rice



Source: RiceLand

3.6 The Green Revolution's impact

Green Revolution is also known as the Third Agricultural Revolution. The connection between the Green Revolution and the lightening of neediness is anyway mind-boggling, which has offered to ascend to wide. Enormous ranches were the key improvement victors, with poor ranchers either uninfected or aggravated, as a town and family unit tests were performed in a matter of seconds a short time later when green transformation developments are distributed. A few reports have, nonetheless, watched positive long-haul results of neediness (Yao *et al.* 2017).

3.7 Rice yield trends over time

Somewhere in the range of 1999 and 2019, worldwide rice creation has dramatically multiplied with a compound yearly development pace of 2.24 percent (2.21 percent in Asia, which produces rice). Most rice creation increments because of better returns, which rose by 1.74 percent yearly overall, contrasted and a yearly normal 0.49 percent development rate in the territories collected. Completely, the paddy yields expanded at a normal yearly pace of, 1 kg/ha, albeit both the rate and the total build were diminished (He *et al.* 2018).

3.8 The ongoing rice production slowdown

There are various potential explanations behind the rice development and creation stoppage: the uprooting of oats on better terrains with increasingly beneficial harvests, for example, groundnuts, and decline as reasonable exchanges for current species when the water system and preparing utilization are high. There is concern likewise that the opposition of sicknesses and illnesses to present-day pesticides is hindering development, and that the yield capability of huge green insurgency crops has been to a great extent abused by reproducers.

Unreasonable and unsustainable utilization of manures or a synthetic mixture of different components. That taint waterways and reduce to fine particles helpful creepy crawlies and animals in the various zones of the environment are issues. Expanded water shortage insignificant stream bowls and groundwater reclamation in zones. Some of these outcomes were unavoidable, since the utilization, just because, of current contributions. By a huge number of homesteads, which were to a great extent ignorant, was worst by insufficient augmentation and preparing. Lacking powerful water use and quality guideline and information estimating and sponsorship strategies that made present-day inputs unreasonably modest for and energized their abuse (Chitawo and Chimphango, 2017).

3.9 Difficulties in rice productions

The worldwide rice utilization in numerous Asian and African nations stays solid and controlled by the government just as monetary development. Be that as it may, per capita utilization has started to decay at a moderate pace lately in some creating Asian countries, including India, Vietnam, and Indonesia, with expanding income. Rice utilization per capita

stays expanding in different nations of Asia including the Philippines, Myanmar, Cambodia, Bangladesh and Laos (He *et al.* 2018).

Given this variance, per capita utilization in Asia is required to start or to keep on diminishing, later with rising salaries as residents differentiate their weight control plans. In most of the Asiatic nations, it is generally anticipated. There are special cases like India, where rice utilization examples cannot change drastically even as income increment and urbanization quickly influence nourishment propensities. There are Remotely in Asia, where rice stays unaltered, and utilization per capita keeps on rising. This applies specifically in most sub-Saharan African nations, which are quickly extending with high populace development and changing customer inclinations.

As livelihoods rise, individuals move from tuber and cassava to rice in the least created nations, for example, Nigeria, Tanzania, and Ghana. In the Middle Eastern nations, comparable high development all through utilization was clear, with rice consumption nearly multiplying in the previous two decades and considerably more grounded ascends in certain Pacific island nations. The quick increment in per-capita utilization, together with high populace development, drove likewise to such fast rice request development. Rice utilization likewise keeps on developing in Latin American and Caribbean nations, as both populace development and an unflinching ascent in per capita utilization have expanded by 40 percent over the most recent two decades. Per capita utilization keeps on developing, in part due to shifts in the eating regimen from meat to more strands, and movement from Asian nations, even in created economies/areas, for example, the U.S. or on the other hand the European Union.

The UN statistic appraisals and income projections by the Food and Agriculture Policy Research Institute (FAPRI) are relied upon to increment worldwide rice requests to 496 million tons in 2020, from 439 million tons in 2010 (processed grain), and further to 555 million tons in 2035. This is a 26% ascent normal throughout the following 25 years however the development rate will drop from 13% over the initial 10 to 12% over the following 15 years, with populace development falling and individuals expanding from rice to different items (Sann *et al.* 2018).

Asian utilization of rice is anticipated to represent 67 percent of its all-out increment in the various rice-expending nations, from 388 million tons in 2010 to 465 million tons by

2035, while per capita utilization in both China and India keeps on declining. Moreover, Africa will require 30 million tons more rice, an expansion of 130 percent contrasted with 2010. In the Americas, normal rice consumption in the following 25 years is anticipated to increment by 33 % (Heet *et al.* 2018)

3.10 System of strategies

While the Green Revolution was essentially an innovative upheaval, it requested solid government backing and arrangements in the improvement of advancements, the development of the fundamental framework, the activity of business sectors, account, input frameworks, and adequate information and financial motivating forces for ranchers to grasp new practice. Asian nations contributed 15.4 percent on horticulture all things considered by 1972 and significantly increased their genuine estimation of agrarian spending by 1985 (Majumder *et al.* 2016).

Numerous legislatures have utilized their measures to guarantee that little homesteads are not abandoned. Significant experimental proof around then showed that little ranchers were the most proficient makers in Asia and that horticultural change and improvement programs for the advancement and advancement of enormous quantities of little scale ranchers were actualized. Not exclusively was little scale agribusiness advancement increasingly effective, yet additionally professional poor, a successful plan for development and neediness decrease (Davis *et al.* 2016).

4 PRACTICAL PART

4.1 The Trend Analysis of Major Food Grains in India

This research seeks to establish accurate forecasts for the future production of food grains, including rice, wheat, coarse cereals, sugar cane, and pulses by measuring the variation in food grain production, trend analysis, and correlation coefficient. The relationship between rice and wheat production is estimated because of its high importance as a daily food in India.

India is a rising example in the improvement of nourishment grains, sugar sticks, and yield. We may note if there should be an occurrence of nourishment grains, all-out heartbeats, and oilseeds the most noteworthy yield during the year 2016-17 and again it is diminished in 2017-18.

The generation of sugarcane is steady, yet it diminished to 310 million metric tons in 2016-17 and recuperates again in 2017-18. The normal example esteems are diminishing in every one of the cases (Food crops, Pulses, Oilseeds, and sugarcane).

H_0 : There is no variety in the generation of various nourishment crops.

The estimation of variety is utilized for estimating a huge contrast between the classifications of means. The ANOVA shows that the significance of esteem is under 0,000 (i.e., $p=0,000$). This is because the factors imply that they fluctuate at 5% and the invalid theory (H_0) is expelled. To check, which of the gatherings was contrasted altogether it is checked the Turkey post hoc technique, here we acquired the Multiple Comparisons which contains the p estimations of each pair and homogeneous gatherings of non-huge factors.

The above homogenous subsets, first, second, third and fourth incorporate the absolute factor grains, complete gross oats, p -esteem 1000 wheat, and rice, recommend that the elements contrast incredibly from the various elements, so each grain produced is the entirely unexpected form factor. It is apparent from the methods plot that general heartbeat yield is insignificant and rice creation is high. This examination shows that nourishment grains contrast altogether.

Karl Pearson's connection coefficient is viewed as noteworthy; it implies that the rice and wheat are items with a similar degree increment in the year insightful generation and they are distinctive a similar way. In any case, they are autonomous as per the P -esteem. This

discovery demonstrates even though rice and wheat are ordinary nourishment of Indians however their creation isn't in a similar amount.

This paper expresses that the primary nourishment yields, for example, corn, wheat, vegetables, oil are created in India. They inquired about these classes. There, the ends can be gotten by utilizing measurable methods, for example, pattern investigation for the estimation and investigation of future generation variety in the assessment of varieties of the improvement of various nourishment grains, and the relationship among rice and wheat is additionally watched.

4.2 The Trend Analysis of Major Food Grains in China

Historically, China is an agricultural dominant country. The total output of China's grain has raised by five times over the past 60 years, from 113 million tons in 1949 to 571 million tons in 2011, a statistic that attracts producers in other parts of the world. Producing grains per capita doubled, in the same period from 209 kg to 425 kg. China has successfully maintained fundamental grain autonomy at the national level over the last three decades. But China will need around 776 million tons of grain to feed its people by 2030, a net increase from its best record year by 35.9 percent, given the increasing population pressure and the growing appetite for animal products. China's quest for food security in the future is hampered by problems such as low resource productivity and lack of space, reduced yield reactions, competing for non-farmland uses and environmental degradation.

Thanks to the "green revolution" of genetic development, increased investment of energy and advances in the nutrient control of the grain production mechanism and most of the successful and encouraging agricultural policies, China has made phenomenal progress in the past six decades in grain output and food safety.

The long-term war before 1949 has caused China's agricultural production to be largely fragile and astonishing. In order to solve the problem of low-efficiency grain production by household farmers, the government had imposed the 'People's Commune' scheme from 1949 to 1977. Under this program, extensive work was performed to farm wastelands, to reclaim property and to enact programs on the protection of agricultural land and irrigated soil.

Grain production was strongly encouraged through the People's Commune program. Nevertheless, the sovereignty of the indigenous farmer was significantly diminished because the government removed the privileges of farmers to sell their produce. The growth in cereal

production was very small in the last few years of the 1970s. Consequently, ambitious initiatives and structural changes have been introduced to empower rural households to increase production.

In 1978 the government established the household obligation scheme, which allowed households to sell the grain to the government with a certain quota at contract prices and in return for the use of rights to certain property (Shea, 2010). In 1978, primary land rights were shifted from collective farms to rural households. So long as the quota requirements are met, farmers will generally grow whatever plants they want and sell their crops at the price of the market. The average annual increase in national grain yield over the six years from 1978 to 1984 amounted to 4.8 percent, the highest rate since 1949.

4.3 Procedures of global rice trading

4.3.1 Export subsidies on rice

Colombia, Indonesia, Uruguay, EC (European Commission), and the United States undertake commitments to the reduction of export subsidies under the Uruguay Round Agriculture Agreement (URAA). The practical use, while knowledge is challenging to even get from the WTO, of export subsidies has been limited below the threshold. Proposals for further contributions to cuts would undoubtedly meet the EC's resistance. Additional problems have emerged about rice export pricing, concerning the allocation of US export credits. Nevertheless, export incentives should be interesting, though little information is available in conjunction with such activities, often widely used in government-to-government transactions.

India has been using export subsidies since mid-2001 to facilitate rice exports controlled by the Indian government's Food Corporation. According to the WTO, India is not eligible for export subsidies for rice but states that the nation is excluded from the obligations on distribution, manufacturing, and transportation export subsidies according to the URAA (Article 9-4). Although this is a controversial stance, many countries in the WTO have not so far questioned the nation on that basis.

4.3.2 Limitations on Export

Often, export restrictions on paddy and rice without husk are extended to the safety of the milling industry by many exporting countries. This approach limits the versatility in which

importers try to encourage value-adding industries through the importation of non-milled rice.

4.4 Domestic support

In WTO phrasing, rules are recognized by the “Boxes”. There are 3 types of boxes: Amber box, Blue box and Green box. These are the subsidies given by member countries to promote their agriculture sector. These colour classifications are based upon their effects on trade. You can imagine these boxes as the traffic lights. Amber box (yellow colour) means slow down, Green box (Green colour) means permitted, Blue box (blue box) means restrictions.

4.4.1 Amber box domestic support

In 2000, developed countries fulfilled their AMS (Aggregate Measure of Support) elimination obligations, primarily through demand subsidy reductions. Such reductions were correlated with the increase in rice-makers' compensatory compensation in the EC (European Communities) Japan and the United States (classified in either the ' blue' or the ' black' box). There has been no major production decrease in the change from market assistance to income support, and some advanced countries have now large stocks of rice.

A very large share of the overall AMS in Japan and the Republic of Korea is sponsored by the rice industry. Our plans to reclassify measures (e.g. from the green or blue box to amber box) are likely to be resistive. More cuts in the AMS will also be counteracted on the grounds of concern for national food protection and agricultural sustainability, from a financial, economic and cultural viewpoint.

No developing countries have applied an AMS basis and therefore few are subject to reduction obligations. In countries that have applied AMS in domestic currencies and where inflation is strong, the effect of inflation and exchange rate adjustments on current AMSs may be far more significant.

Figure 3: Amber Box



Source: World Trade Organization

4.4.2 Blue box domestic support

The rice farmers in the EC, Japan, the Republic of Korea and Mexico are subject to decoupled, production-restricting payments. After 1999, the effects of low prices have been critical for producers to deal with. Many participants of the rice industry have strongly criticized them because they are not "decoupled," and they recommend that the decoupled income support and revenue safety nets be removed or decreased from the blue or green boxes into the amber container so that they are vulnerable to declining obligations.

Figure 4: Blue box



Source: World Trade Organization

4.4.3 Green box domestic support

The United States has supported the sector with considerable resources by contracts for versatile output, deductions, and natural disaster compensation, all of which are known as green box initiatives. The new Farm Act, which had been originally issued in the US Farm Bill (FAIR ACT), has since 2002, endogenize the counter-cyclical and disaster payments and is divided into green box initiatives. Besides, there is a propensity to endorse non-materials services such as compensation schemes for producers, including in developing countries.

Figure 5: Green box



Source: World Trade Organization

Many developed countries advocate the introduction of a ' Food Safety ' box that would require protection from cuts of certain policies. This would include measures to reduce hunger and funding for low-income growers directly for goods. It is very important for rice production in many countries, especially in India. This is very important.

4.5 Worldwide production of rice

In the last three decades of the 20th century, there was a massive rise in rice production. The Green Revolution in the 1940 s–1960 s contributed to a rise in farming productivity by developed countries, largely through the conversion of a variety of technical and development initiatives. While low-income populations rose by 90 percent between 1966 and 2000, paddy rice production increased by 130 percent over the same era.

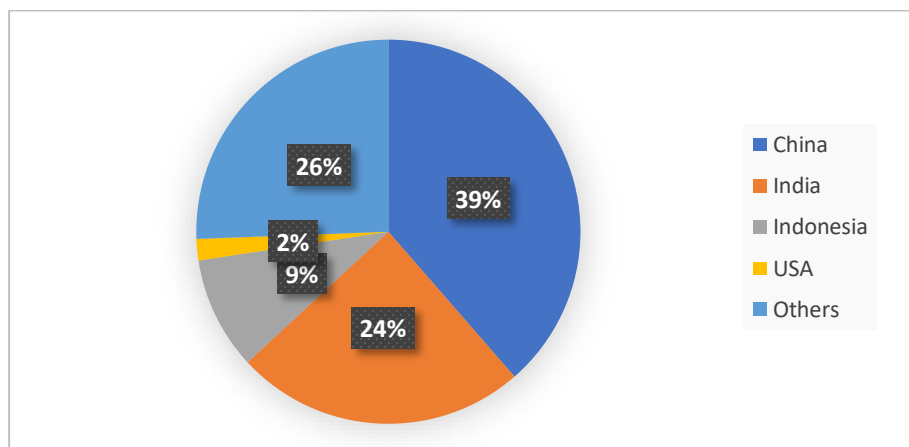
Approximately 84 % of rice production growth was attributed to modern agricultural technologies that produce semi-dwarf, early mature rice species that plant up to three times per year and react to nitrogen fertilizers.

These new rice species grown in the irrigated soils of half of the world's harvested area contribute to approximately three-fourths of the world's total rice population. In many Asian countries, the yield levels doubled or tripled from the average of the pre-Green Revolution. Asian rice demand is projected to grow by 70 % over the next 30 years, mainly driven by population growth.

Currently, rice is grown in over 100 countries which produce over 715 million tons of milled rice (490 million tons of milled rice ;). Fifteen countries accounted for 90% of the world rice harvest. Roughly 50 per cent of rice production is made up of China and India alone. Asian countries make up 90 per cent of the world's total rice production, along with Indonesia, Bangladesh, Vietnam, Myanmar, Thailand, the Philippines, Japan, Pacific, Cambodia, Nepal and Sri Lanka. Brazil, the United States, Egypt, Madagascar, and Nigeria, all of which together constitute 5% of the total rice produced globally.

Other major non-Asian countries producing rice. Rice is the most rapidly growing food in Africa. Throughout Africa, gross cereal production gradually grew from 9.3% throughout 1961 to 19.2% in 2017. However, local suppliers account for only 54 per cent of rice consumption.

Figure 6: Worldwide production of rice

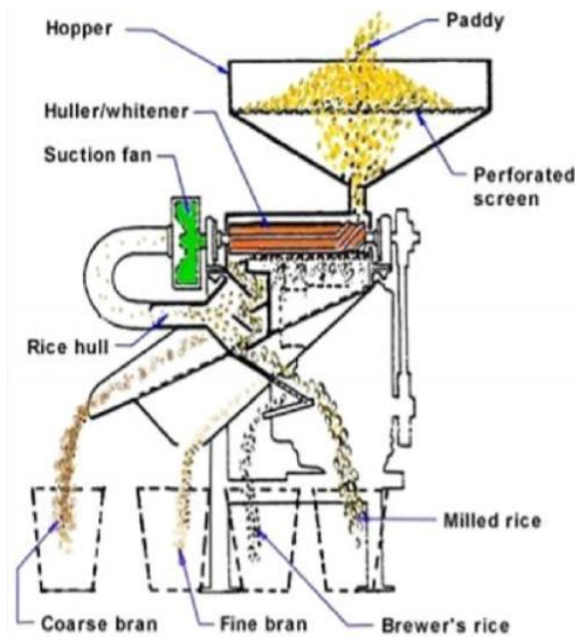


Source: Agri Manila

4.6 Rice Milling

Rice paddy is the final product of the rice grain harvest and threshing. It is usually harvested with around 20% humidity and dried up to around 14% so it can be stored safely. The paddy rice consists of an external layer of the husk, germs, bran, and endosperm. The outermost husk layer can be removed by various levels of friction to produce brown rice kernels, or barns and germ layers can be removed for white rice kernels. The milling process is carried out in one-stop, one-stop village mills, or in a multi-stored process involving the passage of rice grain through a variety of different processes and machinery, from paddy to brown to white rice. On average, 25% husk, 10% bran and germ and 65% white rice are produced by paddy rice. Rice milling, though, contributes to a significant loss of a variety of vitamins and minerals found mainly in outer germ and bran. Rice is a poor source of nutrients and vitamins and the cycle is further depleting the crops. Vitamin and mineral deficiency (VMD) populations subsist in rice are highly risky.

Figure 7: Rice Milling



Source: IOSR Journal of Engineering

But rice can be fortified with vitamins and minerals using various methods for reducing friction losses and/or adding these micronutrients to milled rice. A process that can minimize nutrient losses during the raw rice is swamped in water and partly steamed before drying

and milling contribute to a further transfer to grain by certain B-vitamins. Another successful approach is to improve the vitamin and mineral content needed in its bioavailable type. Today, new technologies have proven themselves to strengthen rice with improved coating methods and cold and hot-extrusion techniques. The research papers provide a detailed description of available technologies, the bioavailability of added nutrients in fortified rice kernels and estimate of the levels of fortification.

In many sections of this world, rice is milled and processed for their use by farmers in thousands of small and medium-size mills in the vicinity of their property. In Asia, the majority of these are less than 1 ha. The local factories use old machinery and technology, ranging from 5 to 60 tons of paddy rice per day.

There are approximately 200 million rice farms in Asia. Mills produce a large share of broken kernels; the rice recovery is white at 53–55 percent and the rice recovery (whole kernels) is only around 30 percent. Nevertheless, in many nations, the rice sector consolidates to include more medium-sized and big mills with a higher processing volume of 60-220 tons of paddy rice per day. We can yield rice up to 50–60%, and broken kernels from 5–10%.

4.7 Worldwide consumption of rice

Practically for a large portion of the total populace, rice is the staple nourishment. Rice is the main food of over 3.5 billion individuals for more than 20 percent of their everyday calories. All through 2019, Rice got 19% of the worldwide vitality per capita for human use and 13% of the protein per capita. Asia represents 90% of the world's rice consumption and there is yet an expansion in all-out rice requests there. Outside Asia, where rice isn't yet a staple, utilization per capita keeps on developing. Rice is Africa's quickest developing staple, and one of Latin America's quickest developing wares. The worldwide utilization of rice, controlled by the populace and monetary development in numerous Asian and African nations specifically, stays solid.

The admission of rice in Asia is extremely huge, in numerous nations more than 100 kg for each annum per capita. Rice offers over half of the nourishment supply for about 520 million residents in Asia, many are low or exceptionally poor. It has been broadly expected that in most Asian nations the per-capita utilization of rice would start or keep on declining as livelihoods rise and diets become enhanced.

Over the most recent four decades, a huge decrease in per capita utilization has been seen among high-salary Asian nations like Japan, Taiwan, and South Korea, just as in Hong Kong. During the most recent few decades, comparative examples have developed in nations with normal earnings, for example, China, Malaysia, and Thailand, as more meat and vegetables have started to be devoured.

As of late per capita utilization has begun to decrease in numerous other Asian creating nations, including India, Vietnam, and Indonesia. Then again, there is an expansion in per-capital utilization in a considerable lot of Asia's mid-to low-salary nations, including Myanmar, Cambodia, Bangladesh, and Laos. It isn't sensible to expect every single Asian nation to follow a similar pattern of diminished rice consumption as expanding extra cash considering the diverse national dietary propensities, for example, the huge number of Lacto vegans in India. The focal inquiry is how every nation's market inclinations move as salary increments and a quick increment in urbanization impacts dietary propensities.

Inside and out, the all-out rice request in Asia keeps on expanding, although the Asian per capita pattern has been watched. Rice is additionally one of Latin America's generally significant and quickly developing essential staples, especially among urban purchasers and poor people.

Rice request in Latin America and the Caribbean has developed over the most recent two decades by 40 percent, because of the blend of development in the populace and the consistent ascent in utilization per capita. The normal yearly utilization of rice per capita in South America is 45 kg, contrasted with 70 kilograms in the Caribbean. Latin America, including Asia, is a net merchant of rice with an expected 4 million tons yearly shortfall in 2015.

The Middle Eastern nations, as well, have seen a comparable sensational increment in utilization, and rice consumption has multiplied during the most recent twenty years. Per capita utilization of rice is expanding even in the created nations and locales, for example, the United States and European Union, somewhat because of movement from Asian nations. The worldwide interest for processed rice is relied upon to increment, considering the United Nations populace and salary gauges from the Food and Agricultural Policy Research Institute (FAPRI).

In the following 25 years, this is a normal 26% ascent; however, the pace of development tumbles from 13% in the initial 10 years to 12% in the following 15 years, when populace development decays and buyers are broadened from rice to different groceries. Asian utilization of rice, given the proceeding with the decline in per-capita utilization in China and India, gauges at 67 percent of the general generation, from 388 million tons, in 2010 to 465 million tons, in 2035. Africa would require an extra 30 million tons of rice, up 130 percent from 2010. In America, throughout the following 25 years, complete utilization of rice is required to increment by 33 percent.

Rice presentation is firmly connected to nourishment security and political steadiness in most creating nations. In a few nations there was social distress because of changes all through rice supply, and in this way the quality. The World Bank detailed that 100 million additional individuals were constrained into hunger during the nourishment emergency of 2008, rice costs tripartite. Rice represents right around one-portion of its nourishment expenses and one-fifth of its absolute family unit costs, by and large, to the incredibly poor in Asia, which live on under \$1.25 every day. This gathering contributes 62 billion dollars (PPP) every year on rice alone.

4.8 The market for rice (imports, exports)

The foreign rice industry is seen as "volatile," because rice is mostly used in the country in which it is grown and the shortage of production results in price volatility. In some situations, the world trade in rice accounts for only 7 percent (35 Million Metric Tons) of the total produce, many of Asia's countries have strict policies and restrictions on rice imports (import and tariff quotas) and exports to achieve national food safety and protect production prices and income, resulting in significant trade distortions; and trade-in rice is heavily segmented by rice varieties (India, Japonica or Aromatic Rice), processing degrees (paddy, parboiled, brown and aromatic rice).

Furthermore, Asian rice grown with rains depends heavily on climate change and leads to uncertain rice yields and supplies. These combinations lead to volatile rice prices and traded volumes. Over the last two decades, demand changes reflect the growth of the economy and, at the same time, market structure liberalization in developing countries has led to significant changes in the rice market. As a result of the Uruguay Round Agreement on Agriculture (URAA), rice exchange has increased both in quantity and as a share of

demand in contrast with the 1970s. Rice remains, though, one of the world's most secure food crops.

Exports of rice now have a focus on 12 countries, including Thailand, Vietnam, Pakistan, India, Italy, Uruguay, China, Benin, Argentina, and Brazil, accounting for over 90% of the world's rice traded in rice. The imports and exports of rice to China, Indonesia, India, Japan, South Korea, Vietnam, and Australia are subject to the control of State trade undertakings. Rice remains a strategic commodity for food security both in China and India. China is now allowing rice producers to offer rice on the open market and stresses price over volumes, and rice production is increasingly becoming more demand-based. Countries like Japan and the Republic of Korea ended their rice import ban decades after agreements under the URAA in the 1990s.

Japan has the rice imports limit now and the products outside the quota have a prohibitively high tariff. Most of the rice purchased is never issued onto the market directly. Its domestic industry is supported by the consumers (mostly short and medium grain Japanese) and producer prices still 10 or more times higher than prices in other countries that grow rice in Japanese or short and medium grains. Similarly, a minimum market access agreement for imports was agreed upon with the Republic of Korea. The fall in rice use and rice imports has contributed to surplus stocks.

4.9 Rice prices

Global rice prices have experienced a declining pattern since the early 60s, largely representing income earnings, grain bumper crops, and policy changes in leading producer countries and exchange-rate changes. There are currently numerous international rice price quotes. In the context of global rice price development, FAO has established initiatives in India and Thailand. The Thai 5% split F.O.B Bangkok is the most used export product in the industry. Many prices may be going in different directions on a regular or even monthly basis, but the numerous rice markets have been consolidated, as prices tend to move together on a long-term basis.

In brief, for a large majority of communities live in developing countries rice is closely connected with food and nutrition welfare. The world saw record increases in rice production, starting with the Green Revolution which implemented sophisticated agriculture technology and new rice varieties. Although the market structure of developing countries

has been liberalized, global rice trade accounts for just 7% of overall production. Rice is a poor source of minerals and vitamins and losses during the process of frying occur. Vitamin and mineral deficiency populations that are present in rice are highly risky. Enhanced rice fortification techniques may tackle the impact of vitamins and minerals on these communities and their potential adverse health implications.

It would be easier to implement plans for building facilities to accumulate rice for both local consumption and export since global rice output is concentrated in only 15 nations, mainly Asia and many exports come from a relatively small number. There can be several critical points in the supply chain from the supplier to the manufacturer to the production center fortification. A considerable proportion of rice from large mills for commercial distribution or use in large government-wide safety net programs, particularly women and young children, could be bolstered by rice factories in many countries. For promoting and implementing rice fortification in countries, multi sectoral approaches are required.

5 RESULT AND DISCUSSION

Currently, rice is grown in over 100 countries which produce over 715 million tons of milled rice. Fifteen countries accounted for 90% of the world's rice harvest. Roughly 50 percent of rice production is made up of China and India alone. Asian countries make up 90 percent of the world's total rice production, along with Indonesia, Bangladesh, Vietnam, Myanmar, Thailand, the Philippines, Japan, Pacific, Cambodia, Nepal, and Sri Lanka. Brazil, the United States, Egypt, Madagascar, and Nigeria, all of which together constitute 5% of the total rice produced globally, are other major non-Asian countries producing rice. Rice is the most rapidly growing food in Africa. Throughout Africa, gross cereal production gradually grew from 9.3% throughout 1961 to 19.2% in 2017. However, local suppliers account for only 54 percent of rice consumption.

The UN statistic appraisals and income projections by the Food and Agriculture Policy Research Institute (FAPRI) are relied upon to increment worldwide rice requests to 496 million tons in 2020, from 439 million tons in 2010 (processed grain), and further to around 560 million tons in 2035. This is a 26% ascent normal throughout the following 25 years however the development rate will drop from 13% over the initial 10 to 12% over the following 15 years, with populace development falling and individuals expanding from rice to different items.

Asian utilization of rice is anticipated to represent 67 percent of its all-out increment in the various rice-expending nations, from 388 million tons in 2010 to 465 million tons by 2035, while per capita utilization in both China and India keeps on declining. Moreover, Africa will require 30 million tons more rice, an expansion of 130 percent contrasted with 2010. In the Americas, normal rice consumption in the following 25 years is anticipated to increment by 33%.

Many countries such as the Philippines, Saudi Arabia, the United Arab Emirates, Malaysia, and Iran import significant quantities of rice from Iraq, South Africa, Cameroon, Mexico, and Brazil. Many countries import rice to meet the national food security requirements, which are typically among the least advanced countries in the world. In Sub-Saharan Africa with rice being grown and consumed in 38 countries, the gap between demand and supply in 2008 reached 10 MMT of milled rice which estimated imports cost

the region at \$3.6 billion. Most rice consumed in the countries of the Pacific Island is also imported, with a handful of import companies managing the trade.

In 2008, the rice price more than tripled during the world financial crisis, having significantly negatively affected the poor, in Asia. Rice prices fell, but remained significantly higher than historical prices, with prices ranging from 61% to 71% in 2016 to 2017 up from the 2006-07 average. Rice prices in major rice-producing countries are currently approximately US\$ 300-500 per MT. The expense of inputs and processes inefficiencies in Africa is \$500-700 per metric note, and in Japan and Korea, it's over \$600 for rice with high-quality preferences.

These statistics show that most farmers' Rice fields in the developing countries were affected by natural disasters. The results show three major conclusions: Firstly, expanding capital investment into agriculture machinery at the provincial level is the key input factor affecting the total rice production; secondly, increasingly adjusted utilization of supplements diminishes methane outflows while supporting yields. Lastly by strategies for seeding rice without working the ground keep up stable soils. Besides, the pesticide is another significant element in the increase of rice production in the household. These are simple strategies in most developed countries around the world to improve rice production.

6 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Agglomerating all the points elaborated above one can conclude that the quality and profitability of rice production, is the prevalent basic foodstuff in the world and plays a significant part in the producer country's sustainable economic and social growth as well as in its battle against food insecurity.

The main objective of the analysis was to calculate the technological output of rice production in the world to evaluate the major influence factors both at national and household rates. The findings revealed that the rice production rates in the world differ with the different amounts of expenditure in agricultural machinery, overall real rice harvested region and application of technological fertilizer in the provinces. Also, the rice output rates for households vary based on discrepancies in production process performance, production method variations, total annual land produced from real rice, and the use of agricultural fertilizers and pesticides technically.

Furthermore, the input elasticities calculations show that the harvested areas have the highest elasticity of all input rice production variables at the national and household level in most of the rice-producing countries. This has clearly shown that increased rice production in harvested areas will lead to higher input rice performance than any other region.

Besides, most of the developing countries like India, Bangladesh, and Pakistan still retain poor irrigation infrastructure, irrigation systems, and average water management practices which are the key factor in the expansion of rice areas by multi-cultivation systems. Important contributions and activities undertaken to address the issue are therefore required.

Also, another main factor influencing rice production in the world includes productive techniques for rural farmers, technical skills and numbers of agricultural supporting workers. However, rice production is very capable in those above-mentioned countries to natural disasters such as floods, droughts, and insects as the irrigation network fails and does not function properly. Thus, the construction of water irrigation systems and good water management practices is a major consideration of policymakers to implement strategic policies aimed at improving domestic and household rice quality.

Therefore, capital expenditures in agriculture machinery as well as machinery productivity and the practical usage of machines, of fertilizer and pesticide. As well as

effective water control and irrigation, processing strategies, and technical support staff. Which have a key effect on the rice production inclination tend to be the main factors which influence rice production. Nonetheless, irrigation zones, the number of plots and the age of the household head are key influence factors leading to an increased rice production volume.

6.2 The recommendations

The study advises that the following occurs to increase rice production in the world. Clear attention should also be given to irrigation systems and good practices in water management, and to bring in more effective intervention by both the central government and the related agencies to prevent regularly occurring natural disasters.

- Raise investment in the high-potential province of rice production in farm machinery and especially large machinery.
- Improving support staff and farmers' technical capabilities
- Certain unique techniques or methods may be needed to improve the productivity of the use and distribution of labor.
- More investigations into new techniques of production are required and should be widely applied to rural rice producers.
- Encourage the expansion of the application for household rice output of fertilizers and pesticides, whereas more effective handling of the manufactured fertilizer and pesticides may also be required to prevent inefficiencies. Also, it may be a worthwhile idea if the rice-producing countries manufacture agricultural fertilizers and pesticides on their own.

6.3 Importance of the research

Since insights into factors that influence rice production, the results of this study will be beneficial both for rice farmers, as well as for government and other stakes, However, to establish more effective policies and strategies for enhancing sustainable rice production in the world and find out what policy improvement policies should be implemented to increase rice output in the producer countries.

The findings of the present study are also anticipated to be used as a guide, a case study, or as a resource for helping potential researchers from the young generations to learn more about the rice industry in the world, for example, students who are interested in food health,

agricultural development, overall productivity factor, technical performance or rice productivity terminology.

6.4 Research scope

The current study centered on rice, which are the economic and nutritional staples for most of the nations, among different components of the agricultural sector worldwide. While rice is produced in a large number of countries in the world, the focus has been mainly on India and China has been chosen for research in the report because they are the top two countries in the production and also in consumption. Thus, rice output characteristics of farmers in various regions of the world may not be identical.

6.5 The prospect of the research

Although rice production is the main component of farming in most of the countries in the world, the hallmark of the agricultural sector as a whole could not be the rice farmers. The condition could not be enough in one area to represent the entire world. Thus the proposal for future productivity work and the quality of rice production in other provinces as well as in the other regions, which have strong rice crop capacity, complementing the lack of data on rice production in the world that could be useful for the policymakers and related parties to boost rice production. More work on productivity and efficiency in other areas of the agriculture industry in the world for instance in wheat, sugar, spices, cereals, teas, fish products, forest products and other short-term and long-term plants will be essential.

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