

Climatic shock and coping mechanisms of a Rural economy- Case of two villages in semi arid region of Karnataka

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Abstract- The rural economy more so the agricultural economy is vulnerable to a no of stressors prime among being the climatic changes leading to high temperature, sporadic rainfall , dry weather conditions among others. There are some crops who withstand the vagaries but some are not, the paper explores through the sustainability and resilience test the strength of lands and crops to withstand climatic shocks. An understanding of the vulnerability faced by rural economy becomes important not only to understand the effects of climatic changes but also effect and to provide remedial measures which needs in form of policy recommendations. An empirical study comprising an extensive primary data collection of two villages were done. The sustainability and resilience of Rampur is extremely low compared to Bableshwar.

Index Terms- Climate ,Sustainability, Resilience, North Karnataka. Khariff ,Rabi Crop

I. INTRODUCTION

Agriculture is extremely vulnerable to climate change. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run fall in production levels. Climate change is creating winners and losers, not surprisingly, the winners are primarily rich,industrially developed Countries. Adaptation planning has grown into a substantial industry, and is being for instance included in public investment in infrastructure, with countries such as Germany, France and the United Kingdom creating National institutions for adaption planning and implementation. In contrast, adaptation in the world's poorest countries is largely a matter of self-help -Channing 2012. Furthermore, it is reasonable to expect that farmers in developing countries may be less able to adapt to climate change due to credit constraints or less access to adaptation technology.

India one of the largest economies of the world has been an agrarian economy for a long time, with more than sixty percent of its population depending on its output. Karnataka the eighth largest state in India is no less.The agricultural sector of Karnataka is characterized by vast steppes of drought prone region and sporadic patches of irrigated area. Districts like Bijapur, Bellary, Bagalkot, Koppal, Gadag, Raichur and

Chitradurga can be classified as low rainfall districts where average annual rainfall (1998-2010) is less than 650 mm. This leads to severe unemployment in the rural areas. Given to a particular occupation and poverty , the farmers and labourers who are dependent on agriculture find themselves in a precarious position. With this backdrop, a study was done to understand the impact of climatic shock on the coping mechanism of a village economy, where production and distribution takes place but on a small scale.

The sustainability and resilience tests were done using the agricultural yields, cost of production and returns. This was done mainly to understand given climatic shocks whether agricultural land are able to sustain adversities in form of severe drought and whether the farm were resilient to a change mainly in terms of cropping changes, input cost, and changes in output price.

II. STATEMENT OF THE PROBLEM

The village economy unlike an urban economy comprises limited occupations which is unique to the area. Agriculture is the main occupation of the majority of the population in the villages of Karnataka with more than 70% of the population depending on it. Despite the serious efforts to boost agricultural production, the sector fails many a times owing to the growing demand of the increasing population, adverse climatic conditions, decline of productivity of crops and shrinking resource base, especially agricultural land, accelerating land degradation, affect the economic development of many villages in the study area. Though the economic activities are restricted to a very few occupations, the lack of knowledge in identifying and prioritizing activities that have high growth linkages and strong income-enhancing activities impact the economic development. It is seen that many a times long term sustainability of economic growth and its welfare largely depend on the magnitude and strength of inter-sectoral linkages and the manner in which income is distributed. It thus becomes important to identify the drivers in the production, marketing, distribution and consumption channels to trace the drivers of economic development and also to map out the most effective route for enhancing growth and improving livelihoods in rural areas. . It has also used economic indicators of sustainability and resilience as indicators to test the impact of climatic shocks on returns of farm lands. In this context it becomes prime

importance to understand and trace the various **drivers of growth** in a village economy. Village are small rural areas whose main occupation is agrarian. Their main livelihoods depend on agriculture with its vagaries.

III. LITERATURE REVIEW

Global warming has led to severe climatic change throughout the universe. A warmer and drier climate could lead to more intense droughts. Rising temperatures associated with climate change will have a detrimental impact on crop production, livestock, fishery and allied sectors. It is predicted that for every 20°C (which has been predicted by 2030) rise in temperature, the GDP will reduce by 5 per cent.

Mutevaka 2009 states there is need to conscientise farmers about climate change and design adaptation strategies that take into cognizance existing local level knowledge and practices on land and water management. There is also need to avail agricultural research results relevant to the small holder farmers and train them on how to use the results to make informed on-farm investment decisions. Melissa 2008, uses annual variation in temperature and precipitation for the past 50 years to examine the impact of climatic changes on economic activity throughout the world. The results indicate that higher temperatures substantially reduce economic growth in poor countries but have little effect in rich countries. Second, higher temperatures appear to reduce growth rates in poor countries, rather than just the level of output. Third, higher temperatures have wide-ranging effects in poor nations, reducing agricultural output, industrial output, and aggregate investment, and increasing political instability.

Elumalai 2011, discusses the trends and patterns in agricultural growth at the national and sub-national levels in India. The analysis of data reveals that the cropping pattern in India has undergone significant changes over time. There is a marked shift from the cultivation of food grains to commercial crops. Among food grains, the area under coarse cereals declined by 13.3 per cent between 1970-71 and 2007-08.

According to Subramanian 2009, The success of the agriculture mainly depends on proper utilization of land and water these are the two most important natural resources in the development of Agriculture. Water is an essential ingredient for food production. Initially, natural rains provided water supply to agriculture in forest areas. The preliminary analysis shows that water and fertilizer play an important role in agricultural production. But addition of irrigation has not resulted in any increase in overall food grains production. The review of early studies indicate multitudinal impact in the form of low production, high price, poor yield and unemployment leading to poverty. The present study would also find whether climatic changes effect the productivity and other interlinkages of the farming community in the two villages

IV. OBJECTIVES OF THE STUDY

1. Contribution of the various sectors of the village economy
2. Analyse the impact of climate shocks on the vulnerability of the village economy

3. To document the coping mechanisms followed.

The two villages which was taken up for the study include Bableshwar and Rampur

V. ANALYTICAL FRAME WORK

Profile of the study area.

The total area of Bableshwar is 7649 hectares the total population is 1528. The villages is highly backward in nature with very poor basic amenities. This is the same scenario which also exist in the surrounding villages. Eighty percent of the farmers cultivate only during the kharif season which is between July and October. Crops cultivated are ground nut, suji, sunflower, sugarcane, horse gram and cotton. The type of soil is generally black soil. The total land area is 2253, population amount to 3608 according to the 2011 census. Male population is 1859 and female is 1749.the main workers are 1097 among them the agricultural worker are 504. The main occupation of the population is agriculture where underemployment plays a predominant role.

A brief description of indicators representing spatial scale of sustainability developed for the study is presented below.

1. Degree of crop heterogeneity on farms:
2. Application of eco-friendly inputs:
3. Ratio of cost of purchased inputs to the total cost of cultivation of the crop
4. Degree of pesticide use:
5. Fertilizer application per unit of cropped area
6. Per cent area under input intensive crops

VI. SUSTAINABILITY

1. Degree of crop heterogeneity on farms: The number of field crops grown per farm was considered to indicate crop heterogeneity. The more the number of crops grown per farm, higher will be the sustainability of agriculture
2. Ratio of cost of purchased inputs to the total cost of cultivation of the crop: If the ratio of cost of purchased inputs (including seeds, farm yard manure, fertilizers, plant protection chemicals, irrigation, hired labour, etc.,) to the total cost of cultivation of the crop is lower, such a farming system is said to be relatively more sustainable
3. Per cent area under input intensive crops: The acreage under input intensive crops like paddy, sugarcane etc., per acre of cultivated land was calculated. It was hypothesized that a farming system with lower proportion of area under input intensive crops was more sustainable. The research aimed to use only three of these indicators .

VII. RESILIENCE

The resilience has been viewed in terms of stability of farms to absorb any external shocks and continue the farming business. The resilience test include

- Average cash cost per unit of Output:** The cash expenditure incurred for fertilizers, pesticides, hired labour, etc., to produce an unit of output was computed. Assuming this to be true, it can be hypothesised that higher the average cash cost per unit of output, lesser will be the resilience of the farming system in that particular zone.

2. Sensitivity Analysis: The sensitivity analysis approach was used to study the extent of reduction in net returns for changes in price of inputs and outputs. For this, a simulation exercise was performed. The prices of inputs and outputs were increased and decreased by 25 per cent each respectively. It was hypothesised that lower the reduction in average net returns upon increase or decrease in input and output prices, higher will be the resilience of that farming situation.

VIII. ANALYSIS AND RESULTS

Table 1 Occupation status in Rampur and Bableshwar.

Occupation	Rampur	Bableshwar
Labourer	15(4.31)	57(18.4)
Cattle Rearing	13(3.74)	14(4.5)
Own land	185(53.16)	238(77)
Nil	135(38.79)	0(0)
Total	348(100)	309(100)

Occupation is captured in terms of the respondents who are employed in the particular profession. More than fifty percent of the respondents were having own land and cultivating on them, though they were not very successful as far as yield is concerned as the crops were rain fed and that the region was prone to drought conditions. A very small percent of them were labourers working in fields and another four percent of them were into cattle rearing. Three fourth of the respondents in Bableshwar were land owners cultivating on their own land once a year. 18.4 % were agricultural labourers, where as a small percentage comprised of people following cattle rearing.

The term sustainability referred to as a measure of self reliance of the production system when it depends on the external system for its input. A system which has a greater dependence on external source of inputs and markets and lower level of eco-friendly inputs into agriculture is considered to be more vulnerable and hence less sustainable in the long run and viceversa. This can be relation to the productivity of land also (Heinen quoted in Bell and Morse, 2000). The sustainability explains whether during a adverse conditions the crops are able to sustain their productivity and also if they are resilient to the adverse conditions.

IX. SUSTAINABILITY AND RESILIENCE OF AGRICULTURAL LAND.

The global warming has its adverse effects on climate changing the pattern of rainfall leading to extreme cyclonic conditions or drought conditions, both affects the farmers in an adverse manner. Certain farm lands and crops are able to sustain the extreme climatic conditions but some are not. The sensitivity analysis is done to find the sustainability and resilience of the lands in the below study area

X. INDICATORS OF SUSTAINABILITY

The research aimed to use only three of these indicators I;

1. Crop Heterogeneity - The number of field crops grown per farm was considered to indicate crop heterogeneity.
2. Per cent area under input intensive crops: The acreage under input intensive crops like paddy, sugarcane etc., per acre of cultivated land was calculated.
3. Ratio of cost of purchased inputs to the total cost of cultivation of the crop

Table 2 Indicator of Sustainability of Agricultural land

Sl No	Indicator	Rampur	Bableshwar
1	Degree of crop Heterogeneity	.76	.88
2	Per cent area under input intensive crops	88	76.2
3	Ratio of cost of purchased inputs to total cost of cultivation	0.89	0.86

The sustainability of agricultural land was studied through different indicators developed for the study. The values of various sustainability indicators for the two sample villages is furnished in Table 2. The indicators reflect physical, economic and environmental aspects of sustainability. It was hypothesized that more the number of crops grown per farm, higher will be the sustainability of agriculture. Since higher crop heterogeneity introduces an element of informal insurance against risk in the farm business. Moreover, from ecological point of view, crop heterogeneity is preferred over monocropping.

It could be observed from the table 2 that the degree of crop heterogeneity was very less in both the villages. It was just twenty four percent in Rampur and only twelve percent in Bableshwar. The reason being though various crops like cotton, sugarcane, wheat and others were grown the percent of their coverage was found to be extremely low in both villages. This mainly due to the high dependence on rainfall and sever drought situation as the villages fall in the semi arid zones. Thus it could be concluded both the villages were more prone to monocropping i.e cultivation of one crop turdhal.

The per cent area under input-intensive crops is another important indicator of sustainability. The percentage of coverage for intensive crop (tur) was 88% in Rampur and 76% in Bableshwar indicating a very low sustainability factor in times of adversity like drought.

The indicator of ratio of cost of purchased inputs to the total cost of cultivation revealed that the input cost for farmers in both the villages was very high. 88% villagers of Rampur depended on external inputs followed very closely by farmers of Bableshwar by 87. The high dependence on the external inputs like the usage of manure or fertilizer indicates a very low sustainability level. The high level of dependence on external inputs was due to low fertility of land and poor yield.

XI. RESILIENCE

Resilience can be considered as a measure of system stability. It indicates a system's (farm's) ability to absorb disturbances before it vaults from one state to another (Holling quoted in Kooten and Bulte, 2000). The resilience has been viewed in terms of stability of the agricultural lands to absorb any external shocks and continue the farming business. For instance, a lower amount of cash expenditure implies greater degree of resilience since farmers can recover quickly from financial losses if expenditure is lower. In line with this rationale, two indicators have been used to measure the resilience of agricultural lands.

1. Average cash cost per unit of output: The cash expenditure incurred on agricultural inputs like fertilizers, pesticides, hired labour, etc., to produce a unit of output was computed. Generally, the level of cash expenditure per unit of output could be related to risk, for example, in times of adversity, an individual farmer cannot afford to incur huge costs on farming alone as one has to meet the basic requirements first. Assuming this to be true, it can be hypothesised that higher the average cash cost per unit of output, lesser will be the resilience of the farming system in that particular zone.

2. Sensitivity analysis: The sensitivity analysis approach was used to study the extent of reduction in net returns for changes in price of inputs and outputs. For this, a simulation exercise was performed. The prices of inputs and outputs were increased and decreased by 25 per cent each respectively. It was hypothesised that lower the reduction in average net returns upon increase or decrease in input and output prices, higher will be the resilience of that farming situation.

Table 3 a.Average cost per unit of output (Rampur and Bableshwar)

Khariff Season		
Crop	Average cost	Average returns
Tur	27826.47	6825.36
Sugarcane	108722.9	188566.27
Wheat	0	0.00
Cotton	59727.27	17696.97
Total	37089.66	23006.90

Table 3b.

Khariff Season		
Crop	Average cost	Average returns
Tur	27826.47	34651.84
Sugarcane	108722.9	297289.16
Wheat	0	0
Cotton	59727.27	77424.24

Total	37089.66	60096.55
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One of the indicators of measuring resilience is to compare the average cash cost to net average returns. A comparison between the two villages in the khariff season among the major crops indicate the average cash cost to be high among all crops except sugar cane. In Rampur the average returns for tur is four times less than its cost. The average returns for cotton is three times less than the cost. Sugarcane obtains the average returns which is one half times than its cost.

In Bableswar it was found that except for tur which occupies more than 76% acreage, the average returns is only one fourth of the average cost. In case of sugar cane returns is almost one half times its cost. A similar trend is found with wheat and cotton. Thus Rampur has a very low resilience with all crops. Though the land under sugarcane has moderate resilience, its acre acreage is found to be very less. The land under bableswar have a comparatively high resilience except for turdhal .

XII. SENSITIVITY ANALYSIS

Sensitivity analysis: The sensitivity analysis approach was used to study the extent of reduction in net returns for changes in price of inputs and outputs. For this, a simulation exercise was performed. The prices of inputs and outputs were increased and decreased by 25 per cent each respectively. It was hypothesised that lower the reduction in average net returns upon increase or decrease in input and output prices, higher will be the resilience of that farming situation.

Table 4 a. Sensitivity Analysis-Rampur

25% Increase in Input cost		25% Reduction in output prices		
Crop	Avg Net return	percentage	Avg Net return	percentage
Tur	-7670000	-85.31	7906000	87.94
Sugarcane	-19563750	-2357.08	-7226250	-870.63
Wheat	-1226250	0	81750	0
Cotton	-730000	-221.21	547500	165.91
Total	-29190000	-287.58	1309000	12.90

1

The effect of changes in market prices (sensitivity analysis) on the profitability of the different crop from both villages under study was examined. A 25 per cent rise in input prices in Rampur resulted in the greatest reduction to negative returns. This was found for almost all crops. The increase in input cost shows no effect on net returns as the yield per acre is below average production, due to many inherent factors like rain fed irrigation and owing to severe drought conditions.

Similarly the effect of changes in market price of output revealed that a 25 percent reduction in out put price would reduce the tur out put by 87% and cotton by 165. The rest of the crops like wheat and sugar cane showed zero and negative returns.

Table 4b. Sensitivity Analysis - Bableswar

25% Increase in Input cost			25% Reduction in output prices	
Crop	Avg Net return	Percentage	Avg Net return	Percentage
Tur	55020000	661.30	5040000	60.57
Sugarcane	28025000	1751.56	-8577000	-536.06
Wheat	5834250	4167.32	-4786500	-3418.93
Cotton	7605600	1618.21	-3744600	-796.72
Total	96484850	911.09	-12068100	-113.96

The sensitivity analysis of market price changes on net returns revealed that the percentage reduction in net income due to rise in input price or fall in output prices by 25 per cent showed that effect of such price variations was very high with the increase input cost for all the crops and with the reduction of ouput price except for tur which showed decrease by 60%, the rest of the crops in bableswar once again exhibited negative returns. This could be because of high input cost like purchase of all inputs from outside the village, crops being rain fed as well as crop yield being low owing to severe drought conditions.

with a lower amount of per capita expenditure is said to possess a greater resilience, because during the times of adversity, the household will be capable of reducing costs. The percapita household expenditure was rs 2790 for Bableswar with an average family size ranging between five to six members. On the other hand the percapita household expenditure for Rampur was rs 4106 and the family size ranged between 5 to 6 members. Though the percapita expenditure in both the villages is low, Rampur is comparatively lower, thus indicating moderate resilience to economic adversity.

3.Per capita Household Expenditure: The ratio directly indicates financial resilience of households. A household (farm)

Table 5 Coping mechanisms

Type of Work(migratory place)	Rampur and baleshwar	%
Agricultural Labour	29	5.7
Bottle Making	1	.1
Brick Making	193	38.2
Cooking	4	.8
Cable wire work	27	4.5
Construction sector	251	49.7
Total	505	100.00

Due to severe drought conditions and poor yield from land it is found that both land owners who are mostly marginal farmers and labourers move out to other places in search of jobs. The above table explains the type of jobs which they take up in migratory places which includes Maharashtra, Bangalore, Bijapur among others. More than half the respondents land up in construction jobs be it private buildings or works sponsored by local government. Thirty percent of them land up in brick or making hollow blocks for buildings. The rest take up petty jobs in agricultural jobs and in laying cables etc

XIII. SUMMARY AND CONCLUSION

Karnataka state is basically agrarian in nature but most of its land holding s are uneconomical and the farmers are marginal farmers who are highly dependent on rains for their cultivation process. The results of the sustainability test indicate that Rampur has a extremely low sustainability with compared to all crops. Though Baleshwar exhibits the same pattern it has a slightly high sustainability in terms of one crop that is Tur dhal as the area of coverage is huge. The resilience tests indicate poor resilience of both the villages in term of average cost of production and returns and sensitivity of crops towards change in input cost and output price. The per capita expenditure is low in both villages indicating moderate resilience. The coping mechanism for the villagers has taken shape in the form of migration where it is seen closer to eighty percent of them moving out during the nonagricultural season. This calls for policy changes in the form of providing needed financial and

knowledge support to farmers so that they continue to cultivate in the Rabi season also which will have a cascading effect on the other sectors.

Sufficient support in the form of inputs and ways to cultivate the crop can also go a long way increasing the yield of crop which is much below the threshold level. Government schemes in the form of employment and training support in real earns to be given to farmers so that they stay in their own villages and improve their local economy than migrating and becoming floating population

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