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**Kuldeep Rajpoot**  
Ph.D. Scholar (Agricultural  
Statistics), Department of Farm  
Engineering, Institute of  
Agricultural Sciences, Banaras  
Hindu University, Varanasi,  
Uttar Pradesh, India

**Abhishek Singh**  
Associate Professor (Agricultural  
Statistics), Department of Farm  
Engineering, Institute of  
Agricultural Sciences, Banaras  
Hindu University, Varanasi,  
Uttar Pradesh, India

**Jhade Sunil**  
Ph.D. Scholar (Agricultural  
Statistics), Department of Farm  
Engineering, Institute of  
Agricultural Sciences, Banaras  
Hindu University, Varanasi,  
Uttar Pradesh, India

**Corresponding Author:**  
**Kuldeep Rajpoot**  
Ph.D. Scholar (Agricultural  
Statistics), Department of Farm  
Engineering, Institute of  
Agricultural Sciences, Banaras  
Hindu University, Varanasi,  
Uttar Pradesh, India

## Ranking of major agricultural risks using Garrett's ranking technique in Jabalpur district of India

**Kuldeep Rajpoot, Abhishek Singh and Jhade Sunil**

### Abstract

Risk in field of agriculture is a major threat to the stability of farm production in many developing countries, including India. To understand and identify the major risk, a study of how farmers perceive and ranked these agricultural risks is essential. In this study, a survey of 296 farmers was completed in the Jabalpur district of India by using multistage simple random sampling, in which farmers ranked all concerned farm risks. The Garret ranking method was adopted to finalize the ranking of all included risk sources. Farmers deal with a variety of risks, with that production and economic risks are major concerns and institutional and personal risks ranked as least important. Climate and weather impact on farming and production was ranked as the top risk in all selected ten risk sources with a mean score of 75.01 as per farmers' responses. As per crop-specific garret ranking production risk is a top-ranked risk for all crops except wheat, in wheat crop economic risks are top-ranked risk and production risk comes in 2<sup>nd</sup> place. Economics risk has come in 2<sup>nd</sup> place for the rest of the crops and personal risk ranked as the least impacted risk with 5<sup>th</sup> rank for all crops. Overall Production and economic risk are top-ranked in the study area and the government needs to make plans accordingly to mitigate these risks and increase farmers' income.

**Keywords:** Agricultural risk, farmers' risk perception, sample survey, garret ranking, ranking of farm risk

### 1. Introduction

In India, agriculture is still the key source of income for the majority of people, and still, more than half of the total population directly depends on farming for their livelihood (Ahmad *et al.*, 2011) [2]. Agriculture is one of the risky professions with uncertain outcomes and a variety of risks faced by Indian farmers over the whole growing season (Choudhury *et al.*, 2019; Kumar *et al.*, 2021) [5, 19]. Agriculture risk is described as the product of the degree of yield loss and the likelihood of occurrence of a risky event. One of the most vital agricultural risks is the production or biological risk, which is mostly brought on by climate variability (such as irregular rainfall and unstable temperature), and it is getting worse every day as a result of climate change. and it is increasing day by day due to climate change (Kanwal *et al.*, 2022; Mahdi *et al.*, 2015; Raghuvanshi & Ansari, 2019; Rao *et al.*, 2017) [15, 21, 24, 26]. However, many other factors such as biological, financial, legal, marketing, technological, social, and human personal factors (health issues, etc) can contribute to agricultural risk in addition to this climate change effect and farmers have to deal with that all risk sources (Baquet *et al.*, 1997) [4]. For instance, events like insects-pest attacks, bad quality of inputs, epidemics, volatile prices, and unavailability of inputs can also decrease the production as well as income of Indian farmers (Choudhury *et al.*, 2019; Kumar *et al.*, 2021; Rajpoot *et al.*, 2022) [5, 19, 25].

There are some major sources of risk in the field of agriculture and based on these risk components and sources, agricultural risk can be broadly classified as economic, production, technological, institutional, and personal risk. The majority of these risk categories have previously been covered in the available literature (Musser and Patrick 2002) [22]. For specific kinds of risks, several sorts of empirical studies have been conducted to describe the impact and severity of these risks (Kanwal *et al.*, 2022; Karadas & Birinci, 2018; S. E. Saqib *et al.*, 2021a) [15, 16, 27].

However, very few studies had been conducted for the concurrent examination of all kinds of risks together such as (Angelucci & Conforti, 2010; Komarek *et al.*, 2020) <sup>[3, 17]</sup>, which provided an overview of various types of farm risks in a very nice manner.

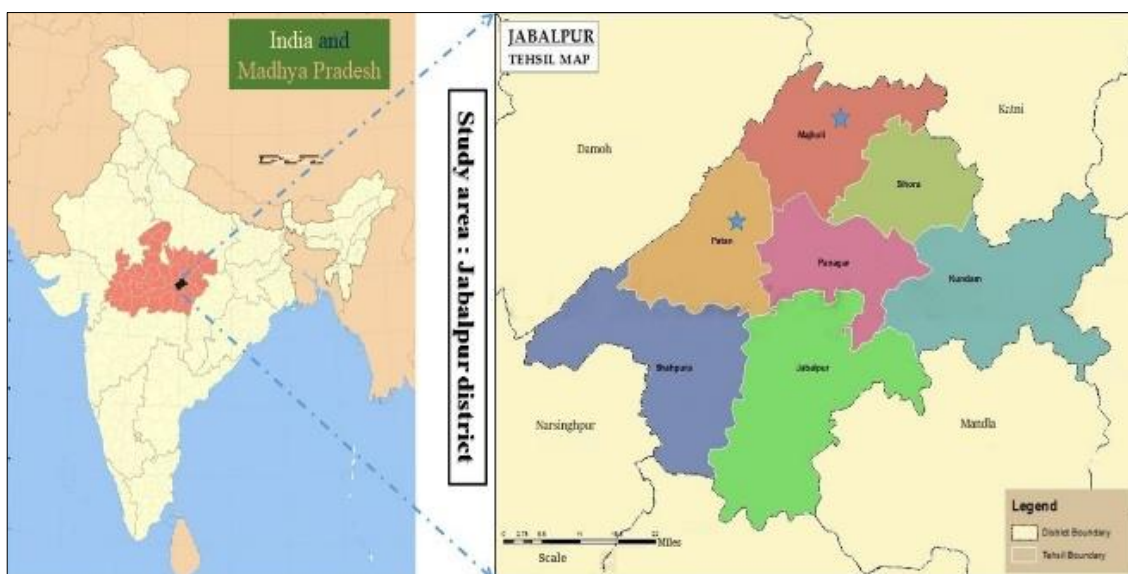
This study concentrated on the farmers' survey and research done in the Jabalpur district of India. In the present era, India is a developing nation, where urbanization, the depletion of natural resources, and rapid population growth have already adversely impacted agriculture. After so many efforts for the improvement of farmers and farming such as the green revolution, the contribution of the agriculture sector to India's GDP has still decreased from 51.9 percent in the 1950s to 15.4 percent in 2015-16 (Deshpande, 2017) <sup>[6]</sup> and still agriculture GDP contribution is below 20 percent. One of the key causes of this reduction in GDP contribution was rising climate-related risks such as flood, drought, hail storms, and irregular rainfall distribution over time, which harm the agriculture sector (Gadgil and Gadgil, 2006) <sup>[11]</sup>. As per the recent studies on climate change and the IPCC report, India would be one of the main countries affected by climate

change calamities such as erratic rainfall, droughts, and floods (Eckstein *et al.* 2021) <sup>[9]</sup>. So it is important to identify major agricultural risks and rank them as per their severity and the concern of the Indian farmers. This can guide governments and policy planners to design better policies or plans to manage these top-ranked farm risks.

## 2. Materials and Methods

### 2.1 Description of the study area

The study was confined to the Jabalpur district of India. Jabalpur is a district of Madhya Pradesh located in the central part of India. Jabalpur is situated at an elevation of 412 m above sea level, between the latitude 22.828 to 23.614 and longitude 79.350 to 80.584. In Jabalpur district, eighty percent of the population lives in rural areas and depends on farming. Crops like paddy, soybean, pigeon pea, maize, and sesame in kharif and wheat, gram, pea, and mustard in rabi are grown predominantly with this wheat-paddy were the most dominant crops in the district (Krishi Vigyan Kendra Jabalpur, n.d.). The Jabalpur district is divided into seven administrative blocks (Fig. 1).



**Fig 1:** Study area (Jabalpur district) map, in which selected blocks under survey are indicated by blue stars

### 2.2 Sampling Design and Framework

To identify the prime sources of risk at the outset of our research, we organized two focus group discussions (FGD) by including 10 and 20 participants in each FGD at the two selected blocks of Patan and Majholi. These FGDs provide a key source of risk in farming and a compiled list of all key agricultural risks faced by them, this gives an idea for the proposal of a draft of a questionnaire form for the ranking of agricultural risk. The validity of the planned survey schedule was then examined by a pilot farmers survey of size 30. Finally, an enriched revised survey schedule was eventually

finalized to survey farmers after fixing the flaws identified during the pilot survey which was used for the final survey of farmers. Since many of the farmers in the research area lacked formal education or were illiterate, questions were translated into their regional languages Hindi and Baghelkhandi. At the final point, the data from 296 farmers in the Jabalpur district was gathered through a physical survey by using multistage (three stages) sampling which includes a random selection of two blocks (Patan and Majholi), 30 villages, and 296 farmers on first, second and third stages, this sampling plan with time frame was presented in figure 2.

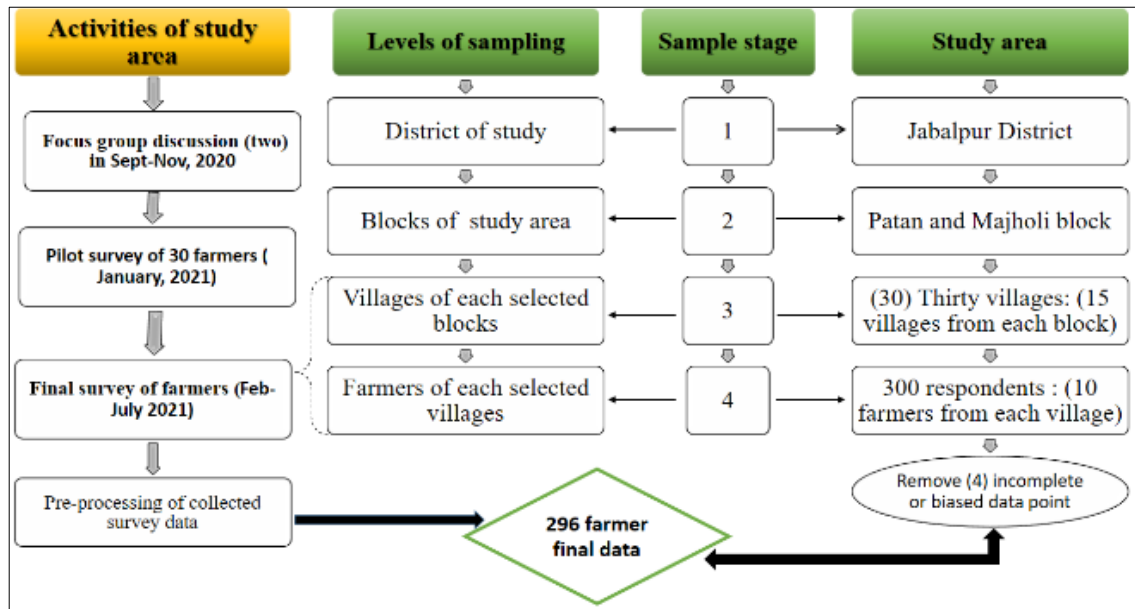


Fig 2: Design of sampling framework

In the prepared survey schedule, ten major risks are selected for ranking based on FGDs and discussion with the subject expert, and all these risks are ranked by the respondent in the range 1 to 10 by following the thumb rule that a unique rank was allotted to each risk. Rank 1 provides to most significant risk sources while rank 10 assigned to least significant risk source from all selected risk sources. The meaning of all five kinds of risk was explained to the respondents and then the crop-specific ranking of all five kinds of risk was also done for all major crops separately such as the 1 rank provided to most significant risk while the 5 rank provide to least significant risk category.

**2.3 Garrett ranking method**

To identify the order of high to low impact risk, ranking of all selected 10 prime risks and for crop-wise ranking of all 5 kinds of risks, the Garrett ranking method was adopted in this study. The ranking of all risks is done by using the Garrett ranking method by calculating the respondent's data as a factor of the percentage position value using the following formula.

$$\text{Percentage position} = \frac{100(R_{ij}-0.5)}{N_j} \tag{1}$$

Where,  $R_{ij}$  = Rank has been given for the  $i^{\text{th}}$  risk statement by the  $j^{\text{th}}$  respondent.

$N_j$  = Number of risk statements ranked by the  $j^{\text{th}}$  respondent. The percentage position of each rank was converted to scores by referring to the Garret ranking tables given by Garret and Woodworth (1969) [12]. The total score was then calculated for each factor by adding the scores of each respondent. This total

score was then divided by the total number of respondents whose scores were collected. The ranking of alternative risk sources is done based on the mean scores by arranging them in descending order (Vishwakarma *et al.*, 2020) [30].

**3. Result and Discussion**

**3.1 Ranking of the major risk sources according to their cumulative impact on farming and farmers**

To identify the order of high to low impact risk, ranking of all selected ten major risks was done by using the Garrett ranking method, and outcomes were presented in Table 1. Out of these all 10 risk statements, 3-3 risk sources belong to economic and production risk, 2 risk sources belong to institutional risk, and one risk source belongs to each technological and personal risk.

In the inclusive risks, climate and weather impact on farming and production was ranked as the top risk with an average or mean score of 75.01 by the farmer respondents (Table 1). (Choudhury *et al.*, 2019) [5], also reported frost frequently damages maize crops, leading to reduced yields in the highlands of northeast India. Followed by the lower market value of crop products; the high price of inputs fertilizer, seed, insecticides, etc.; the impact of insect, pest, and plant disease on farming and production; lack of good quality input like seeds, fertilizer, insecticides, etc.; high variability in production; non-availability of a proper market for sell of Agri. products; mishap or sickness problem in the farmer's household or labour; unexpected changes in regulations by the government; and Kisan credit card or bank account seized by the bank were ranked 2 to 10 based on higher to lowers impact full risk with a mean score 72.15, 60.72, 59.33, 53.11, 48.63, 41.69, 38.05, 32.55, 18.76 respectively. (Table 1).

Table 1: Ranking of the risk according to their impact on farming and Farmers

S. No	Type of risk and risk statement	Score	Rank	Overall Rank
<b>I</b>	<b>Economic Risk</b>			
	Lower market value of crop products	72.15	1	2
	High Price of inputs fertilizer, seed, and insecticides	60.72	2	3
	Non-availability of a proper market for sell of Agri. Products	41.69	3	7
<b>II</b>	<b>Production Risk</b>			
	High variability in Production	48.63	3	6
	Climate and weather impact on farming and production	75.01	1	1
	Insect, pest, and plant diseases impact on farming and production	59.33	2	4

<b>III</b>	<b>Technological Risk</b>			
	Lack of good quality input like seeds, fertilizer, and insecticides, etc	53.11	1	5
<b>IV</b>	<b>Institutional Risk</b>			
	Unexpected changes in regulations(like a penalty for stubble burning and Krishi Bill) by the government	32.55	1	9
	Kisan credit card or bank account seized by a bank	18.76	2	10
<b>V</b>	<b>Personal Risk</b>			
	Mishaps or sickness problems in the farmer's household or labour	38.05	1	8

As per table 1, the lower market value of crop products, the high price of inputs fertilizer, seed, and insecticides, and the non-availability of a proper market for sell of Agri. products were ranked first, second, and third in the economic risk category.

Climate and weather impact on farming and production, insect, pest, and plant disease impact on farming and production, and high variability in production were ranked first, second, and third in the production risk category.

Unexpected changes in regulations (like a penalty for stubble burning and Krishi Bill) by the government, and Kisan credit cards or bank accounts seized by the bank were ranked first, and second in the institutional risk category. These risk also comes at last place all over rank, as farmers had no hope now for any improvement from the government side and they are not focusing on these risk.

Technological risk and personal risk both categories had only one risk so these risks by default come on the first rank in this

category. Overall we can conclude production and economic risk were the top most concern in the study area. A similar result was found by (Angelucci & Conforti, 2010) [3], who concluded, that price (economic) and production risks were of utmost important across the countries. These findings were supported by (Jankelova *et al.*, 2017; Komarek *et al.*, 2020; Thompson *et al.*, 2019) [14, 3, 29], who reported price and production risk as a major concern.

**3.2 Crop-wise ranking of all five risk categories**

To identify the order of high to low impact all five risk categories ranking of were done for four major crops in the study area. Garrett's ranking method was used for ranking each crop *viz.* wheat, paddy, pulses, and soybean separately, by following the thumb rule that a unique rank was allotted to each risk category between 1 to 5. The mean score and obtain the rank of all risk types for each crop are presented in Table 2 given below.

**Table 2:** Crop-wise ranking of all five risk categories

Crops	Wheat		Paddy		Pulses		Soybean	
	Mean Score	Rank	Mean Score	Rank	Mean Score	Rank	Mean Score	Rank
Economic risk	70.86	1	61.32	2	61.69	2	60.78	2
Production risk	63.45	2	73.33	1	73.09	1	72.94	1
Technological risk	47.47	3	47.94	3	43.20	4	44.02	3
Institutional risk	41.13	4	40.73	4	45.18	3	42.06	4
Personal risk	27.09	5	26.69	5	26.83	5	30.20	5

By observing table 2 we can conclude that economic risk, production risk, technological risk, institutional risk, and personal risk were ranked first, second, third, fourth, and fifth for the wheat crop with a mean score of 70.86, 63.45, 47.47, 41.13, and 27.09 respectively. The ranking was done by all 296 wheat-growing farmers.

Paddy crop was cultivated by all 296 respondents so the ranking of all five risk categories is done by all 296 paddy cultivators. Production risk, economic risk, technological risk, institutional risk, and personal risk were ranked first, second, third, fourth, and fifth for the paddy crop with a mean score of 73.33, 61.32, 47.94, 40.73, and 26.69 respectively.

Pulses crops were cultivated by 278 respondents so the ranking of all five risk categories is done by 278 pulses cultivators. Production risk, economic risk, institutional risk, technological risk, and personal risk were ranked first, second, third, fourth, and fifth for the paddy crop with a mean score of 73.09, 61.69, 45.18, 43.18, and 26.83 respectively.

The soybean crop is sown by 51 respondents because year to year high variation in production, so the ranking of all five risk categories is done by 51 soybean producers. Production risk, economic risk, technological risk, institutional risk, and personal risk were ranked first, second, third, fourth, and fifth for the paddy crop with a mean score of 72.94, 60.78, 44.02, 42.06, and 30.20 respectively.

So finally it is summarized that production risk is a top-ranked risk for all crops except wheat, in which economic risk are top-ranked risk and production risk comes in 2<sup>nd</sup> place. Economics risk has come in 2<sup>nd</sup> place for the rest of the crops and personal risk ranked as the least impacted risk with 5<sup>th</sup>

rank for all crops. Economic risk is a top risk for wheat crop, this result is supported by the finding of (Ahmad & Afzal, 2022; Haile *et al.*, 2017) [1, 13], who reported price risk and high cost of input as prime risks for the wheat crop. These results were supported by (Jankelova *et al.*, 2017; Komarek *et al.*, 2020; Thompson *et al.*, 2019) [14, 3, 29], who reported production and economic risk as top risks for all crops.

**4. Conclusion**

Farmers deal with a variety of risks, in which production and economic risks are more impactful as compared to technological, institutional, and personal risks. As it is founded climate and weather impact on farming and production was ranked as the top risk with a score of 75.01 followed by lower market value of crop products which ranked second in all over risks with a score of 72.15 by the farmer respondents. The institutional and personal risks ranked as least important in all five kinds of risks based on the rank of all ten risk sources. Crop-specific garret ranking shows production risk is a top-ranked risk for all crops except wheat, in wheat crop economic risk is the top-ranked risk, and production risk comes in 2<sup>nd</sup> place. Economics risk has come in 2<sup>nd</sup> place for the rest of the crops and personal risk ranked as the least impacted risk with 5<sup>th</sup> rank for all crops. Risks in the field of agriculture are too complex phenomena and these all kinds of risks are interconnected with each other, this empirical research can guide governments and policy planners to identify major risks in an area and design better policies or plans to manage these top-ranked farm risks

#### 4.1 Funding

This research received no external funding.

#### 4.2 Data availability

The data that support the findings of this study were collected through farmer's survey so it cannot be publically available to maintain privacy policy of the concern respondent's farmers but available from the leading author, Kuldeep Rajpoot, upon reasonable request. E-mail: kuldeeprajpoot@bhu.ac.in.

#### 4.3 Ethics statement

All respondents gave their informed consent for inclusion before they participated in this study and privacy of respondents maintained as per Indian law.

#### 4.4 Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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