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Environment and Changing Agricultural Practices: Evidence from Orissa, India

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ABSTRACT

In this paper attempt is made to examine vulnerability of farm households' to adverse consequences of climate variables and extreme conditions like: food and cyclone. Three key components impeding food security with in the substance production structure are identified as (i) Inadequate food production by farm households. (ii). Distribution and marketing constrains and (iii) Low households' income & procurement. Sampled data was used in the Cobb-Douglass function. This model and its results reveal that agriculture is largely dependent upon input prices, prices of livestock, and that of fertilizers. Highly significant response of farms' income to precipitation reveals that investment in irrigation would improve farms' income.

JEL. Classification: C35; C52;C67;J21;J30;O12;O13;O15;O18;R14;R15:R41

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1. INTRODUCTION

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1.1. Agricultural Adaptation

Changing climate condition has severe impact on developing countries. Studies of Parry (1990), IPCC (1997), Easterling,, Crosson, Roserberg, McKenney, Katz and .Lemon (1993) and Winters, Murgai, Janvry, Sadoulet and Frisvold (1999) have observed such a contention. Climate condition affects agricultural production and food security through income from agriculture production, costs to consumers and food scarcity.

Orissa is predominantly agrarian. Exploitation of agricultural and other natural resources remains the driving force for the state economic development, extending livelihood support to some 70% of the total population. Therefore, climate induced production variability has had immediate and important macro economic impacts.

Agricultural production largely depends on climatic variables, such as temperature, precipitation and light. Ability of the farm households to grow enough food to support their family and livestock, to a large extent, is determined by the weather condition. Downing (1992) examined the effects of changing global climate condition on agricultural production and observed that this may present risks to future livelihood. Changing pattern of precipitation and temperature are important parameters for agrarian societies like Orissa. Continuous vulnerability to flood and cyclone has aggravated the danger on agricultural productivity. How far the state has taken steps in this direction. Has it made the people conscious enough to change the agrarian pattern so that it can adjust with the climatic vulnerability?

This exercise on the basis of an econometric model attempts to assess the climate related factors that influence agricultural income. Understanding of such variables and the way in which they affect society and environment is a prerequisite for attempting to improve agricultural productivity and increase farm incomes. An assessment of the impact of weather variable on food production and farm level income will contribute to efforts aimed at ensuring both increased food availability through sustainable domestic production storage and trade as well as farmers' adaptation to a long term climate change anomaly.

Prediction of climatic fluctuation is highly impossible. Yet it is crucial for the farmers, marketers, government and to economy as a whole. Quite a few exercises has examined and reviewed the nature and potential impact of climate variation and climate change (Tobey, Reilly and Kane (1993). Nordhaus (1991) and Cline (1991) have examined the monetary impact of climate change. Reilly, Hohmann and Kane (1994) and Rosenzweig and Parry (1994) have studied the impact of changing climatic condition on agriculture. Climatic variation, undoubtedly, has a wide ranging impact on both human as well as natural system. While changing soil and water availability, climatic extremes cause serious crop diseases leading thereby to drastic fall in agricultural yields and serious food scarcity.

Agricultural decisions have complex interaction with climatic extremes. Proper forecasting about climate extremes could make it possible to adjust farm decisions so as to reduce unwanted impacts and take advantage of the favorable condition. Climate

information can be grouped into three categories: (i) Historical climate information (for example average rainfall and its variability, (ii) information from real time monitoring and (iii) forecast information on future climate, seasonal, year to year and long term forecasts (Maula 2002). This exercise attempts to examine the impact of average rainfall variability on food security.

Changing climate condition has severe impact on developing countries. Review of literature from different countries also supports this claim and suggests for improvement of it by reforming and providing awareness among the local people by making efforts with active NGOs and government organization. These studies also suggest ways of microfinance for farm households' support and diversification of livelihood and poverty elevation. It is supported with also following studies: Sudan (2007); Zeller (1999); Herani (2002); Herani, Rajar, and Khaskheli (2007); Herani, Rajar and Dhakan (2007); Rajar, Herani and Dhakan (2007); Herani (2008); Herani, Wasim, Rajar and Shaikh (2007); Herani, Wasim, Rajar and Shaikh (2008); Kar (2008).

1.2. Vulnerability to Climatic Extremes and Food Security

Reducing negative impact of climatic variability has been cautiously attempted by the developed countries. Forecasting seasonal fluctuations with a great degree of accuracy and planning out agricultural practice accordingly has saved these countries from facing an unsecured food situation. But developing countries like India are not so lucky, least to speak of less developed states like Orissa where the condition is still more deplorable. In this state farmers carry out agricultural practices on the basis of past experience. Agricultural practices are mostly rain fed, and as such, fluctuations of rainfall, as well as, other climatic extremes cause a great variation in the income level of the farmers on whom the state's economy thrives. Keeping in view the above drops back we conducted this study.

Organization of the remaining paper is as below: section 2 is about methodology, in which purpose of study and data collection is given. In section 3, empirical model is formulated and explained. In section 4 empirical results are given and finally section 5 gives conclusion and implications.

2. METHODOLOGY

2.1 Purpose of Study

This study attempts to examine the vulnerability of households to adverse consequences of climate variability and extreme condition like food and cyclone, and to identify the key components impeding food security with in the substance production structure.

2.2 Data Collection

To achieve the purpose of study both primary and secondary sources of data are used. With the selected sample the present exercise has attempted to examine vulnerability of the farm households to adverse consequences of climatic variability and extreme conditions like flood and cyclone. Three key components impeding food security within the subsistence production structure are identified as (i) inadequate food production by farm households, (ii) distribution and marketing constraints and (iii) low household incomes and food procurement. Food security is hampered by physical and economic constraints. Physical inaccessibility arises because of inadequacy of production and improper distribution system, which comprises storage, transportation and marketing. Economic inaccessibility restricts the farm households to buy necessary amount of food. This creates vulnerability and poses a challenge. This challenge is aggravated by increasing unpredictability of the nature of rainfall and weather conditions.

Farmers of this region are unaware of modern facilities irrigation, use of fertilizer and pesticides to improve farm production are nominal. Land tenure system further eats into agricultural productivity as the farmers are aware that they have to part with the produce of the land, their inclination to increase production declines. All these adversaries are mounted by adverse weather conditions which are hardly predicted with acceptable accuracy. Poor farmers are left with no other option but to change farming practices. This exercise attempts t address the issue of farm level adaptation.

Farmers in the sample were asked about crop protection techniques they use in different seasonal aberrations to protect crops from climatic constraints like cyclones and floods. In the aftermath of such natural hazards, long days of water logging, salinity of soil also reduces farm production. Proper storage of food remains a still major concern.

Response of the farmers as regards farm level adaptation remained very little. Around 40% of the total 250 farmers surveyed adjusted farming practices in response to climatic variability. All of them used the indigenous soil and crop management technique. Even though agricultural extension offices are active in the region very little help was extended by them. Except supply of seed and fertilizer they did not advise about modern techniques of farming and crop protection. Some of these practices are costly and at times beyond the reach of the poor farmers. Lack of adequate credit facilities constrained them to take up short term and long term improvement of the land. As such, agricultural research and extension services very often remain un-implemented.

This apart, deforestation, both natural and man-made and soil erosion has aggravated the condition. Land impoverishment through loss of soil has reduced agricultural productivity. Agricultural extension centers and NGOs admit the problem but find no solution to unauthorized encroachment of land by the migrants. Government sponsored social forestry programmes to induce the farmers to plant casuarinas trees in the vacant land have been of a limited success. NGOs have also induced the localities for reforestation and soil conservation. These are hardly practiced. It was

observed that the people were aware of the benefits of large scale reforestation, such as blocking of natural calamities, reduction in the loss of top soil, yet they could not practise it due to the fear of loss of land.

In sum, climatic extremes, along with insufficient use of modern facilities like fertilizer and pesticide, impracticability of suitable cropping practices and lack of reforestation has been identified as the major reasons for low productivity of agriculture and loss of food security. Insufficient weather forecasting system together with lack of coordination between meteorological and agricultural unit has further aggravated miseries of the poor farmers. Unrestricted migration and deforestation, if not checked properly are very likely to increase vulnerability.

On the basis of the sample survey this exercise attempts to examine level of farm income in response to fluctuations in seasonal conditions. Precipitation data were collected from the office of Indian Meteorological Department. Significance of changes in the cropping pattern and storage facilities estimated in order to guide policy recommendations to improve food security.

3. EMPIRICAL MODEL

In this model an attempt is made to examine the impact of farm level adaptability on farm revenue. A Cobb – Douglass (C-D) type production function is used for the purpose. It is simple to use and easy to estimate and interpret the results obtained in this function. The original C-D function prior to taking natural log is:

$$R = \beta_0 P_i^{\beta_1} P_B^{\beta_2} X_{lb}^{\beta_3} X_{ft}^{\beta_4} RFG^{\beta_5} \exp(\beta_6 D)$$

This function could be put in a log form as:

$$\ln R = \beta_0 + \beta_1 \ln P_i + \beta_2 \ln P_B + \beta_3 \ln X_{lb} + \beta_4 \ln X_{ft} + \beta_5 \ln RFG + \beta_6 Di + \varepsilon, \text{ where,}$$

R is the gross farm revenue per hectare measured in rupees,
P_i is the price of agricultural inputs like seed, other tools and implements etc.
P_B is the price of bullock power,
X_{lb} is the labor used in man days and
X_{ft} is the fertilizer and pesticides used per hectare.
R_i is the weekly average precipitation is the sample area.
D_i is the dummy variable, which takes the value of 1 if the farmer adapts changing cropping patterns or any other method of increasing agricultural output and '0' otherwise.

Agriculture is the prime source of income of the sample households. Unfavorable weather conditions affect agricultural productivity. Therefore, farmers use large amount of fertilizer and pesticides to maintain the level of income. This increases cost of agricultural production as well as income of the farmers. This apart, varying

climatic condition, an exogenous variable also plays a great role in determining farm income.

Agriculture in the state in general, and the sample villages in particular, are highly labor intensive. Farmers use both family as well as hired labor. Majority of the households (80%) employ family labor while 15% use both family and hired labor. Only 5% were observed to be depending on hired workers.

Agriculture Extension offices were observed to be functioning in these villages. Prime functions of these offices are to help the farmers in the use of various inputs and provide necessary guidance in adopting modern techniques of agriculture. These offices also advise the farmers to change cropping and harvesting pattern in response to certain predicted meteorological fluctuations. But there are only a few farmers who go for a changed pattern. Majority of them prefer the much used traditional method. When enquired they revealed that they are more comfortable with traditional practices. Yet quite a few farmers have worked as per the advice of the agriculture extension offices and have adopted modern practices like better variety of seed, fertilizer and pesticides. It was also observed that very often financial constraints obstruct the farm households from adopting modern practices which is capital intensive. Farmers were also observed to be mythical about use of fertilizer and pesticides and they opined that these affected the food as well as soil quality and result in continuous degradation of the productivity of land.

It was expected that the signs of the parameters estimated for the changing crop practice option would be positive, indicating that they lead to an increase in farm return.

4. EMPIRICAL RESULTS

The coefficients of statistical test results obtained from the double log regression analysis (estimated by OLS method) are presented in table below. The results are as per expectation. Most of the signs of the independent variable fit the tested hypothesis. The values of the estimated parameters are observed to be in conformity with the expectation (Table – V.I)

Table – 1. Regression Coefficients Explaining Farm Income.

Independent Variables	Coefficients	Estimates	T Values
Constant Term	β_0	4.36	2.98
Input Prices (P_i)	β_1	-0.28	-4.50*
Bullock Power (P_B)	β_2	0.11	3.95*
Labour Power (X_{lb})	β_3	-0.19	-1.98*
Fertilizer (X_{ft})	β_4	0.13	1.99*
Precipitation (R_i)	β_5	0.27	3.44*
Adaptation Method(D_i)	β_6	0.15	2.30*
Adjusted R^2	0.75	F Statistics	36.40

* indicates statistical significance maximum up to 10% level.

The above table reveals that input prices are exerting inverse influence on the farm income. This means with rising price of inputs like seed and other implements cost of production will increase and farm income will fall. Increased use of bullock power is also raising farm output. However, this is not the case of increased use of labor power. Agriculture in Orissa is marked by surplus labor. Disguised unemployment and underemployment in this sector makes marginal productivity of labor negative. Therefore, with increased use of labor the wage cost increases when the workers are hired. When the farm household uses more of the family labor which is a regular feature in Orissa they are not able to find a job outside the farm but depend on the farm income; so income of the household declines with rise in labor use.

Agriculture in the state is largely rain fed. As such, increased precipitation improves farm income. But this result should be viewed with a little caution as very high level rainfall may have adverse effect on farm income. Such an observation has been supported by a number of studies. Ozsabuncuoglo (1998) established on identical relationship between wheat production and climate variables in Southeastern Turkey. Maula (2002) has also found identical results in a survey in Cameroon. Significant coefficient of rainfall explains the success of agricultural potential in humid tropical regions. Quite expectedly, increased use of fertilizer increases farm income.

It is interesting to record that adoption of changing farm practices has an income improving impact. The sample farm household, when surveyed favored the traditional pattern of cultivation as they are much used to these. They also opined that the agricultural extension offices are not very dependable as they guide half heartedly and casually. Moreover, changed farm practices are capital intensive and expensive which the poor farmers were reluctant to adopt. Yet, the educated farmers often have a close interaction with the agriculture extension officers and worked in accordance with their advice. These farmers also opined that well coordinated and holistic help from these centers, particularly at the time of climatic hazards, are of a great favor. In general, adoption of changing farm practices in response to changing climatic condition is observed to be having an income improving effect.

High value of adjusted R^2 (75%) reveals that 75% of farm income can be attributed to changes in input prices along with increased use of fertilizer, changes in rainfall, improved use of bullock power and also improved agricultural practices on the suggestion of the agricultural extension centers. The F' value also indicates acceptability of the model at the statistically significant level.

5. CONCLUSIONS AND IMPLICATIONS

It is revealed from this empirical exercise that agricultural income is largely dependent upon input prices, prices of livestock and that of fertilizer. If prices of inputs like seed pesticides and other implements is increased by a single percentage

point farm income will fall by 28%. One percent increased use of labor power also reduces farm income by 19%. Farm income increased by 11% and 13% respectively; with increased use of bullock power and fertilizers. The empirical analysis records 27% response of farm income to rainfall. This underlines vulnerability of agriculture to precipitation, both in terms of length and intensity.

Highly significant response of farm income to precipitation reveals that investment in irrigation would improve farm income. However, this must be supported by adequate improvement in supply of other inputs. Agriculture in the state is rain fed. Low rainfall affects crop production and the income position of the poor farmers is worsened as they can hardly afford costly fertilizer and pesticides. Majority of the farmers also expressed their ignorance about the pattern and intensity of using these products and also the side effects. This calls for a strong role of the agriculture extension services. Formation of farmer groups and training them regarding improved farm practices, crop rotation systems and input usage will help them a lot in this aspect. Farmers of the state are poor. Improved agricultural practices are beyond their reach. Easy access to credit can lend them a support to progress in this direction. Supply of finance along with proper guidelines to utilize the same could be a major support to the vulnerable ones.

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