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Climate Change and complexity in Environment

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ABSTRACT
Climate change is any long significant change in the average weather in a given region. We mean average weather includes average temperature, precipitation and wind pattern. It involves changes in the variability. The variation is the rule of Nature, occurs automatically balancing each and every component in universe. The connectivity of the components in atmosphere sustains the climate. Human activities affect the whole climate to shift from its real form and causes climate change. The parameters such as temperature, pressure, Precipitation humidity are responsible for climate change in scale of measurable variables. As for instance, substantial increase of CO_2in the atmosphere is the main contributor to global warming. Mathematical Modeling represents a very efficient and powerful instrument for comprehending the world and solving complex problems for the sake of society to be alert as well as awakened. In turn, climate models of varying degrees of complexity are used to predict the effect in climate change and variability on global and regional scales. Climate change affects the productivity in a region. If we assume the relation between productivity y_{it} and climate variable x_{it} viz. precipitation and temperature is given by the Just-Pope stochastic production function. The mathematical calculation is relevant to the experimental in some places with temperature and precipitation.
KEYWORD: Parameters, global warming, Degrees of complexity, Diffusivity, estimation function

I INTRODUCTION

The variation is the rule of Nature, occurs automatically balancing each and every component in universe.
Climate change is of the following types:
 *Past climate change
 *Recent climate change.
and *Future climate change.
Past climate change- it deals earth's climate has changed throughout historical periods and glacier period. Scientists have been able to receive picture of earth's climate dating between decades to millions of years ago by analyzing a number of surrogate or proxy measure such as ice core, box holes tree rings Glacier etc.
Causes of past climate change- In past climate change is assessed in following ways
1.Climate changes takes place in the earth's orbit
2.It is due to change in sun's intensity
3. volcanic eruption
4.aerosed emission
5.carbon dioxide emission
At present carbon dioxide percentage is 400 ppm. The climate change record is in the past of 2000 years which are medieval climate, little age, wide variety of evidences, industrial era.
Recent climate change – this change happens due to human activities.
The addition of green house gases of aerosols has changed the composition of the atmosphere.
The major factors are atmosphere change, temperature precipitation and storm, sea level change, Land cover and land use and green house gases.
Aerosols -
This is caused due to radioactive forcing such as green house gases, Carbon dioxide occurs naturally.
Precipitation and storm change- precipitation is greatly increasing over a land. It has become very wetter in eastern region.

Sea level change- sea level is rising worldwide and along much of the U-S- Coast.
Similarly glacier melting ranges between 0 to -4 up to 2000 data.
Effects: the effect of above described factor causes crops damaged by wind, rain and flooding**..**
Economy – it also affects our economy system badly**.**
Energy – most power stations are built in coastal areas so power stations may be vulnerable when sea level increases.
Health- health problem may cause due to change in temperature and pressure. it may lead to devastate hotels, water and tourism.
Indoor Air Pollution-
The presence of particles contaminates into the indoor environment. We spend 90% of time in our indoor, in office and at school. It is clear that the air surrounding has been polluted .we find the sources causing are out door sources, indoor sources , road and soil dust, automobiles, local burning. All these come inside house. This is because encroachment of our permeable structures of house.
More over chemicals released from modern industry, buildings and furnishing materials.
Addition –to-indoor environment-
The indoor environment is polluted due to following factors:
1.Combustion, gases from fire place, Kitchen etc.
2. chemicals from Rains and solvents.
3.Molds all bacteria
4. Chemicals from cleaning products
Indoor sources – cigarette, animal hair and dander, carbon monoxide fume, from attached garbage, cases including radon.
Indoor air particle size is about 0.1micro.
Indoor Air Pollution – the indoor air pollution cause headache, dizziness, irritated,
There are also some other sources outcomes, membrane, getting a cold and allergies cause heath problem.
HCHO – formaldehyde –it remains in building materials such as ply wood resins and carpeting.
Impacts:
There are some materials which produce some pollutants and cause acute health –such as building materials- Repairable particles.
Common symptoms of sick building – it has set some volatile materials which cause headache, nasal chills fever etc. The entire article is divided into eight segments to present the detail study as I introductory, II Methods, III discussion, IV objective, V conclusion, VI recommendation, VII Future research and VIII references.
II **Methods**: Climate change affects the productivity in a region. If we assume the relation between productivity y_{it} and climate variable x_{it} viz. precipitation and temperature is given by the Just-Pope stochastic production function
y_{it} =f(x_{it}; β) + $\omega_{it} h(x_{it}; \delta)^{\frac{1}{2}}$...(1)
Where, y_{it} = productivity in a place i, in time t.
x_{it} = climate variable at a place i in time t.
ω_{it} = stochastic term with mean zero and variance β and δ are production function parameters.
The independent variables (x_{it}) used for estimation include a constant, annual precipitation(P), temperature T. The expected productivity is given by
E(y_{it}) = f(x_{it}; β) and product variability
V(y_{it}) = σ_ω^2h(x_{it}; δ).
The function f(x_{it}; β) and h(x_{it}; δ) are called mean and variance functions respectively.
From above equation
y_{it} =f(x_{it}; β) + u_{it} ....(2)
where, u_{it} = $\omega_{it} h(x_{it}; \beta)^{\frac{1}{2}}$

with E(u_{it}) =0 and $V_{ar}(u_{it})$ = $\sigma^2 h(x_{it};\, \delta)$.
The mean function can be extended as
f($x_{it};\, \beta, d$)= β_0 + β_1P +$\beta_2 T$+β_3t + $\beta_4 P^2$ +$\beta_5 T^2$+β_6PT + $\sum_{i=1}^{i=3} d_i\, D_i$ .....(3)
Where, D_i, i=1,2,3,...... are place variables taking values 0 and 1.
The variance function σ_ω^2h($x_{it};\, \delta, \eta$) with σ_ω^2 =1 was assumed to have exponential form
h($x_{it};\, \delta, \eta$) = exp(δx_{it}+ηD)
= exp(δ_0+δ_1P+ δ_2T+δ_3t+$\sum_{i=1}^{3} \eta_i\, D_i$) ....(4)
for easier way $\frac{\partial h}{\partial P}$ = $\delta_1 h$
Since the variance function h is always positive p, precipitation will be risk increasing if $\delta_1 > 0$ and it will be risk decreasing if δ_1<0. The mean function can be used to study the maximum possible productivity minimum variance and also the impact of climate change. The Ist order condition for maximum productivity is given by differentiating eq.3 w.r.to P and T separately.
$\frac{\partial f}{\partial P}$ = β_1 +2β_4P +β_6T=0 ....(4a)

$\frac{\partial f}{\partial T}$ = β_2 +2β_5T +β_6P=0 ....(4b)
and the second order conditions are given by
$\frac{\partial^2 f}{\partial P^2}$ = 2β_4 < 0 ....(5a)
$\frac{\partial^2 f}{\partial T^2}$ = 2β_5 <0.. (5b)

$$\begin{vmatrix} \frac{\partial^2 f}{\partial P^2} & \frac{\partial^2 f}{\partial P \partial T} \\ \frac{\partial^2 f}{\partial T \partial P} & \frac{\partial^2 f}{\partial T^2} \end{vmatrix} = 4\beta_4\beta_5 - \beta_6^2 \quad ....(5c)$$

Solving equations 4(a) and 4(b) we obtain levels of precipitation and temperature for which the productivity is maximum.

Estimation of the parameters
Under the assumption that ω_{it} ~N(0,1) the likelihood function (estimation function) is given by

$$L= \left(\frac{1}{2\pi}\right)^{N/2} \prod_{t=1}^{T} \prod_{i=1}^{R} \left[\frac{1}{h(x_{it\,;\delta})}\right]^{1/2} \exp\left\{-\left(y_{it} - f(x_{it\,;\beta}\right)^2 / 2h(x_{it};\, \delta\right\} \quad ...(6)$$

Where R is the no. of places and T is the number of time periods and N=RT. So the log likelihood function is given by

$$\ln L = \frac{1}{2}\left[N ln(2\pi) + \sum_{t=1}^{T} \sum_{i=1}^{R} \ln(hx_{it}\,;\delta) + \sum_{t=1}^{T} \sum_{i=1}^{R} \frac{y_{it} - f(x_{it};\delta)^2}{h(x_{it};\delta)}\right] .....(7)$$

which has to be maximized to estimate the parameter β and δ.

III **RESULT AND DISCUSSION**

Solving equation 4a and 4 b we can find the productivity as in term of precipitation and temperature i.e. maximum. Using the secondary data we can hold the whole theory in productivity in some different places. Separate Just and Pope Functions were fitted for each crop and for each season by maximizing the log likelihood function given in equation (7). The results for each crop are discussed below.
a) Rice
Rice is the most important food crop for people of South India and Andhra Pradesh's share in rice production in the country is 12.75%. It is grown in most of the districts of Andhra Pradesh during both Kharif and Rabi seasons. Following (Barnwal and Kotani, 2010), for the purpose of our study, Kharif season is from June toNovember and Rabi season is from December to April. The productivity has an increasing trend in both the seasons.

Further, during both seasons, the data of four districts have been collected and we find in general, yield of Karminagar and Nizamabad districts are higher than the other two districts.

Table 1: Projected changes in Climatic Variables

Change in Mean Daily Average temperature (℃)			
	Kharif (June to November)	Rabi (December to April)	
Change from Baseline to Mid-Century	1.93	2.22	
Change from Baseline to End Century	4.03	4.28	
Change in Mean Precipitation (%)			
	Kharif (June to November)	Rabi (December to April)	Overall
Change from Baseline to Mid-Century	12.5	17.6	13.6
Change from Baseline to End Century	13.0	53.4	17.8

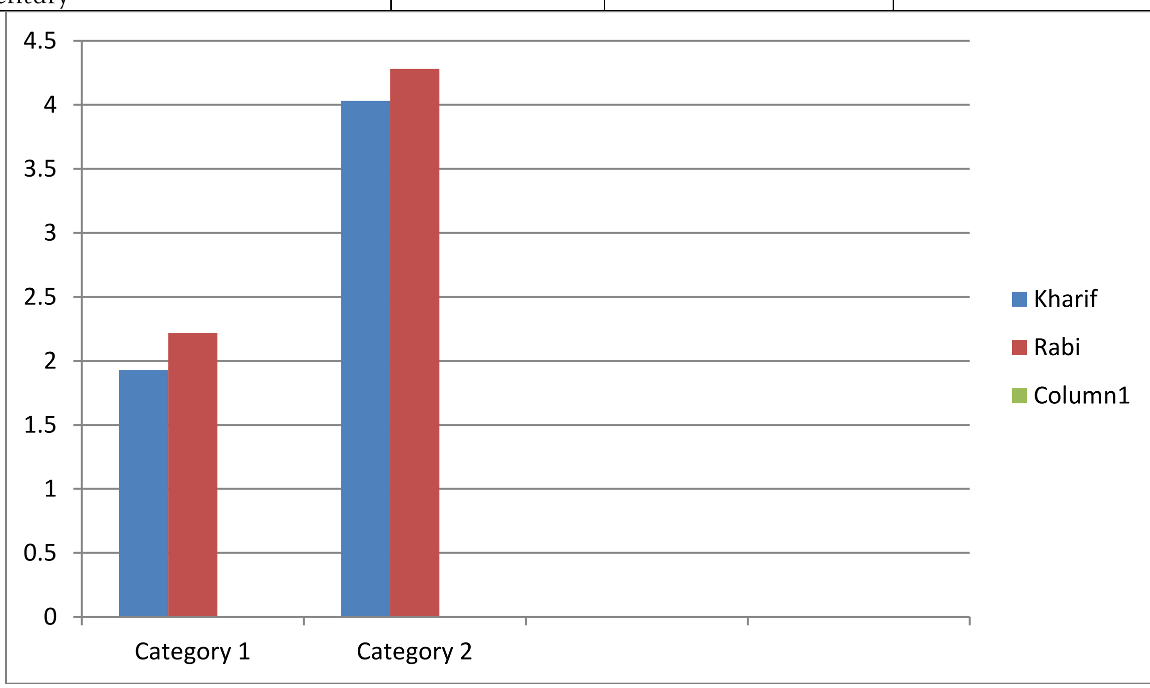

Fig:1 Change in Mean Daily average Temperature(°C)

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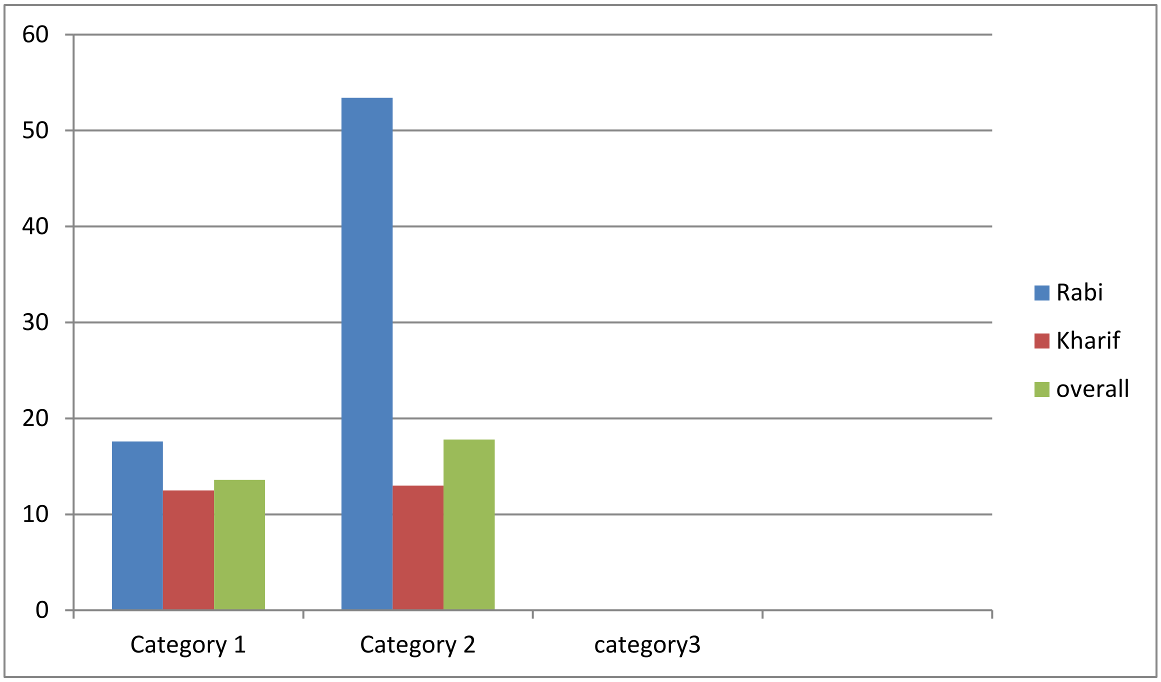

Fig:2 Change in Mean Precipitation (%)

Table:3 Summary statistics of yield of rice and climate variables

District	Kharif season(June to Novemer)			Rabi season (December to April)		
	Yield(kgs/ha)	Precipitation (mm)	Temperature (oC)	Yield (kgs/ha)	Precipitation (mm)	Temperature (oC)
Adilabad	1543	941.4	27.3	2179	43.1	26.5
Karimnagar	2437	905.8	27.0	2523	56.1	26.2
Nizamabad	2241	888.2	26.7	2242	47.0	26.5
Warangal	2167	817.8	27.8	2039	50.5	26.7

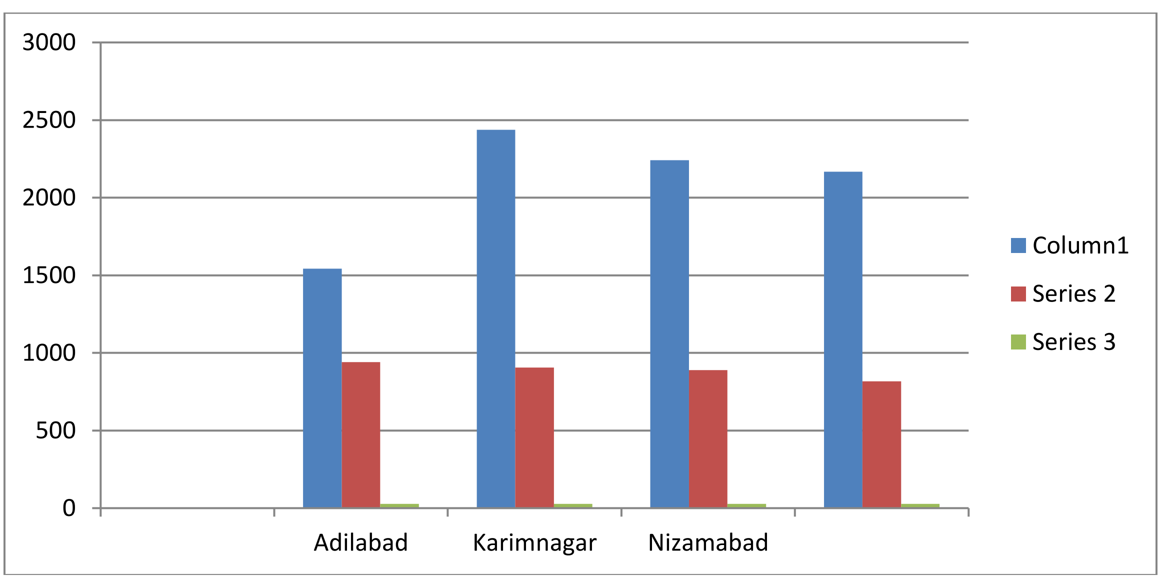

Fig.3 Kharif season(June to Novemer)

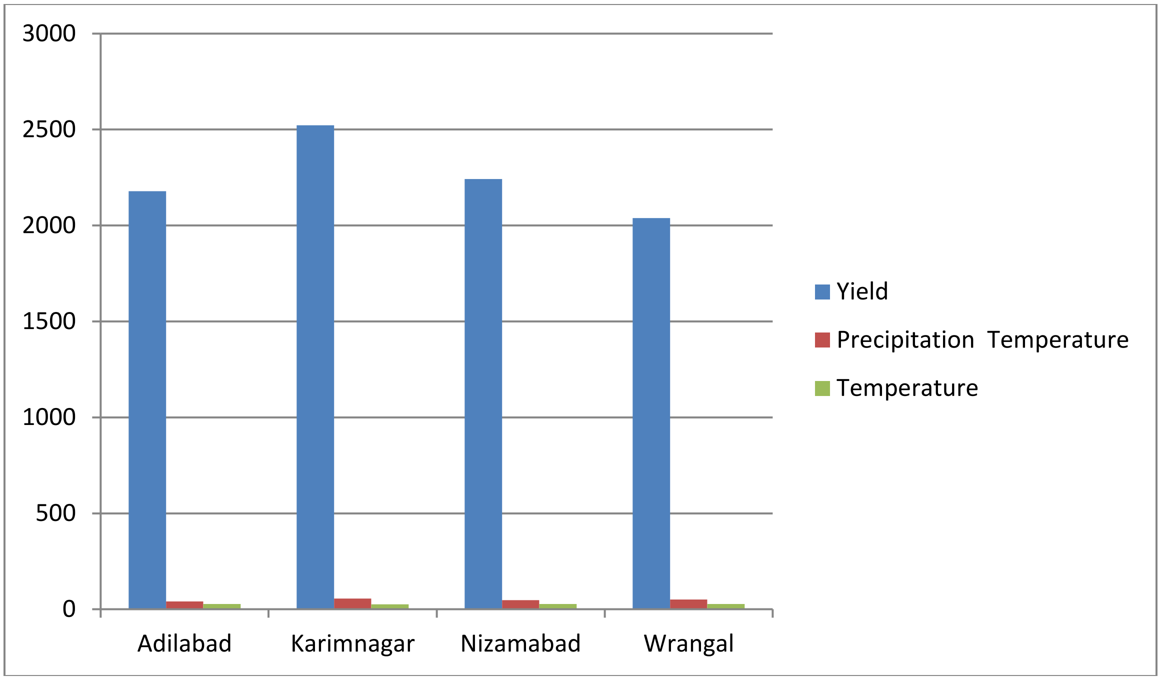

Fig: 4 Rabi season (December to April)

IV Objective: Minimizing water use

a) Season: Kharif

The objective is to minimize the water use in agriculture. That is Minimize water use *Kharif.*

The constraints on water availability and labour are removed and all other constraints that were included for maximizing income are retained. Two new constraints, one for fixing target for rice production and the other one for fixing target for income are added. If T and MI are respectively maximum rice production is maximum and maximum income MI, the constraints can be written as:

Thus the model will estimate the required minimum quantity of water that will ensure the target rice production T and maximum income MI.

b) Season: Rabi

The constraints are same as given for Kharif season.

Optimization for the first two objectives are carried out with 4 different climate change scenarios and 8 different management options assumes 10% reduction in water availability for agriculture and 5% reduction in labour availability. The reduction in water availability is based on the assumption that, in spite of increase in precipitation predicted by climate change scenarios, the share for agriculture will be reduced due to increased demand for domestic consumption and industrial use. Similarly labour availability will also reduce due to mechanization. In this scenario, the productivities of the crops derived from Just and Pope functions for the Kharif and Rabi seasons are used. For example, SRI is the most recommended technology for rice cultivation and MWM is recommended for maize. The third objective seeks to minimize water use in agriculture and at the same time meeting the targets on rice production and income. The target T1 refers to the current situation. The maximum possible rice production and maximum income achievable under 8 management options are the targets to be met while minimising water usage. For the second target T2, the maximum rice production and income levels when water available and labour are reduced respectively by 10% and 5% are used. In this optimization framework, the objectives are first prioritized as stated above. First priority is given for maximum rice production because food security for the society is of primary importance. Next primary maximum income as it will ensure better livelihood for the farmers. While running the linear programs to meet the second objective, a new constraint which will ensure that the rice production will be at least equal to the maximum level as dictated by the first objective is met. Thus the results of the first two objectives will ensure maximum food production and better livelihood. The third objective is to minimize water usage in agriculture.

This objective is important because, as shown by historical data, the share of water use in agriculture is declining over years due to increased demand for water in other sectors. The results of the first two objectives are incorporated as constraints in meeting the third objective. Thus the results of all the three optimization models

will provide a complete framework for optimum land and water use planning to meet triple targets: food availability, better income and minimum water use.

The optimisation models are formulated separately for Kharif and Rabi seasons as the crops grown in the two seasons in the Sri Ram Sagar Project area are different. The optimization is carried out for all the combinations of the scenarios and management options for the first two objectives. In the case of the third objective it was done for all combinations of target levels and management options. In other words the optimization is carried out for 32 combinations of scenario/target and management options for each season. Thus for the complete model, several linear programs were solved.

V. CONCLUSION

The optimization model has thus projected that the climate change impact in the long-term basis is projected to reduce the rice production in the project area by 25%-30%. The key message is that water is the key constraint in rice production in the long-run and land put under current fallow due to water scarcity will be a key issue to be dealt with. Implementation of various rice water and labour saving technologies will minimize the reduction in rice production between 20%-25% under the medium-term and long-term basis. Hence, simply implementing the

water management technologies will address the rice production constraints without making any structural interventions such as construction of new storage structures. Already field level studies in the project area had shown that water saving technologies will have a higher rate of return in rice production systems.

VI. RECOMMENDATIONS

Water management technologies should be piloted in selected locations of the project and based on the success of these technologies, the up scaling mechanisms should be initiated.

A cluster approach (covering a group of villages in a location) will be more useful in up-scaling the water management technologies and farmers will be free to interact and follow up with the relevant technologies.

Labour saving technologies such as machine transplanting has proved to increase the rice area and production in all the climate scenarios. Hence given the future labour scarcity in rice production, machine transplanting package should be organized at village level through the involvement of local community. A custom hiring unit can be established in the cluster of villages and farmers can easily forecast their requirement for paddy seedlings and planting in a given time schedule.

The existing government programs with the agriculture department of the Government of Andhra Pradesh should include the water management technologies in their program.

Adequate capacity building programs in technology upscaling and mainstreaming should be established. The expertise with the agricultural university research stations should be explored for strengthening the capacity building programs.

VII. FUTURE RESEARCH

There is scope for studying risk minimisation strategies for land use planning in the presence of large uncertainty. It may also be true that certain crops have lower expected yield, but less variance. Minimizing risk, instead of maximising expected yield, may be a wiser strategy in the presence of large uncertainty. In same land different crops can be sowed which can tolerate less water consumption rate while others have to maintain the scarcity. The water consumption can be minimized with multiple crops in the same season.

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