A STUDY ON RAINFALL INDEX IMPACT ON AGRI COMMODITIES

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ABSTRACT

The analysis of rainfall index impact on Agri commodities of MCX has been done for the period of 2013-2014. Augmented Dickey Fuller test has been applied to measure the stationary of the select commodities along with the indices for the analysis. Granger causality test has been applied on the Johansen cointegrated data between rainfall index and Agri commodities. The analysis has shown that all the commodities were influenced significantly by the rain index. The regression equation had predicted Almond, Cotton and Chana to move upside. Partial correlation shows that Guar seed and cotton found to be strongly correlated among the select commodities. This analysis is useful for the commodity traders and investors along with the farmer community who lastly depend on Agriculture.

KEYWORDS: MCX, MCXAgri, Rainfall Index, Agri commodities

INTRODUCTION:

The Multi Commodity Exchange of India ltd (MCX) developed Rainfall Indexes with the help of weather risk management Pvt. Ltd. The MCX Research Department constructed based on annual cumulative rainfall and adjusted with actual cumulative rainfall up to the date of Index. The rainfall index tells us the percentage of normal cumulative rainfall expected till the date of the index it actually rained. The MCX designed the following Rainfall Indices

1. RAINDEXMUM
2. RAINDEXIDR &
3. RAINDEXJAI

The above indexes record the rainfall at Mumbai, Indore and Jaipur. The index is designed in such a way that it considers the normal historical rainfall Mumbai, Jaipur and Indore. The historical and the current rainfall data has been provided by the Indian Meteorological Department (IMD).

The normal Rainfall index values of index for Mumbai, Jaipur & Indore are 1950, 950 & 350 respectively. The rainfall index values are recorded on daily basis and updated on the website during the monsoon season from (June to October) of every year. The Rainfall Indexes can help Agriculture Industry because it mostly depends on the rainfall. A cap will be adopted on the maximum daily rainfall to reduce the impact on the index during the times of unpredicted rainfall on a single day. The rainfall index is not for weather forecasting or predicting the rainfall in respective places.

Multi Commodity Exchange of India (MCX): It was established in the year 2003 it is the independent commodity exchange in India. The National commodity exchange which facilitates

online futures trading and settlement in commodities futures. The MCX offers around 40 commodities in various sectors such as Agriculture, Energy, Precious and Non- precious metals.

The different MCX indices are as follows:

MCX AGRI – Agriculture index, MCX METAL- Metals index, MCX ENERGY – Energy index

MCX Comdex reflects the performance of MCX AGRI, MCXMETAL and MCX ENERGY.

MCX agri index: MCX Agriculture index indicates the overall agri commodities indices returns. The mcx agri index is the major commodity index of mcx. The agri commodities traded on mcx are Almond, Cardamom, Chana, Cotton, Coriander, Jute, Maize, Soybean, Wheat, Sugar, Menthaoil, and Coffee, Sunflower oil, Potato, pepper, red chili and Guar seed. The agri commodities are traded on daily basis.

OBJECTIVES:

1. To measure the relationship between Agri commodities of mcx.
2. To know the rainfall index impact on Agri commodities prices.
3. To predict the Agri commodities future movement based on rainfall index.
4. To measure the risk level of select Agri commodities.
5. To find the returns performance measure on Agri commodities.

SCOPE OF THE STUDY:

The analysis has been focused on the year 2013. This paper emphasized to find out performance of all the Agri commodities along with the MCX Agri index. This analysis mainly focuses on the Agri commodities sector of mcx. The data of monsoon rainfall season from June to October of 2013 and agri commodities data from mcx has been considered for the analysis.

NEED OF THE STUDY:

To know the relationship of agri commodities and rainfall index impact on agri commodities. The performance of agri commodities and the future movement of Agri commodities can be known. To know that if there is a risk in Agri sector. There is a need of more Rainfall indices to analyze the performance of Agri sector.

RESEARCH METHODOLOGY:

Partial Correlation: Partial correlation is a method used to describe the relationship between two variables whilst taking away the effects of another variable, or several other variables, on this relationship.

	A	B	C
A:	*		
B:	r(AB)	*	
C:	r(AC)	r(BC)	*

The partial correlation of A and B adjusted for C is:

$$R_{ABC} = \frac{R_{AB}-R_{AC}R_{BC}}{\sqrt{(1-R^2_{AC})(1-R^2_{BC})}}$$

Cointegration: An (n x 1) vector time series $\mathbf{y}_t$ is said to be cointegrated if each of the series taken individually is non-stationary with a unitroot, while some linear combination of the series **a**'**y** is stationary for some nonzero (n x 1) vector **a**."Hamilton uses the phrasing that $\mathbf{y}_t$ is cointegrated with **a**', and offers a couple of examples.

$$Ak\,(L)xt = \mu 0 + \Psi Dt + \varepsilon t.$$

Granger Causality test: The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. Granger causality is a statistical concept of causality that is based on prediction. According to Granger causality, if a signal X_1"Granger-causes" (or "G-causes") a signal X_2, then past values of X_1 should contain information that helps predict X_2 above and beyond the information contained in past values of X_2 alone.

$$X_1(t)=\sum_{j=1p}A_{11,j}X_1(t-j)+\sum_{j=1p}A_{12,j}X_2(t-j)+E_1(t)$$

$$X_2(t)=\sum_{j=1p}A_{21,j}X_1(t-j)+\sum_{j=1p}A_{22,j}X_2(t-j)+E_2(t)$$

Regression Analysis: In statistics, regression analysis is a statistical process for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables.

Formula isY= a+bx where x- intercept, b-slope

Treynor ratio: Treynor ratio shows the risk adjusted performance of the invested fund. Here the denominator is the beta of the portfolio. Thus, it takes into account the systematic risk of the portfolio. Jack Treynor extended the work of William Sharpe by formulating treynor ratio. Treynor ratio is similar to Sharpe ratio, but the only difference between the ratios is that of the denominator.

Formula for Treynor ratio: **(Rp-Rf)/Beta**

Sharpe ratio: Measure of the performance of an investment, computed by dividing the excess return (that is over the return on a risk-free investment such as on Treasury bills) by the amount of risk taken to generate the excess (the standard deviation of the rate of return).

Formula is **s(x)=(Rx-Rf)/stdev(x)**

Jensen ratio: Jensen's Alpha, or just "Alpha", is used to measure the risk-adjusted performance of a security or portfolio in relation to the expected market return (which is based on the capital asset pricing model (CAPM). The higher the alpha, the more a portfolio has earned above the level predicted.

Jensen's alpha = Portfolio Return − [Risk Free Rate + Portfolio Beta * (Market Return − Risk Free Rate)]

$$\alpha_J = R_i - [R_f + \beta_{iM} \cdot (R_M - R_f)]$$

LIMITATIONS:

1. AM values of MCX Agri indices were ignored PM values were considered for this analysis.
2. MCX Indore rainfall index has been considered for this analysis.
3. Rainfall index data is available for five months.

LITERATURE REVIEW:

K. Krishna Kumar, K. Rupakumar, R. G. Ashrit, N. R. Deshpande, and J. W. Hansenon:

This paper about climate impacts on Indian Agriculture presents the analysis of crop-climate relationships in India. Agriculture is the backbone of India's economy which mostly depends on monsoon rainfall during the months from June to October. The major crops like (rice, wheat, sorghum, groundnut and sugarcane) correlation analysis have been done using historic statistics of production of these crops and for the total food grain, cereal, pulses and oilseed. The total annual production except sorghum and sugarcane and the production in the monsoon except sorghum and post monsoon season (except rice and sorghum) were correlated to the monsoon rainfall. The monsoon season crops are strongly correlated with the monsoon predictors. It is found that the impact of sub divisional rainfall is strong in most areas of the country when compared with state-level crop production statistics.

S.K. singh, Krishna M.singh, R.K.P.Singh, Abhay Kumar, Ujjwal Kumar: The above author's paper is impact of rainfall on Agricultural production in Bihar. In Bihar state agriculture sector contributes 19% to the state GDP and where 70 percent of people work in rural areas in agriculture. The rainfall is erratic to poor and unreliable but during June to September it varies by 23 percent, adversely affecting the rice production. It is observed that there is a decline in rainfall by 5 to 25 percent 8 percent of districts by twenty five percent. They found the relationship of rainfall(SPI index) and rice production and it has been found positive in all the agro-climatic zones and highly significant in low rainfall area. They suggest that varieties need to be developed on priority basis for sustainable farming in Bihar. Irrigation infrastructure need to be created in state for sustainable agriculture production.

Jemma Gornall, Richard Betts, Eleanor Burke, Robin Clark, Joanne Camp, Kate Willett and Andrew Wiltshire: This paper is about the Implications of climate change for agricultural productivity in the early 21st century. They considered the reviews recent literature relating a wide range of processes through which climate change could potentially impact global-scale agricultural productivity, and presents changes in relevant meteorological and plant physiological quantities from a climate model ensemble to illustrate key areas of uncertainty. They found that there is a high uncertainty in the extent to which the direct effects of carbon dioxide rise on plant physiology will interact with climate change in affecting productively. They concluded that at present, the total impacts of climate change on global-scale agricultural productivity cannot be reliablyquantified.

Salvatore Di Falco, Jean-Paul Chavas: This paper is about Rainfall shocks and dynamic effects of crop diversity on the productivity of agro systems which focuses of investigating the dynamic effects of rainfall shocks on agro-ecosystems productivity. This analysis estimates the panel data model of cereal production in southern Italy. It documents the adverse effects of a reduction in rainfall on the agro ecosystem productivity both in the short run and the long run. It finds out the increasing level of spatial crop diversity can mitigate negative impact. They finally

conclude that empirical evidence shows higher diversity supports resilience and maintains the system productivity under challenging climatic conditions.

AnupamaMahato: The author's topic is Climate impacts on agriculture. The author clearly defines the word weather in long term and short term. In the short term "weather" refers to daily changes in temperature of a region and the long run, the climatic changes may affect agriculture in many ways like quantity and quality of crops in terms of productivity and growth rates. The climate change directly impact production of food across the globe and increase in the mean seasonal temperature can reduce the duration of crops and reduce the yield. The result of agriculture production to climate change, and climate change is having a negative impact on agriculture, are severe which project to have a great impact of food production and threaten food security and hence, require agricultural measures to combat with. Warming will impact yields more in areas where temperatures are close to physiological maxima for crops.

KanikaMahajan: The author's article is Rainfall shocks and gender wage gap: Agriculture labor in India. The author says that many of the studies are done on urban labor markets and very few papers consider the effect of crises in rural areas. The crisis in developing countries is the variability in rainfall that affects demand for agricultural labor in rural areas. National sample survey data for India from 1993 to 2007 has been used and created a district level panel dataset to examine the rainfall shocks, that affect demand for labor in Indian agriculture, affect wage gap in agriculture between males and female, overall the author found the such shocks does not affect the wage gap, but when rainfall is low in years that affects the wage gap adversely in rainfall fed rice growing regions of India. The author concludes the effect of rainfall shocks on gender wage gap in agriculture depends upon the gender roles other than technology of production in agriculture.

Jaehyuk Lee and Denis Nadolnyak: Global warming has been an issue recently in many aspects because it has been in increasing trend since 1980. This paper estimates the climate change effects on the United States agriculture using the pooled cross-section farm profit model. The data is mainly based on the yearly Agricultural Resource Management Survey (ARMS) from USDA for the time period 2000 to 2009 in the 48 contiguous States. For measuring the climate, the growing season drought indices (the Palmer Drought Severity Index (PDSI) and Crop Moisture Index (CMI)) are applied to the analysis and both indices have a negative relationship with the temperature. The estimates indicating that one unit increase in PDSI (CMI) leads to 5.5% (13.9%), 4% (9%), and 5% (14%) increase in the farm profits for all farms, crop farms and livestock farms in the United States(US). This paper provides more contributions to the literature. First, the data set is rare and unique national survey that provides an individual farm of level observation. Therefore, it gives more detailed structure of farm and financial information for the analysis compared to other studies. Second, drought indices (PDSI and CMI) are used for estimating the impact of weather on farm profits while temperature, precipitation and growing degree-days are typical weather variables in literatures.

IfabiyiIfatokun Paul and Omoyosoye Oluwasin: Rainfall within the tropics is highly variable and it is the most important variable affecting crop yield. This represents a study of the impact of rainfall characteristics on maize yield in Kwara state. Using the correlation and regression analysis, the effects of some rainfall indices (monthly and annual rainfall, rain days,and rainfall onset and rainfall cessation) on maize yield in Kwara State are examined. The results of the correlation statistics showed that rain days has the strongest association (r=- 0.55) with maize yield. It has been observed that early maize and late maize suffer moisture deficiency in March

and November respectively while excessive rainfall of June/July and September also have implication for the yield of maize. The paper further derived 5 Rainfall-Yield Models for predicting maize yield in Kwara state.

Salvador Barrios, BazoumanaOuattara and Eric Strobl: This paper examines the impact of climatic change on the level of total agricultural production of Sub-Sahara Africa (SSA) and non-Sub-Sahara Africa (NSSA) developing countries. It uses a new cross-country panel climatic data set in an agricultural production framework. The results show that climate is measured as changes in country-wide rainfall and the temperature, has been a major determinant of the agricultural production in sub-Sahara Africa (SSA). In contrast, NSSA countries appear not to be affected by climate in the same way. Simulations using estimates suggest that the detrimental changes in climate since the 1960s can account for a substantial portion of the gap in agricultural production between SSA and the rest of the developing world**.**

Ajadi, B.S., AdeniyiAdedapo, and AfolabiMonisolaTunde: This paper examines the impact of climate on urban agriculture in the city of llorin. Climatic data on rainfall, evaporation, relative humidity, and temperature and sunshine hours were collected for a period of 10 years alongside agricultural data on rice, sorghum, maize, cowpea and yam. Multiple regression, trend analysis and correlation analytical techniques were employed to analyze the data. The result obtained shows that the selected climatic parameters have a weak correlation on urban agriculture within the years under review. It is therefore recommended that the use of fertilizers and modern agricultural techniques should be employed to improve agricultural yield generally in the study area.

DATA ANALYSIS:

1. To measure the relationship between Agricommodities of mcx.

Control Variables			almond	cardamon	chana	coriander	cotton	jute	maize	menthaoi	soyabeen	guarseed	wheat	sugar
mcxagriindex	almond	Correlatio	1											
		Significan	.											
		df	0											
	cardamon	Correlatio	0.421	1										
		Significan	0.045	.										
		df	21	0										
	chana	Correlatio	-0.082	0.207	1									
		Significan	0.708	0.344	.									
		df	21	21	0									
	coriander	Correlatio	0.421	1	0.207	1								
		Significan	0.045	0	0.344	.								
		df	21	21	21	0								
	cotton	Correlatio	-0.137	-0.287	-0.263	-0.287	1							
		Significan	0.534	0.184	0.225	0.184	.							
		df	21	21	21	21	0							
	jute	Correlatio	-0.292	-0.101	0.071	-0.101	0.39	1						
		Significan	0.176	0.646	0.746	0.646	0.066	.						
		df	21	21	21	21	21	0						
	maize	Correlatio	0.222	0.154	-0.253	0.154	0.07	-0.166	1					
		Significan	0.308	0.483	0.245	0.483	0.752	0.449	.					
		df	21	21	21	21	21	21	0					
	menthaoi	Correlatio	-0.405	-0.217	0.365	-0.217	-0.411	-0.276	-0.248	1				
		Significan	0.055	0.32	0.087	0.32	0.052	0.202	0.255	.				
		df	21	21	21	21	21	21	21	0				
	soyabeen	Correlatio	0.351	0.074	-0.244	0.074	0.781	0.148	0.135	-0.631	1			
		Significan	0.101	0.737	0.262	0.737	0	0.499	0.541	0.001	.			
		df	21	21	21	21	21	21	21	21	0			
	guarseed	Correlatio	-0.051	0.3	0.286	0.3	-0.392	0.004	0.005	-0.072	-0.174	1		
		Significan	0.819	0.164	0.186	0.164	0.064	0.987	0.98	0.746	0.428	.		
		df	21	21	21	21	21	21	21	21	21	0		
	wheat	Correlatio	0.221	-0.108	-0.007	-0.108	0.363	-0.21	-0.016	-0.072	0.451	-0.113	1	
		Significan	0.311	0.624	0.976	0.624	0.088	0.336	0.943	0.743	0.031	0.609	.	
		df	21	21	21	21	21	21	21	21	21	21	0	
	sugar	Correlatio	-0.307	-0.125	0.628	-0.125	-0.05	-0.071	0.279	0.388	-0.218	0.112	0.045	1
		Significan	0.154	0.57	0.001	0.57	0.82	0.748	0.197	0.067	0.318	0.611	0.839	.
		df	21	21	21	21	21	21	21	21	21	21	21	0
			strongly correlted											
			moderately correlated											
			slightly correlated											

Slabs: 0 - 0.3 slightly correlated

0.3- 0.7 moderately correlated&0.7- 1 strongly correlated

Interpretation: Partial correlation has been applied to find the relationship between all Agri commodities and it is found that there is very strong relationship between coriander and cardamom, Menthaoil and soybean have a weak relationship. Most of the agri commodities are slightly correlated.

2. To know the rainfall index impact on Agri commodities prices.

	cointegration	granger
almond	-1257.034	0.5694
cordamon	-1294.234	0.6719
chana	-1505.535	0.8693
coriander	-1573.894	0.5438
guarseed	-1563.351	0.7024
cotton	-1709.465	0.4297
jute	-1462.758	0.6584
maize	-1362.416	0.4162
menthoil	-1327.4	0.5719
soyabeen	-1501.481	0.5444
wheat	-1394.594	0.6202
sugar	-1464.976	0.6367

Interpretation: Cointegration analysis has been done on Agri commodities with Rainfall index and found that all the agri commodities are cointegrated with Rainfall index.Granger causality test has been applied on Agri commodities with Rainfall index to find out Rainfall index impact on Agri commodities. It is found that all the Agri commodities are influenced except cotton and maize.

3. To predict the Agricommodities future movement based on rainfall index.

	Regression Analysis				
	x-intercept	a	slope(b)	y=a+bx	prediction
almond	1175.60269	574.75	0.304934	933.231	upside
cardamom	1644.69264	724.3	-0.40971	50.4496	downside
chana	1269.54111	3138	0.069309	3225.99	upside
coriander	1629.01932	6791	-0.04936	6710.595	downside
guarseed	1705.105	5500	-0.05803	5401.056	downside
cotton	1118.4894	20390	0.010634	20401.89	upside
jute	1636.6012	2669	-0.11451	2481.6	downside
maize	1424.94355	1250	-0.06081	1163.351	downside
menthaoil	1809.52762	937	-0.47942	69.46982	downside
soyabeen	1634.9245	3777.5	-0.08512	3638.333	downside
wheat	1501.34725	1620.8	-0.10642	1461.03	downside
sugar	1601.63944	2868	-0.08936	2724.872	downside

Equation of Regression y=a+bx; where x=intercept, b=Risk

Interpretation: Regression analysis has been done on agri commodities based on movement of Rainfall index. The agri commodities Almond, Chana, and cotton prices are expected to upside and all other are expected to go downside.

4. To measure the risk level of select Agri commodities.

risk level of agri commodities	
almond	1.012651
cardamom	0.987579
chana	0.01368
coriander	0.100247
guarseed	0.051253
cotton	0.030016
jute	0.264982
maize	0.499996
menthaoil	0.755117
soyabeen	0.143112
wheat	0.355675
sugar	0.294335

Interpretation: The above table show the beta values of all agri commodities and it is observed that Almond only had risk and rest all the agri commodities are less risky.

5. To find the returns performance measure on Agricommodities.

		performance of Agri commodities returns										
	almond	cardamom	chana	cotton	guarseed	jute	maize	menthaoil	soyabeen	wheat	sugar	mcx agri
Avg returns	17.81137	-27.7607	-26.5358	31.69659	-66.0164	18.45707	-9.57361	-40.9896	19.24324	5.213959	-10.4135	7.379074
STDV	51.95648	96.21616	292.092	541.0723	2502.736	166.4554	109.4486	203.5545	250.0586	50.20794	110.7325	111.4682
risk	1.760227	-0.74085	-0.21107	0.033792	-0.03145	-0.28827	0.160347	-0.24599	0.034162	1.756232	-0.66931	
Treynor ratio	9.834741	38.14656	128.0912	923.2057	2115.072	-62.2923	-62.8237	168.6648	548.6566	2.684133	16.30554	
sharpe ratio	0.33319	-0.29372	-0.09256	0.057657	-0.02658	0.107879	-0.09204	-0.20383	0.074955	0.093889	-0.09856	
jensen ratio	5.202643	-23.1644	-25.5838	30.96413	-66.3001	19.94011	-11.1766	-39.7975	18.50824	-7.36729	-6.30926	

Interpretation: The above table shows the performance of all the Agri commodities with three different ratios of measure of performance were used.

- Treynor ratio shows that guar seed performance is better and maize performance of returns is worst when all the Agri commodities are compared.
- Sharpe ratio shows that Almond' performance is better and cardamom performance of returns is worst.
- Jensen ratio shows that cotton performed better and guar seed performed worst.

FINDINGS:

- The Agri commodities Coriander & Coriander are strongly related than all the other and there is weak relationship between the Menthaoil& soybean.
- From the risk level of all Agri commodities we found that almond has more risk when compared with all the other.
- The performance measure show that Almond, Guar seed, and cotton performed better and maize, cardamom performance of returns is least.
- The log likelihood ranks were observed in decreasing mode in all trend models along with the 2alpha levels when Agri commodities data cointegreted with Rainfall index.
- The market movement of Almond, Chana, and Cotton is expected to go upside and rests all are expected to go downside.
- The Rainfall index is cointegrated with all the Agri commodities.
- From the granger causality it is found that there is an impact of Rainfall index on all the agri commodities except cotton & maize.

CONCLUSION: I conclude the analysis of Rainfall index impact on select Agri commodities of mcx. With this analysis Almond is having high risk where as other commodities were observed with low risk.Rainfall index is having significant impact on the Agri commodities in the past year except cotton and maize. The partial correlation had shown with the movement between Cardamom & coriander found to be strongly correlated whereas Soybean & Menthaoil are slightly correlated during the analysis. The Almond, Cotton & Chana are expected to outperform whereas the rest of Agri commodities are predicted to move downside.

The investors of Commodities market in Agri segment need to be careful while taking the decision in Agri segment.Hence there is a further scope to do research in this area to help the commodities investors and forming community. There is a need to design more rain indices based on the Agri production in respective status of indices.

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