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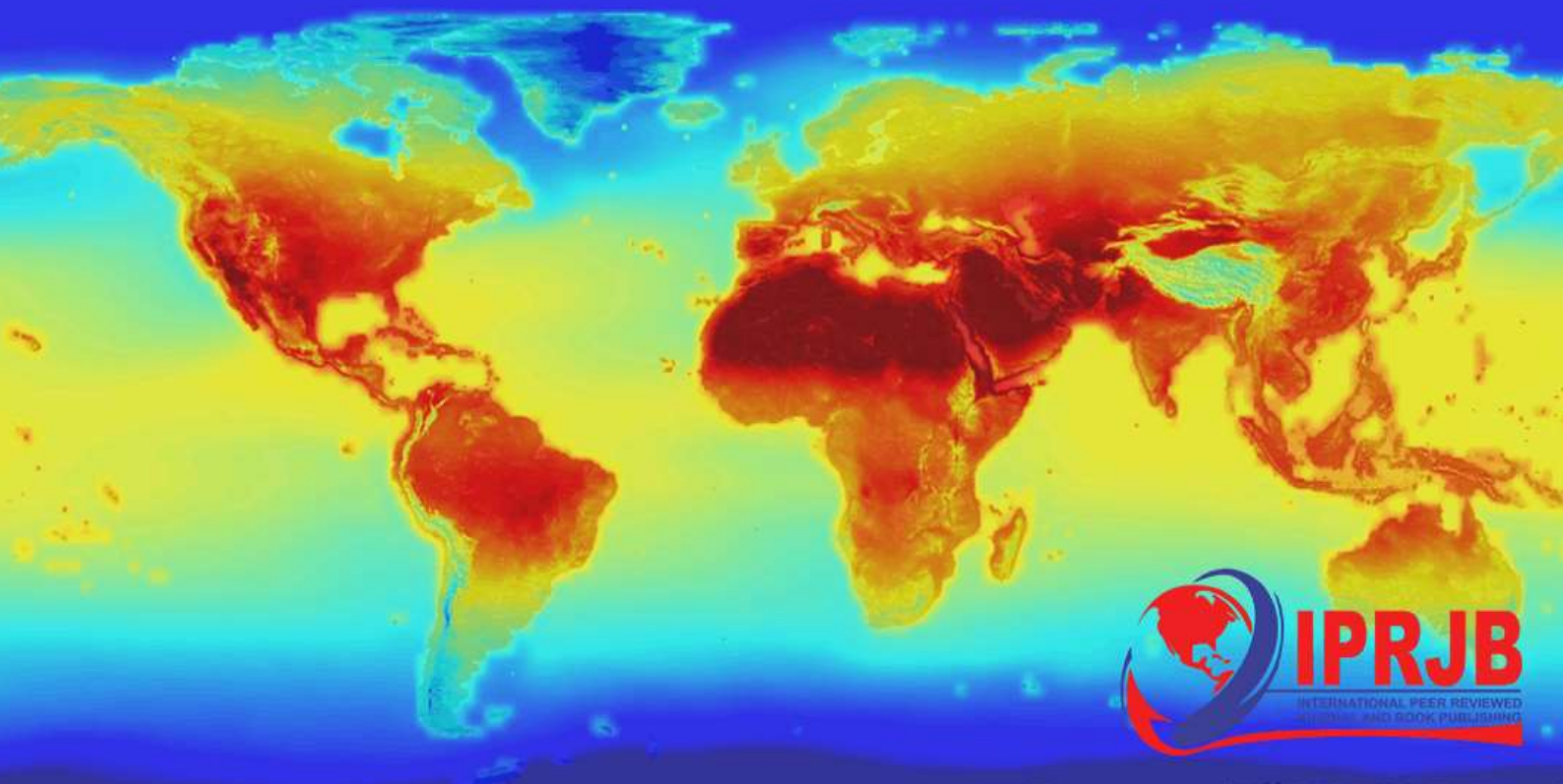

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# Factors That Impact Productions of Crops in Northern China

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**Abstract**

**Purpose:** The study aims to illustrate how climate change can be used as an advantage to increase crop productions.

**Methodology:** Past experiments and theory done by other researchers.

**Findings:** adopting different techniques contributed towards increase in crop productions in different district in China.

**Keywords:** *Crops, Climate Change, Irrigation, Production*

## INTRODUCTION

Crops are main elements for around 50% of the people in the world and are the primary source of food steadiness for many countries. Rice is an important component that China and most of the Asian nations rely on sin it is the main food for overall daily consumption compared to any other source like wheat. Being the largest producing country that produces and exports rice, China showed that production of rice itself presents 30% of total income for the Chinese Government. The purpose of this study is to identify different factors that impact productions of crops in Northern China. The study also shows based on previous case studies how various causes done by human or climate have positive outcome for productions of crops. It identifies relationships between productions of crops and climate and human causes. It is not surprising that a non-noticeable variation in the rice farming will have a huge impact on rice planting, local selling and globally importing. Thus, it is important to examine and review various internal and external factors affect rice production mainly in a positive way (Yu, 2020). It is also important to recognize many approaches and practices adopted that contribute in increment of rice production. The study in the proposal is suggesting quantitative methods of gathering data to show how different factors can play major role on impacting crops productions through carefully designed experiment and observation. The study will also present the expected findings that might occur if the quantitative data methods were carried out. The expected outcomes should show positive impact after collecting information from data set used for the observation and experiment techniques. Any new adopted procedure wouldn't arrive to a successful outcome without threat; hence some related challenges may appear when testing new methodologies to rise production.

## LITERATURE REVIEW

This study relies on literature review to identify the relationships between different factors either environmental or man-made that affect the crops productions in China. In this study I'm focusing to highlight the positive impact of climate change that can work as advantage on crops yields (Ribeiro et al., 2020). The following study will focus on relationship between adopting new technology in farming and harvesting. It will also explore connection between climate change and harvest production. Moreover, it will review different irrigation methods that impact crops productivity.

The study highlights many methods used to reach the final findings depending on mostly quantitative research methods such as specific experiments to reach tangible results and audience measurements to get the required information for planning and evaluation purposes.

### Relationship between New Technology in Farming and Harvest Production

In agriculture there are two methods for farming either by using mechanical or biochemical and or both techniques. Both ways aim to improve agriculture field and upgrade the traditional way to more efficient methodology that targets saving time, resources and increase yields. The Induced innovation hypotheses has been tested by creating the required environment presented in injecting the soil lacking nutrition with new fertiliser that is consist good substances and replacing most of the workers with modern machines. The demand on new soil nourishment showed an increase of fertilising use in China for 30% of fertilisation use globally. This approach was adopted due to the increase of population as the lands for planting were not enough to align with the growth of Chinese population.

Since 2004, new mechanism for planting has been introduced and people were pursued to move

to that approach because innovation in agriculture aims to a significant quality production of products and not only growth speed of crops (Chandio et al., 2022).

In figure 1 below, a study was done by Chandio et al., (2022) concluded a rise in rice production was a result of a concentrated use of fertilization from new types that consist of nitrogen and carbon that has a positive impact on agriculture growth of the main crop in China which is rice. Another study was done by Yin, (2022) proved the same hypothesis when he studied data between 1995 and 2020, a growth on rice production was noticed from 42.464 million tons to 54.4681 million tons with the factual increase on population and demand as well.

| Variables | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| _Cons | −2.881607 | 1.784180 | −1.615087 | 0.1168 |
| lnRP (−1) | 0.246357 | 0.113660 | 2.167498 | 0.0383 |
| lnFER | 0.259965 | 0.085917 | 3.025749 | 0.0051 |
| MECH | 0.623438 | 0.166159 | 3.752058 | 0.0008 |
| lnTEMP | −0.486761 | 0.277146 | −1.756333 | 0.0892 |
| lnRF | 0.038773 | 0.114849 | 0.337600 | 0.7380 |
| lnRSA | 0.129937 | 0.412785 | 0.314782 | 0.7551 |
| lnACR | −0.034713 | 0.025730 | −1.349087 | 0.1874 |
| lnRL | 0.931849 | 0.226162 | 4.120273 | 0.0003 |
| $R^2$ | 0.773248 | | Adjusted $R^2$ | 0.712781 |
| D-W stat | 1.414508 | | J-stat | 2.143243 |

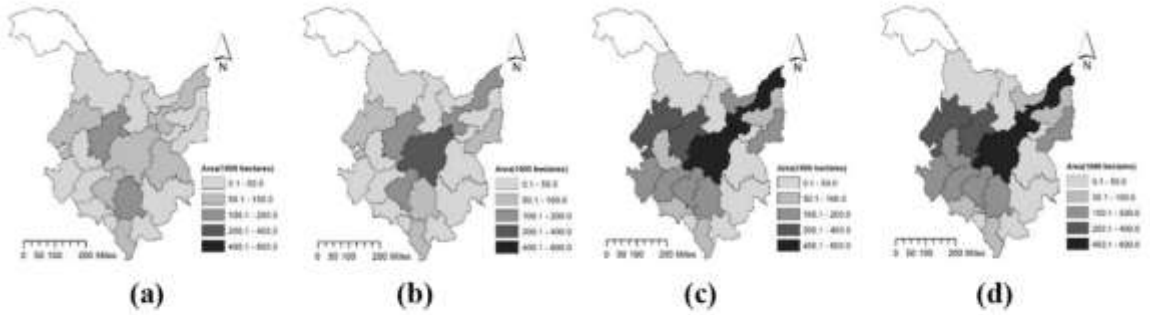
*Figure 1: The Impact of Biochemical Method on Rice Production*

*(Source: Chandio et al., 2022)*

**Relationship between Climate Change and Rice Production**

Global warming poses significant challenges to agriculture sector. Rice, wheat and maize are the most commonly grown and consumed crops in the world are being impacted with rainfall, increased droughts and rise in temperature even during cold seasons (Chandio et al., 2022). There is a relationship between rain fall, high temperature and planting seasons.

The northeast area of China is known for being cold and this impacts crops productions impressively to be less because season for production is only limited by few weeks. Between 1992 and 2017, the temperature has increased in growing season by 52% which led to more rain fall and more rice production (Pickson etal.,2021) and (Yu, 2021). Figure 2 shows increase in temperature and rain between 1992 and 2017 in northeast China that led to more rice production and increase of seeded area to 4,769.72 thousand hectares. Climate change persuades a move in crops area distribution. Moving croplands to other areas and modifying those area to be suitable for farming considered one of the strongest strategies for rice production because more rains and increase in temperature could help in using non-planted area for cropping. Higher temperature due to global warming has significantly impacted cold area in nature. This creates a suitable climate for rice which grows in high temperature with more rain (Yu, 2021).




**Notes:** (a) Area in 1992; (b) area in 2002; (c) area in 2012; (d) area in 2017
**Source:** Created by authors using ArcGIS (2020) software

*Figure 2: Rice Production Area in Northeast of China between 1992 and 2017*

*(Source: Yu, 2021)*

**Rice Production Using New Irrigation Technology**

An experiment of two years has been carried on by directly using different techniques for plant watering. The experiment was depending on three methodologies for irrigation and was divided as following, Traditional Watering System, Water Saving Irrigation and Furrow wetting irrigation. The experiment targeted areas with less water in China to see how effective is this way in compared to the traditional watering system. The Water System Irrigation (WSI) was focusing on dripping method using 50 mm and 35 mm watering methodology and furrow wetting irrigation (FWI) was depending on dry wet concept to feed in wet material to keep rice damp while a last sample was kept with traditional watering system.

The result from the experiment showed that using the WSI way for watering not only increased water productivity but also increased yield of rice in compared to the traditional way of irrigation (Hang et al., 2022). Another experiment done by Xu contradict the findings of this experiment done by Hang using slightly different approach with the same concept. The study was consisting of three irrigation method; traditional watering, "flooded and wet intermittent irrigation" and "flooded and dry intermittent irrigation". The study showed saving only in water but there was no increase of rice yield. In addition, the experiment shows in increase of CO2 and N2O from irrigation system of FWI and FDI which is a risk and threat for climate change (Xu et al., 2015).

| Practice | CK | $DI_1$ and $DI_2$ | | FWI |
|---|---|---|---|---|
| Land preparation and seed sowing method | Ploughing, Dry direct seeding | Ploughing, Dry direct seeding | | Ploughing and furrowing, Dry direct seeding |
| Fertilization amount and timing | N fertilizer: 240 kg N $ha^{-1}$ as urea, 40% applied before seeding, 30% at tillering stage, 30% at panicle stage; P fertilizer: 112.5 kg $P_2O_5$ $ha^{-1}$ as $Ca(H_2PO_4)_2$, applied before seeding. All fertilizers were applied by hand onto the soil surface. | N fertilizer: 240 kg N $ha^{-1}$ as urea, 40% applied before seeding, 30% at tillering stage, 30% at panicle stage; P fertilizer: 112.5 kg $P_2O_5$ $ha^{-1}$ as $Ca(H_2PO_4)_2$, applied before seeding. All fertilizers were dissolved in the irrigation water and applied through drip water flow during watering. | | N fertilizer: 240 kg N $ha^{-1}$ as urea, 40% applied before seeding, 30% at tillering stage, 30% at panicle stage; P fertilizer: 112.5 kg $P_2O_5$ $ha^{-1}$ as $Ca(H_2PO_4)_2$, applied before seeding. All fertilizers were hand applied directly to the soil surface. |
| Plastic film mulching | None | Plastic film mulching before seeding | | None |
| Irrigation methods | Continuous flooding | Drip irrigation with 50 mm at each watering time when RSWC was below 100% | Drip irrigation with 35 mm at the watering time when RSWC was below 100% | The furrows constantly supplied with water to maintain moist condition in the strips during the entire rice growing period |
| Seeding and harvesting dates | Direct seeding on 1 May; Harvested on 28 September | Direct seeding on 1 May; Harvested on 24–26 September | | Direct seeding on 1 May; Harvested on 27 September |
| Total irrigation amount | 1270 mm | 700 mm | 520 mm | 625 mm |

*Figure 3: Method and Period of Experimental Field Observes in the Three Irrigation Systems (Source: Hang Et Al., 2022).*

## METHODOLOGY

### Generalized Method of Moments (GMM)

There were several techniques that were used in the past to present estimated data in a period of time for production of crops. The study will mainly focus on quantitative data method to show in numbers or percentage positive increase of crops production via evidence through a detailed review of information. GMM is an observational tool that depend on old data to reach to a real conclusion. The sample of a specific area is chosen where a collection of information should be captured for the same area for a specific period of time. The purpose of this research method is to show how human factors and environmental factors play significant roles in impacting the production of crops in China positively. The "generalized method of moments (GMM)"is the main methodology that will be used to measure the impact of technical intervention, human progress and climatic characteristics on main food crops productions. By applying GMM, it is expected to deliver more healthy and reliable results. The GMM is a suitable tool in measuring climate variables and farming production. The purpose of this method is to find the expected mean of crops productions for specific periods of time using gathered information from a set data.

In my study I will be using a data set for Sichuan (specific town in North China) for annual

time-series data spanning of 10 years where yearly productions for different main crops are captured. To narrow the data more I will be focusing on a random sample by studying 6 crops farms (two each crop; rice, wheat and maize) in Sichuan. In the observation, the focus will be on the following variables, rice production, wheat production, maize production and their count will be measured in tons per hectare. Numerous factors that are expected to impact the study will include the following;

- Technical factors which will be fertilizer use per production in different sessions and it will be measured in tons per hectare. The method also will cover percentage of human machines used per hectare.
- Human factors will be measuring rice, wheat and maize productions where the amount will show as tons/ hectare. Moreover, the labor count that will be presented as numbers against specific crop per land size.
- Climatological factors will concentrate on rainfall as average or mean where it will be measured in millimeter and impact of sun. In addition, the study will include the temperature per session and location in percent (Chandio et al., 2022).

**Saving Water Leads to More Crop's Productions**

Another method that will be used in this research will be depending also on quantitative data collection technique that will be focusing on experimental use of different irrigation technologies. The purpose of this methodology is to identify the best and effective technique related to irrigation. This method should measure amount of water used for irrigation to recognise the water saving technique especially on sessions where rainfall is less than average which can impact crops productions negatively. The outcome of the result should make a decision on the cost-effective method and innovative system to sustain water source and save it when irrigating crops. The study will have a plan to use a sample of a small land of 50 square meters as a location for the experiment. The land will be divided in three equal sections where all conditions should be prepared to be similar in each division such as suitable climate and appropriate soil where a plan like a rice of wheat can grow effectively (Hang et al., 2022).

The study will focus on three different irrigations methods in the same divided land with the above-mentioned prepared conditions;

- Traditional Watering System which will focus on the old technique of watering plants that uses the old way of piping while planting without a control on amount of water used per hour.
- Water Saving Irrigation with dripping of 30 mm that use the time set dripping system which drip water in a certain time of the day. For example, every 2 hours the system starts to drip 30 mm of water to make the plants wet with suitable amount of flood.
- Furrow wetting irrigation that will adopt dry wet concept and it will require a use of specific material that keep the water saved on them where plants are feeding from this water.

**Limitations of Using GMM and Field Experiment**

There are many limitations associated with the chosen quantitative research methods for this study. Although both can benefit the purpose for the research, they have some disadvantages.

First of all, it requires a long time to have the outcome; when you study an area you wouldn't be able to reach to a conclusion before set time planned is finished. You also won't be able to have a solid outcome with a small data set. However, other research methods have more options like retrieving data from old studies. Another disadvantage is the cost involved in both studies is high; if you decided to perform the research all required materials should be included to reach to your desired results and those material used to simulate the environment cost money. Not only that if you are trying to perform an experiment in another country or city where you don't live then travelling expenses should be considered. Also with GMM, pulling old data from National Government means approval is required and paying for service and data might occur (Lenski, 1984).

## FINDINGS

### Expected Finding Associated With Generalized Method of Moments

Crop productions and climatic factors are in a positive relationship because of many reasons. First of all, climate change is the main impactor for crop productions either positively or negatively. The more the climate is suitable for rice planting, the more crops producing is observed. The study sample is expected to show descriptive statistics. It is expected to demonstrate level of productions of crops when temperature is high especially in end of spring and whole summer. Not only that, the study is also expected to show normal to low production when session has less rainfall and cold weather. However, there might be a significant increase in crops productions due to the change in climate that starts becoming warmer in the geographically cold area by nature.

The finding is expected to present the increment of fertilizer consumption in lands is related to higher rice yield. In a study done by Chandio et al., (2022) and Pickson et al., (2021) they concluded that using nitrogen fertilizer has a positive impact on rice harvests in Nepal, Pakistan, and China where their study focused on. Using of advance machinery is predicted to prove a significate and potential advantage for crops production which means there is a correlation between technical factors and crops yields. In the study that has been done by Chandio et al, (2022) a proof of using machine showed a positive increase in crops in many parts of China.

### Expected Finding from Different Way of Irrigation Experiment

There is an inverse relationship between Tradition way of irrigation and crop production. It is expected that the more water pours the high temperature evaporates the water keeping the plant dry. A study done by Hang et al., 2022 confirmed that this was the finding during his study. A correlation between water saving techniques and crop yields is positive. It is expected a significant improvement in crops production using new techniques that are studied in this research. The outcome will be based on inferential statistics which involves comparison during the experiment. The reason is due to the nature of keeping water less and absorbed by plants at the time of irrigation, it is predictable that no water is wasted and whatever is needed is taken by plants. The same has been proofed by Hang et al., (2022) where he showed with evidence the increase on production of crops after using Water Saving Irrigation method during his experiment. There is another expectation that using new technique in watering is not necessary increasing production this has been proofed by (Xu et al., 2015). The finding from this experiment has two goals which are expected to be met and seen in the outcome. The first one is to produce more crops due to the planet nature to keep themselves wet during dripping or

wet techniques. The second aim to focus on methods of saving water especially in those lands that has less nutrition and water characteristic in nature.

## CONCLUSION

Finding effective ways for innovation is the aim for Chinese government because it believes on importance of preparing the existing conditions to create an environment that helps in reaching its target. Raising rice production means achieving food security not only for Chinese but for more people in the world. The more investment in research and technologies will continue to be symbol for sustainability and will play an important role in researches and results to accept new invention that focus on aspect on raising rice production regardless different circumstances and challenges in environment or economic (Peng et al., 2009). For similar study and to have evidence on growth forproductions, quantitative methods can draw trends and identify gaps hence the use of it can proof different aspects when it comes to climate and human changes. Through old studies It was proved how many factors contributed in crops yield. It was also observed how non-farmed area on the same geographical site can be adjusted to a beneficial and productive through different experiments done by many researchers. A demonstration of various ways of irrigation and concentration on effective styles for more rice productively via experiment can be a way to decide on effective processes when it comes to watering. Lastly, many factors can be converted to opportunities by invest and study them to find many solutions for increasing crops productions (Hu et al., 2019).

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