STUDY OF RAINFALL VOLATILITY IN AGRICULTURE SECTOR WITH SPECIAL REFERENCE TO GWALIOR CHAMBAL REGION IN INDIA

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ABSTRACT

To evaluate the monsoon rain-fall volatility across Gwalior-Chambal region and check the feasibility of weather (rainfall) derivative products to hedge rainfall risk in Gwalior Chambal region. Methods: To check the rainfall volatility, the monthly rainfall data has been collected for 100 years (from 1917 to 2016) and have analysed the data by using various statistical tools like Standard deviation, Coefficient of variation, One way Anova etc. Findings: This study shows that there is variation in volatility amongst the various district of Gwalior-Chambal region and the volatility is increasing in recent years. The volatility in rainfall is major cause of increasing losses among the farmers. Novelty: This study is useful to understand the rainfall volatility among the Gwalior Chambal region. The finding of this study can be used to introduce weather(rainfall) derivatives in Gwalior-chambal region and in India.

Keywords: Rainfall Risk, Rainfall derivatives, weather insurance, Crop Damage, One-way Anova

1. INTRODUCTION

India is agricultural driven economy, where most part of rural population directly or indirectly depends on agriculture output for their survival. Indian agricultural is highly susceptible to monsoon condition and in absence of good monsoon, the agricultural production suffer a lot. Volatile rainfall conditions not only affect farmers but also all other business which are directly or indirectly depend on agricultural production. Besides, agriculture, sports events like cricket, football, golf, skiing etc, entertainment industry like water theme parks, construction, tourism, transport, retailing, energy firms are subjected to rainfall risk (Barnett and Mahul, 2007). Indian Government has introduced many crop insurance programs to reduce the loss of farmers due to bad monsoon conditions but they were not much successful. The major reason of their failure is that in case of crop insurance, farmers need to prove the amount of loss due to crop damage which is very tedious and time consuming task. This problem can be solved by introducing weather derivative products in this region (Vashisht and Harendra, 2020).

II. LITERATURE REVIEW

Skees, et al, (2001) broke down the improvement of climate items considering precipitation to safeguard against drought in four Mexican states viz., "Durango, Jalisco, Tamaulipas and Zacatecas". The credibility study had two essential portions. Most importantly, it broke down the relationship among precipitation and respect choose the incident due to nonappearance of downpour. Second, it made a model precipitation contract and examined what this understanding means for the difference in livelihoods from these yields

(Pauline, 2006) communicated that climate hazard is in like manner more a high repeat - low earnestness possibility. Along these lines, standard protection doesn't seem, by all accounts, to be the most legitimate course of action. The ideal length of the data set depends on upon the ordinariness of environment data (float, steady consistency) and somewhere near 10 and 30 years is considered as the norm.

Barnett and Mahul, (2007), in his article expresses that more than one-half rely upon horticulture or farming work as their essential wellspring of job. Consequently, poor country families are especially helpless to the monetary results of climate related catastrophic events. On a fundamental level, customary protection instruments, including crop protection, can be utilized to move the danger of outrageous climate occasions. Notwithstanding,
protection markets are immature and frequently nonexistent in provincial zones of lower pay nations because of helpless agreement authorization; hilter kilter data, high exchange expenses, and high openness to spatially covariate hazards (Skees and Barnett 2006). These issues are especially intense for crop protection. Rao and Bockel, (2008), suggested that climate record protection has similar focal points to those of locale yield protection. This program gives helpful compensation made on the reason of climate list, which is typically exact. All social class whose livelihoods are dependent on the climate can buy this protection.

Gyamerah, et al (2019) investigated that the impacts of climate on horticulture lately have become a significant worldwide concern. Consequently, a powerful climate hazard the executives apparatus (i.e., climate derivatives) that can fence crop yields against climate vulnerabilities is required. In any case, most smallholder ranchers and horticultural partners are reluctant to address for the cost of climate subsidiaries (WD) due to the presence of basis risk in the estimating models. To kill item plan basis risk, an AI troupe procedure was utilized to decide the connection between maize yield and climate factors. The outcomes uncovered that the main climate variable that influenced the yield of maize was normal temperature. A mean-returning model with a period fluctuating pace of mean inversion, occasional mean, and nearby unpredictability that relied upon the neighborhood normal temperature was then proposed.

Shirsath, et.al (2019) Climate based yield protection is an incredible asset for settling ranchers' pay by furnishing opportune payouts straightforwardly connected with climate boundaries. Nonetheless, its exhibition can be defaced by broken plan, prompting high premise hazard and deficient payouts. By joining agro-meteorological factual investigation, crop development displaying and streamlining procedures, a heuristic model is created which creates unrivaled agreement plan which yields better and successive payouts at no additional expense of appropriations (as far as top notch rates). They have likewise presents 'Rancher Satisfaction Index' as an amazing assessment instrument in deciding the viability of protection items through estimation of premise hazard.

Ward, et.al,(2020) stated that in rainfed creation frameworks all through India, farming exercises are reliant upon the mid year rainstorm, and any variation in storm precipitation examples can have serious ramifications for rice creation. There is extensive arrangement interest in planning projects to bring down small-scale ranchers' openness to these kinds of hazard given the routineness with which unfavorable rainstorm occasions happen. This paper presents a field analyze directed with two danger the executives choices in the territory of Odisha: a drought-tolerant rice cultivar; and a climate list protection item intended to supplement the exhibition of the cultivar.

III. RESEARCH METHODOLOGY

To check the rainfall volatility, the monthly rainfall data has been collected for 100 years (from 1917 to 2016) and have analysed the data by using various statistical tools like Standard deviation, Coefficient of variation, One way Anova etc.

Hypothesis Of Study
H0: There is no significant difference in the monsoon rainfall volatility across the Gwalior-Chambal region.
H1: There is significant difference in the monsoon rainfall volatility across the Gwalior-Chambal region.
The above hypothesis has been tested for different time period for entire Gwalior Chambal region by using one way Anova.

IV. RESULT AND DISCUSSION

To achieve the objective of this study, the monthly rainfall data has been rearrange for in different time period as 100 years, 50 years and 30 years of June to September month which is considered as monsoon period in India and various statistical tools have been applied to check the rainfall volatility in monsoon months.
### TABLE 1
**DESCRIPTIVE STATISTICS FOR MONSOON RAINFALL (MM) OF 100 YEARS (1917-2016)**

<table>
<thead>
<tr>
<th>STATISTICS</th>
<th>GWALIOR</th>
<th>SHIVPURI</th>
<th>GUNA</th>
<th>DATIA</th>
<th>BHIND</th>
<th>MORENA</th>
<th>SHEOPUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX</td>
<td>318.54</td>
<td>338.79</td>
<td>418.80</td>
<td>343.87</td>
<td>300.66</td>
<td>300.79</td>
<td>286.23</td>
</tr>
<tr>
<td>MIN</td>
<td>94.18</td>
<td>114.56</td>
<td>109.93</td>
<td>101.63</td>
<td>87.97</td>
<td>89.05</td>
<td>77.88</td>
</tr>
<tr>
<td>MEAN</td>
<td>199.80</td>
<td>212.46</td>
<td>200.77</td>
<td>210.37</td>
<td>189.83</td>
<td>186.06</td>
<td>186.01</td>
</tr>
<tr>
<td>SD</td>
<td>52.01</td>
<td>50.30</td>
<td>52.94</td>
<td>56.55</td>
<td>55.28</td>
<td>50.97</td>
<td>46.09</td>
</tr>
<tr>
<td>CV %</td>
<td>26.0%</td>
<td>23.7%</td>
<td>26.4%</td>
<td>26.9%</td>
<td>29.1%</td>
<td>27.4%</td>
<td>24.8%</td>
</tr>
</tbody>
</table>

Source: Compiled from the rainfall data taken from [www.indiawaterportal.org](http://www.indiawaterportal.org)

### TABLE 2
**DESCRIPTIVE STATISTICS FOR MONSOON RAINFALL (MM) OF 50 YEARS (1967-2016)**

<table>
<thead>
<tr>
<th>STATISTICS</th>
<th>GWALIOR</th>
<th>SHIVPURI</th>
<th>GUNA</th>
<th>DATIA</th>
<th>BHIND</th>
<th>MORENA</th>
<th>SHEOPUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX</td>
<td>316.06</td>
<td>338.79</td>
<td>418.80</td>
<td>343.87</td>
<td>298.74</td>
<td>280.14</td>
<td>270.38</td>
</tr>
<tr>
<td>MIN</td>
<td>94.18</td>
<td>119.18</td>
<td>109.93</td>
<td>101.63</td>
<td>87.97</td>
<td>89.05</td>
<td>77.88</td>
</tr>
<tr>
<td>MEAN</td>
<td>185.36</td>
<td>199.75</td>
<td>198.26</td>
<td>192.79</td>
<td>174.69</td>
<td>174.20</td>
<td>176.79</td>
</tr>
<tr>
<td>SD</td>
<td>50.10</td>
<td>49.63</td>
<td>61.80</td>
<td>56.72</td>
<td>56.17</td>
<td>50.01</td>
<td>46.98</td>
</tr>
<tr>
<td>CV %</td>
<td>27.0%</td>
<td>24.8%</td>
<td>31.2%</td>
<td>29.4%</td>
<td>32.2%</td>
<td>28.7%</td>
<td>26.6%</td>
</tr>
</tbody>
</table>

Source: Compiled from the rainfall data taken from [www.indiawaterportal.org](http://www.indiawaterportal.org)

### TABLE 3
**DESCRIPTIVE STATISTICS FOR MONSOON RAINFALL (MM) OF 30 YEARS (1987-2016)**

<table>
<thead>
<tr>
<th>STATISTICS</th>
<th>GWALIOR</th>
<th>SHIVPURI</th>
<th>GUNA</th>
<th>DATIA</th>
<th>BHIND</th>
<th>MORENA</th>
<th>SHEOPUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>316.06</td>
<td>338.79</td>
<td>418.80</td>
<td>343.87</td>
<td>298.74</td>
<td>280.14</td>
<td>270.38</td>
</tr>
<tr>
<td>Min</td>
<td>94.18</td>
<td>119.18</td>
<td>109.93</td>
<td>101.63</td>
<td>87.97</td>
<td>89.05</td>
<td>77.88</td>
</tr>
<tr>
<td>Mean</td>
<td>175.05</td>
<td>192.20</td>
<td>198.26</td>
<td>192.79</td>
<td>174.69</td>
<td>174.20</td>
<td>176.79</td>
</tr>
<tr>
<td>SD</td>
<td>50.08</td>
<td>52.77</td>
<td>74.11</td>
<td>57.67</td>
<td>57.76</td>
<td>51.39</td>
<td>51.58</td>
</tr>
<tr>
<td>CV %</td>
<td>28.6%</td>
<td>27.5%</td>
<td>36.5%</td>
<td>32.1%</td>
<td>35.5%</td>
<td>31.2%</td>
<td>30.4%</td>
</tr>
</tbody>
</table>

Source: Compiled from the rainfall data taken from [www.indiawaterportal.org](http://www.indiawaterportal.org)

Table 3.1 to 3.3 shows the values of max, min, mean, Standard deviation (SD) and CV% of all the 7 districts of Gwalior Chambal region for different time period of 30 years, 50 years and 100 years. It is evident from above tables that the monsoon rainfall is volatile and varying in Gwalior-Chambal region.

To check whether there is significant difference in rainfall volatility the one way anova test is applied on rainfall data for different time period. The result of one way Anova test can be seen in the table 3.4-3.5
It is clearly visible from above table 3.4-3.6 that significance level is less than 0.05 so we can say that null hypothesis is rejected. It means there is significant difference in the monsoon rainfall volatility across the Gwalior-Chambal region in time period 30, 50 and 100 years.

It is also evident from table 3.1 to 3.3 that monsoon rainfall volatility is increase in recent years.

V. CONCLUSION

Indian agriculture is highly vulnerable to bad monsoon conditions and the monsoon volatility is increasing in recent years. This study show how monsoon volatility is varying across the Gwalior Chambal region. This study can be used as base to introduce risk hedging tool like weather derivatives in Gwalior-chambal region. This study can further be extended to study the feasibility of weather derivatives and the acceptability of these instruments among the farmers of Gwalior-Chambal region.
REFERENCES