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Cost Benefit Analysis of Climate Change Adaptation Strategies on Crop Production Systems in the Lowveld of Swaziland

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Climate change and agriculture

Challenges faced by smallholder rural subsistence farmers should be one of the key issues in policy and development discussions as they form 70% of the African populations and Swaziland is no exception. They manage large areas of agricultural productive land, however, productivity is very low and these households make up the largest share of the undernourished African population. With the negative impacts of global climate change, agricultural productivity continues to decline therefore leaving millions of rural households' vulnerable, food insecure, poor and less resilient to climate change. Climate change also threatens sustainable development by its negative impacts through adverse effects on the environment, health, food security, economic activities, biodiversity and physical infrastructure. This is fueled by the high dependence of African economies, employment opportunities and rural livelihoods on the agriculture sector.

Climate change is characterized by changes in precipitation patterns, rainfall variability, and increased temperatures, which has increased frequency of droughts, floods, wildfires, windstorms and hailstorms. The impacts of droughts

in the Lowveld of Swaziland are worse than the other regions in the country because of its arid to semi-arid climatic conditions. As a result, households have since stopped farming and are solely dependent on social interventions and have developed dependency syndrome with 40 % of the arable land in the Lowveld not being cultivated for over 10 years. Rural dry land crops include maize, cotton, sorghum, drybeans, and cowpeas where maize still takes more than 80% of cropping area even in dry arid or semi-arid regions. This has resulted in very low yields and even total crop failure. A key strategy for managing risk and vulnerability associated with climate change is developing and implementing evidence-based policies and programmes that respond to local realities and priorities through adaptation and mitigation.

Adaptation strategies to climate change in crop production

Agriculture is negatively affected by climate change. Adaptation reduces the negative impacts and increase resilience to climate change and variability. Adaptation refers to the adjustment to ecological, social and economic systems done by individuals, groups or institutions in response to actual or

expected climate stimuli and their impacts. This involves changes in processes, practices or structures to moderate, offset potential damages or to take advantage of opportunities associated with climate change and variability. Such practices enhances resilience and reduces vulnerability of communities as the people change their mix of production activities, local community rules and institutions in order to meet their livelihood need. In crop production, adaptation strategies to climate change involves; changes in management practices such as shifting crops, crop calendar, developing irrigation infrastructure, development of drought tolerant varieties, transport , market and storage infrastructure, land use arrangements and property rights, water shed management institutions, improving access to financial resources, improving education and information dissemination, frequent and accurate meteorological data, research and development, conservation agriculture, climate smart agriculture and crop diversification.

Rural households are adapting to climate change, however the issue of poverty, food insecurity and hunger has not been fully addressed by such attempts as agricultural productivity is still far lower than expected leading to high imports and high dependence on food aid. To maximize the use of scarce resources such as land, water, finances identified adaptation strategies should be economically effective and efficient. This would help households to make economically informed decision when adapting to climate change. Rural subsistence farmers use at least one of the following adaptation strategies: drought

resistant varieties, early planting, late planting, minimum tillage, crop rotation, mulching, and irrigation, switching crops and intercropping. However, the criteria for choosing a strategy are not based on economic reasons. For this reason therefore, most households are adapting using drought tolerant varieties, early and late planting with a few practicing crop rotation, intercropping, mulching, irrigation and switching crops.

Cost Benefit analysis of climate change adaptation strategies

Cost benefit analysis is one of the economic analysis tool that aid social decision-making which is used to evaluate the desirability of a given intervention or interventions. It is a formal discipline used to assist appraisal or assess projects to ascertain whether proposed public or private investments are worthwhile. The analysis method ranks the interventions according to established ratios such as net present value, internal rate of returns, benefit-cost ratio, breakeven point and payback period. The method expresses and compares all cost and benefits in monetary terms and use the ratio to rank them so s to identify the most economical. Based on the used adaptation strategies, a cost benefit analysis using net present value ranks the strategies as shown below. Maize is the reference crop, with NPV of R14.40 at 10% discount rate. Cotton had the highest NPV where the benefits would be more than the costs by R1,864 per ha when compared with the production of maize. Agricultural extension officers have always been advising farmers to grow cotton, a cash crop as opposed to maize in the lowveld, and cotton is more tolerant to drought and heat. However maize is a staple crop in the country, and households are reluctant to replace it with other crops. The next cost

effective adaptation strategy was growing maize under irrigation, with NPV of R440. Switching to dry beans was the third most cost effective alternative with NPV of R292. Few households are irrigating and the reason may be that irrigation requires high initial costs which are not affordable to rural subsistence farmers.

Cost Benefit analysis of climate change adaptation strategies

Adaptation strategy	NPV (R)/ha
Switching from maize to cotton	1,864
Irrigation of maize crop	440
Switching from maize to dry beans	292
Switching from maize to groundnuts	284
Switching from maize to sorghum	283
Switching maize to cowpeas	252
Crop rotation (maize and groundnuts)	284
Growing maize under minimum tillage	44

Factors influencing adaptation strategies

Rural households are aware of climate change and variability with its negative impacts on their livelihoods especially agriculture. They have therefore, identified a wide range of useful adaptation options which therefore, makes households within the same geographical location to use different adaptation strategies in response to climate change and variability. It is necessary therefore, to identify and address significant socioeconomic factors

influencing the choice of adaptation strategies when encouraging households to use a specific strategy or sets of strategies. These factors might enhance or discourage households when adapting to climate change and include; age of household head, occupation of household head, being a member of a social group, land category, access to credit, access to extension services and training, high incidences of crop pest and disease, high input prices, high food prices, perceptions of households towards climate change.

Perceptions of households towards climate change and its negative impacts enhance adapting to the new and perceived climatic changes. Such that when households are made aware of the expected near and distant further climate changes, they are likely to adapt to these expected changes. Youth engagement in agriculture is still low especially farming in the rural areas, such that most farming in rural communities is done by older households. Such individuals are less likely to take up new management technologies, invest in infrastructure and practice climate smart agriculture but are likely to use conservation agriculture, crop rotation and mulching. Access to extension services and training disseminates current information, research outputs and monitors adoption of adaptation strategies. So to encourage households to adapt to climate change, extension services should be enhanced. Adapting to climate change uses financial resources such that given the weak financial background of smallholder farmers, strategies such as irrigation, drought tolerant varieties are less likely to be used unless there is external intervention. High input prices discourage households when adapting especially using strategies that involve finances.

This therefore, makes households with strong financial background which is not the case in rural communities and access to credit not to adapt to climate change using such strategies. Households who are members of social groups such as farm cooperatives, unions are more likely to adapt to climate change as these institutions provide information and access to credit.

Policy Recommendations

1. The identified adaptation strategies should be promoted and supported by government, nongovernmental organisation and civil society organisations if households in rural communities are to be resilient and improve adaptive capacity to climate change impacts.
2. Not all adaptation strategies are economical, so for arid to semi-arid regions, households should consider switching from maize to drought tolerant crops such as cotton, sorghum and dry beans. This can be combined with crop rotation, mulching, intercropping, conservation agriculture, and climate smart agriculture.
3. Irrigation can also be exploited as household should build earth dams to harvest water during heavy rainfall days to supplement rainwater during dry critical growth stages of their crops.
4. As rural households financial constraints and do not have access to credits from commercial institutions in most cases, they should focus more on those adaptation that have lower costs such as switching crops, crop

rotation, minimum tillage and drought resistant varieties.

5. Agriculture extension services should be strengthened by increasing the interaction between households and extension officers by providing enough transport to ensure field visits.
6. Agriculture financial Institutions need to be strengthened and accommodate farmers on communal land. Rural micro-finance institutions need to be developed in order to provide micro loans to households.
7. Policies must aim at enhancing household level adaptation through the support of Department of Meteorological service by reporting and alerting households about weather changes in an understandable way so that they can be able to plan for the future when farming.
8. Farm inputs should be subsidized to encourage the use of new technology systems.

Further Reading

- Kingston, G. (2001). Cost Benefit Analysis in Theory and Practice. *Australian Economic Review* 02, 2001; 34 (4)478 – 487.
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