

Changing agro-climate: Tropical Tubers and Roots as a challenge for Sustainable Livelihood in India

Abstract:

Climate change impact at the global level has become a major concern today. In the regional context, climate change has contributed to unpredictable or erratic rainfall pattern, drying up of local springs and streams, species migration to higher elevations, shift of sow-ing and harvesting period of crops, emergence of invasive species and incidence of diseases/pests in crops. There is a need to develop a comprehensive master plan for strategically planning conservation, addressing poverty and food security in the wake of climate change impacts. Tropical root and tuber crops contribute 6% of the average daily?? Omission here?? considered as third important crop constitute cheap source of food and energy particularly suitable for the poor section of human population and capable enough to withstand biotic and a biotic stresses. Recast this sentence to make better meaning. This study has identified the primary challenges farmers for ensuing adaptive capacity and sustainability of tuber crop in changing agro-climate not understood. Experiments were conducted with short season variety of sweet potato in fluctuating agro- climate like change in temperature, and humidity. Sweet potato was grown with varying temperature, and humidity as treatments independently, individually in different time-. Not understood The result showas that in different agro-climatic parameter treatment lead to no significant yield loss in sweet potato. Along with science, changing agro-climatic parameter application to tuber roots and crops are therefore, the key to pursue our progress towards sustainability. This Abstract was poorly written and not much could be understood from it. Brief information on Materials and Methods and Results should be stated clearly with figures to guide the reader

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Executive summary:

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Indian agriculture is facing challenges due to ~~several~~ factors such as increased competition for land, water and labor from non-agricultural sectors and increasing climatic ~~tee~~ variability. The latter

associated with global warming will result in considerable seasonal/annual fluctuations in food production. All agricultural commodities even today are sensitive to such variability. Droughts, floods, tropical cyclones, heavy precipitation events, hot extremes and heat waves are known to negatively impact agricultural production, and farmers' livelihood. It has been projected by the recent report of the IPCC (Year??) and a few other global studies (Sources??) that unless we adapt what is it to adapt, there is a probability of 10–40% loss in crop production in India by 2080–2100 due to global warming (1–4), despite beneficial aspects of increased CO₂. A recent meta-analysis of CO₂ enrichment experiments (Source??) in fields has shown that in the field environment, 550 ppm CO₂ leads to a benefit of 8–10% in yield in wheat and rice, up to 15% in soybean, and almost negligible in maize and sorghum (5); but increase in temperature may alter these result.

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The Root and tuber crops (cassava, yam and cocoyam) are important sources of energy in our daily diets and constitute a major part of the rural Indian staple diet. With an estimated per capita consumption of 15.4 kg of cassava, 43.3 kg of yam, and they account for 28% of the per capita food consumption; making them a major source of food and government savings on revenue. Root and tuber crops as part of the agricultural export, s generates about 1.5% of government earnings and employs 10% of the population. Experimental research (Source??) has shown that root crop yield response to climate change vary widely, depending on the species or cultivar, soil properties, pest and pathogens. The need to assess the effects of climate change on root crop demand, farm incomes, and price cannot be overemphasized.

This report is an scientific assessment of the consequences of, and adaptation responses to climate change. This report;

- Evaluates evidence that observed changes in climate have on sweet potato crop production.

- Identifies and discusses how adaptation options may ~~reduce~~lessen climate change adverse effects.

- Identifies and analyzed linkages with other aspects of the economy ~~and describes~~

A positive correlation exist between temperature and root crop yield, that this relationship gave a correlation less than 40%.

Scenarios for rainfall amount in the various ecological zones.

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This means that less amount of rainfall should be expected in future. The number of rainy days and total rainfall was found to be highly correlated for some ecological zones, years with high number of rain days have higher total amount of rainfall. The current state and trends in root crop production was assessed; yields were found to be positively correlated to total rainfall with a correlation factor R. Climate factors identified and perceived to be stressors within the limits of the study includes the following;

- Rain fall within the community was unreliable, irregular and unpredictable. Duration of rain has been medium duration and it is either too much (flooding) or too little (drought) as phrased by the community.
- Daily temperature was perceived as hot or high when the sun shines too much, thus scorching crops. They attributed this condition to indiscriminate deforestation.
- Poor or degraded soils as a result of intensive and bad cultivation practices, erosion and deforestation subsequently reduce yields.
- Prolonged drought increases the population of variegated grasshoppers which destroy sweet potato.

- Evaluates evidence that observed changes in climate have on sweet potato crop production.
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Introduction:

The general consensus is that changes in temperature and precipitation will result in changes in land and water regimes that will ~~consequently~~_{subsequently} affect agricultural productivity. Although estimates suggest that global food production is likely to be robust, experts predict tropical regions will see ~~both are~~ reduction in agricultural yields and a rise in poverty levels as livelihood opportunities for many engaged in the agricultural sector become increasingly susceptible to expected climate pressures. While contemporary policy ~~dialogue~~_{has dialogue} ~~—focused~~_{has focused} ~~on mitigating~~_{on mitigating} emissions that induce climate change, there has been relatively limited discussion of policies that ~~can~~ address climate impacts. First, climate variability is already a problem both in developed and developing countries. Second, even moderate climate change provides added impetus to promoting local adaptation options concurrently with the pursuit of global efforts on mitigation strategies. That is, adaptation to climate change ~~and~~ variability (including extreme events) at the national and local levels is regarded as a pragmatic strategy to strengthen capacity to ~~reduce~~_{lessen} the magnitude of impacts that are already occurring, could increase gradually and may be irreversible ~~Sentence too long and have lost meaning~~. Consequently, several key ~~themes have~~_{themes have} ~~emerged from~~_{emerged from} the current literature on adaptations to climate change. First, given the range of current vulnerability and diversity of expected impacts, there is no single recommended formula for adaptation. Second, responsibility for ~~adaptations~~ will be in the hands of private individuals as well as government. Third, the temporal dimension of policy responses is likely to have a significant role in the effectiveness of facilitating ~~adaptation to~~_{adaptation} ~~climate to~~_{climate} change. ~~One set~~_{One set} of ~~measures will~~_{measures} ~~decrease~~_{will decrease} the short-term vulnerabilities of the agricultural sector through adaptations to weather effects ~~(Sources?)~~. These measures will therefore address concerns with climate variability. Another

Introduction:

set of strategies that reduce vulnerability to climate change will thus be necessary. This second set of adaptation measures

include options such as improving water management practices, modernization by adopting and utilizing new technologies, and changing crop types and location.

In all these discussion there were no literature to support your views

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Procedure:

Materials and Methods??

The interactions between impact of climate change on root and tuber crop yields and factors that determine final output such as national policies and economic issues or the indirect effects of climate change was examined. The methods used include the following; Computer aided modeling, Scenario analysis, Simulation gaming, Participatory assessment and qualitative assessment based on existing experience and expertise.

Field experiment was carried out at specified region on experimental basis in small plot in Agribusiness management department of Orissa University of Agriculture and technology as assignment for project work as management course in Utkal university of Odisha in year 2011 taken to study the effect of water level (humidity) and varied temperature on potato yield potato yield (Ipomoea batatas). Sweet potatoes grow best in loose, sandy, well-drained soil (well drained is an absolute must for success). Strategy was to plant slips in raised beds with a center ridge 10-12 inches (prefer SI units) higher than the surrounding area. Each slip was should be planted at a depth of approximately

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2-3 inches (with the leaves sticking above the ground) at an intra-row distance of 12 to 18 inches and inter-row space of three feet apart. Within a row, It was planted successive slips every 12 to 18 inches, but kept rows about three feet apart so that the plants have adequate room to spread out. After transplanting, it is needed to water each slip immediately and do so every few days

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(how many days make the few) until the plants have established themselves. Typically, it is
not needed not to irrigate the plants after they are established unless it was live in the an area has
with limited rainfall. Weed early and often (how often) as this allows the vines to produce large
tubers, that do not have to compete for nutrients.

When the plants get fairly large, they will ~~suppress~~~~shade-out~~ any new weeds that might ~~try and~~ emerge. About one month after transplanting?? Meaning what ??.~~Lastly, with respect to planting,~~
~~it will absolutely needed to protect sweet potato vines from deer if they tend to be a problem~~
~~in that area. Speaking from experience, it is extremely frustrating to have a beautiful bunch of~~
~~sweet potato vines one day and nubs the next morning.~~Treatment comprises of three water levels like (80%, 100%, and 150%) and temperature like low temperature 20-25⁰C and high temperature 45-50⁰C. Date of
~~planting was~~~~planting April was 15 April 15, 2011, for 2011 change for in change~~
~~humidity in humidity. All the~~~~All - agricultural practices~~~~cultural were~~~~practices were~~ conducted by college of agriculture students. Plot size was of 4 decimal approximately?? Not understood. Chemical and physical properties of soil were analyzed before cultivation. The permanent wilting point (PWP) and field capacity (FC) of the trial soil was determined before (before
~~what??)~~. Plant distances were 30 cm apart be consistent with unit i.e., prefer to use SI unit for
your discussions. A distance of 1.75 m was left between two irrigation treatments .Total amount of irrigation water was calculated by class A pan equation (which is the Class A pan equation). The normal agro metrological data of class A pan evaporation was obtained and expressed in mm/day. Drip irrigation was used for the cultivation.~~season. The T~~total amount of drip irrigation ~~water~~s applied was calculated with the aid of ~~by~~ water flow-meter for each treatment.~~EC of~~ water irrigation 0.8 ~~dS/m~~. Irrigation treatments were named as low, medium and high respectively. The EC OF the irrigation ranged 0.7 to 0.9 ~~DC/m??~~. Sweet potato ~~was~~ harvested
in last of September i.e. 30th and total yield for each treatment were calculated
~~estimated~~ separately.

Water use efficiency (WUE) was calculated accordingly to the following equation:

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$$\text{WUE (kg/m}^3\text{)} = \text{Total yield (kg/fed)} \div \text{total applied water (m}^3\text{/fed)}$$

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[What does fed mean??](#)

Variable temperature treatment was done three different ways like keeping plants in normal growing season, others in low temperature treatment like growing plant in controlled condition in green house and also followed for high temperature. All plots were same in dimension i.e. 4 decimal [?? Not understood??](#).

Table (1) ~~the~~ [Chemical](#) and physical properties of soil ~~analyzed~~ before cultivation.

Chemical properties						
EC	pH	Ca ⁺⁺	Mg ⁺⁺	Na ⁺⁺ ??	K ⁺⁺ ??	Cl ⁻
m/moh		meq/1	Meq/1	Meq/1	Meq/1	Meq/1
2.5	6.8	25	11	12.5	1.5	11.5
Physical Properties						
Sand%	Clay%	Slit%	Texture	FC%	PWP%	Bulk Density Mgm⁻³
73.2	12.2	24.6	Sandy loam	20.34	7.45	1.957

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[Unit for EC is wrong, Sodium and Potassium valences are not correct and soil separates present doubt on authenticity of the data presented in Table 1](#)

Varietal coefficients:

Simulations were carried out assuming ~~that~~ successfully optimized resources in terms of humidity and sowing time. Respective coefficients for the crops were taken for the dominant Indian varieties from ~~the~~ previous published studies [\(Source??\)](#). These were calibrated for each grid by simulating the performance of low, medium and high temperature tolerant varieties grown during very late, late, and timely sown periods respectively. The best combination was taken for the baseline and impact assessment.

Re-write Materials and Methods to aptly present what was done, how, when and what data to be obtained. Also data generated must be statistically analyzed

Results and Discussion-discussion:

Agricultural production and marketing policies have been found to affect food availability and food security (Source??). These concerns about of future productivity growth; if ~~correct~~ correct means ~~that simple~~ that simple extrapolation of yield for impact assessment may be overoptimistic. The implication is that confidence in predictions of food demand and supply balance and price trends beyond the early part of the 21st century will be low. Climatic conditions often interact with socio-economic conditions to undermine food security. Climate variability tends to have the greatest impact on people who are landless, poor, or isolated. So far, the above comments have no bearing with data generated from the study. Changes in socio-economic conditions can lead to dramatic changes in food security. Disadvantageous terms of trade, poor infrastructure, and armed conflict also make it more difficult for people to cope with the effects of climatic extremes (Source??). For example, while food security would ~~anyway~~ have been a problem during severe famine 1950s and 1960s in India, economic recession and civil strife were major causes of the widespread famine (Source??). How has this played out in your derived data or what Table shows your yield data??

Effect of different irrigation levels on sweet potato yield was illustrated in T table(2). Discuss the table and bring Table to follow first mention. below.

.Regarding the effect of different irrigation treatments, —, it was found that 100% irrigation yield sed highest, — followed by 80% irrigation ~~which was shown from data. T~~ and the lowest yield was obtained by 150% irrigation treatment.

Relevant to the effect of different irrigation levels on water use efficiency show that increasing irrigation led to decrease in water use efficiency for all irrigation treatment (Table 2) ~~which was~~

~~found out in data that is mentioned in table(2)~~

The result in this study ~~generally agreed with~~show that increase in water level above 100% lead to decline in water use efficiency.

What does this imply in terms of water economy and cost of production of potato?

In case of different temperature treatments, result ~~found in the way shows~~ that high temperature treated vine yield~~sed~~ highest followed by low temperature during growth period, lowest yield ~~was~~ obtained by low temperature treatment ~~as per data that was cited in (Table (3)).~~

But in ~~every case i.e.~~ either varied temperature or varied water treatments, ~~lead~~ declining yield ~~was~~ very small ~~not significantly different??. That is the wonder in case of sweet potato.~~ Both production and productivity are declining in adverse climatic condition but calculated very low in amount. ~~This picture has not been captured in your study. What models have you used to show decline in productivity~~

Table (2): Effect of different irrigation percentage on water use efficiency, ~~as well as~~ actual and estimated sweet potato yield.

Water Treatment		Vine Fresh Yield(Kg/Ha)			
		WUE Kg/ ~~m³~~ water	Actual	Estimated	Yield Change %
80%	2505	5.42	18296	18324	-0.028
100%	3267	5.01	20211	20225	-.01
150%	3756	2.9	16798	16846	-0.06
Mean	3176	4.43	18435	18498	-.031

Correlation Coefficient = .9989

T Value= --.169

P Value= .132

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The correlation coefficient was significant (P- value 0.000); this means same trend was found in predicted and observed data. P test value was not significant (p –value .132); this means no

difference between observed and predicted value. Result of validation of the experiments indicates that the SUBSTOR –sweet potato crop model is validated to grow in odisha. It was noticed that the output data from SUBSTOR –sweet potato crop (predicted data) were in harmony with the observed data in fresh vine yield.

Table (3): Effect of different temperatures on actual and estimated sweet potato yield.

		Fresh vine Yield(Kg/Ha)		
Temperature treatment	Yield	Actual	Estimated	Yield Change %
20-25°C	2023	22553	22783	-.02
30-35°C	2556	23412	23457	-.045
45-50°C	2401	26999	27329	-.033
Mean	2316	24321	24553	-.031

Correlation coefficient $t = .989$

T value = $-.189$

P value = $.154$

The correlation coefficient was significant (P- value 0.000); ~~this~~ this means that same trend was found in predicted and observed data. P test value was not significant (p –value .154); this means that no

difference between observed and predicted value. Result of validation of the experiments indicates that the SUBSTOR –sweet potato crop model is validated to grow in odisha. It was noticed that the output data from SUBSTOR - sweet potato crop (predicted data) were in harmony with the observed data in fresh vine yield in case of varied temperature. Effect of different irrigation levels on sweet potato was illustrated in Table (3)below regarding the effect of different irrigation treatment. It was found that 30-35° C temperature treatment yields highest

followed by 45-50 °C temperature treatment ~~which was shown from data~~. The lowest yield was obtained by 20-25 °C temperature treatment. ~~The R~~result in this study ~~generally~~ agreed with increased and decreased in temperature above 30-35 °C lead to decline in yield. Discussion should be repeated to bring out clearly effect of treatments and discuss them

Conclusion:

~~Overall result:~~ It could be concluded that SUBSTOR model for sweet potato yield can be successfully used in Oodisha. Highest yield ~~was-is~~ found in case of 80% moisture treatment and in case of temperature treatment is 30-35°C. Though yield ~~was~~ reduced due to varied temperature and

moisture treatments. ~~but~~ negative impact of ~~these~~ parameters ~~wereare~~ not significant very negligible .Hence it can be

concluded that impact of climate change on fresh yield of vine cannot impact adversely on what??.

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difference between observed and predicted value. Result of validation of the experiments indicates that the SUBSTOR –sweet potato crop model is validated to grow in odisha. It was

Reference

Kurukulasuriya, Pradeep; Rosenthal1, Shane (~~June~~ 2003). Climate Change and Agriculture A Review of Impacts and Adaptations, The world bank environment department, India. [Pages??](#)

[References were very weakly done on this study. Study must used literature to support investigation and findings if it must be publishable](#)

Medany, Mahmoud (Final Report, 2006) Assessment of impact of climate change and adaptation on potato production, Agricultural research center, Ministry of Agriculture and Land Reclamation, Egypt.

Naresh Kumar¹,[S. S. Aggarwal¹, P. Aggarwal¹, P. Rani, Saxena;](#) Jain¹, Surabhi and [K. Rani, Saxena;](#) Chauhan¹, Nitin (August

2011). [Impact of climate change on crop productivity in Western Ghats, coastal and northeastern regions of India.](#)

Sagoe, Regina ([February](#) 2006) Climate change and root crop production in Ghanaa, Crop research institute, Kumasi, Prepared for environmental protection agency (EPA), ACCRA-Ghanaa??

[References were very poorly written..](#)