CHIESA

Climate Change Impacts on Ecosystem Services and Food Security in Eastern Africa

Increasing Knowledge, Building Capacity and Developing Adaptation Strategies

POLICY BRIEF 5
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Ecosystem pest management and pollination

Focus on Crucifers

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Advising farmers right at their farms is a practical step towards effective control of insect pests

Introduction

It is no secret that climate change is taking its toll on our way of life.

The slow but steady rise in temperature and erratic rainfall patterns contribute to some of the adverse weather events such as flooding in the lowlands or lengthened periods of dry spells. The impact of these changes is profound along the entire ecosystems and value chain contributing to agricultural production and marketing.

Growth and development of host plants, its insect pests and their natural enemies are interlinked, balanced and dependent on the atmospheric temperature, humidity and precipitation among other climatic variables. Hence climate change might eventually disrupt these linkages and balances causing pest outbreaks in areas where there were none before, and in seasons which were not expected.

Other Anthropogenic factors such as changes in land cover, depletion of water resources, replacement of shrub lands and woodlands into croplands and resultant soil degradation is further aggravating climate change effects. Further, limited availability of agricultural lands and depleting water resources for irrigation are leading to clashes between the farming and pastoral communities as experienced in Tanzania.

What do we know so far?

1.Conservative farmers are diversifying their crop production by introducing fast maturing but highly valuable crops for domestic use and the local markets e.g. horticultural crops

2.There are a multitude of insect pests and diseases that affect crop production, whose emergence depend on factors such as the prevailing weather and land use. Population of these insect pests and diseases could be effectively managed below damaging proportions by harnessing ecosystem services such as biological control with their natural enemies

3.Farmers often spray agrochemicals to counter insect pest and disease outbreaks. Further, with limited knowledge on effective use of pesticides, they resort to indiscriminate use of agrochemicals adversely affecting the functional agro-biodiversity such as killing natural enemies of insect pests

4. The level of farmers' intervention and its effectiveness in countering these pests and diseases depends on practical knowledge, resources available, benefits of the intervention and the climatic condition.

Crucifers – a high value crop of smallholders in East Africa

Research on crucifers underscores efforts by CHIESA in addressing problems facing the most widely grown and consumed vegetables in Kenya.

Crucifers, such as kale and cabbage, have a readily available market and offer alternative sources of income for many smallholder farmers. While kales are more suited for the warmer lowlands, cabbages are suited for the cooler highlands.

Productivity of crucifers is seriously constrained by several pests of which diamondback moth (DBM) (*Plutella xylostella*), is a major pest in East Africa. This pest thrives in temperatures ranging between 7.84 and 32^0C and it is also resistant to control with pesticides.

Indigenous natural enemies were not effective in controlling the pest which is not native to East Africa. Successful implementation of *icipe*-led biological control program kept the pest under control in several regions of Kenya and Tanzania including Taita hills and Mt. Meru.

Natural enemies such as *Diadegma semiclausum*, suited for the cooler highlands and *Cotesia plutellae*, suited for the warmer lowlands were released from Taiwan and South Africa, respectively.

However, preliminary findings from the on-going research suggest that such stability with biological control is not guaranteed in the face of climate change, risking future pest-parasitoid synchrony.

What do we know so far from our research on crucifers?

• Different species of parasitoids are concentrated in different altitudinal gradients (e.g. lowlands vs. highlands), unlike diamondback moth, which is found across gradients

• *Cotesia plutellae*, a key larval parasitoid of diamondback moth suited to survive in lowlands, has been traced in the high altitudinal zones of Mt. Kilimanjaro and Taita hills transects, suggesting a possible movement of the natural enemy due to rise in temperature along the altitude

• Exotic parasitoids e.g. *D. semiclausum* and *C. plutellae* are generally more effective than the local parasitoids e.g. *Diadegma mollipla* and *Oomyzus sokolowskii* in control of DBM

• Greater diversity of DBM parasitoids was observed in the warmer low altitudes and declined towards the cooler high altitudes, indicating the potential for disruption of biological control balance with climate change

• Other minor pests such as Cabbage aphid, *Brevicoryne brassicae* and thrips, *Thrips tabaci* were frequently observed in high numbers in the mid-high altitudes and lowlands of Mt. Kilimanjaro and Taita hills, respectively indicating a

A life table experiment of diamondback moth (Plutella xylostella) at 35^{0}C in progress

Diamondback moth (Plutella xylostella) a major insect pest of crucifers in East Africa. Photo courtesy: Sevgan Subramanian/ *icipe*

Damage by diamondback moth on kales

change in pest status

• Emergence of Cabbage aphids as a key pest pose a double threat as it also transmits Turnip Mosaic Virus (TMV).

Comprehensive research by CHIESA's WP5 focuses on assessing the potential impacts of climate change on the host plants, key pests and their natural enemies, with investigations still going on in areas such as:

• Ecological niche and phenological model development

• Establishment and validation of temperature-dependent life tables for key pests and natural enemies

• Integration of factors such as land cover change, precipitation and humidity to enhance the precision of models developed.

Cabbage leaves being prepared for a life table experiment of diamondback moth

What is CHIESA?

The Climate Change Impacts on Ecosystem Services and Food Security in Eastern Africa (CHIESA) is a four-year research and development project aimed at increasing knowledge on the impacts of climate change on ecosystem services in the Eastern Afromontane Biodiversity Hotspot (EABH).

CHIESA is funded by the Ministry for Foreign Affairs of Finland, and coordinated by the International Centre of Insect Physiology and Ecology (icipe) in Nairobi, Kenya.

Through research and training, CHIESA will build the capacity of research communities, extension officers and decision makers in environmental research, as well as disseminate adaptation strategies in regard to climate change. The general areas for environmental research are in agriculture, hydrology, ecology and geoinformatics.

CHIESA activities focus on three mountain ecosystems in Eastern Africa, namely Mt. Kilimanjaro in Tanzania, the Taita Hills in Kenya and Jimma Highlands in Ethiopia. The project consortium monitors weather, detects land use/land cover change, and studies biophysical and socio-economical factors affecting crop yields and food security.

The project also builds the climate change adaptation capacity of East African research institutions, stakeholder organizations and decision-makers through research collaboration and training.

Together with local communities, the project will develop, test and disseminate climate change adaptation tools, options and strategies at the farm level.

Further, CHIESA provides researcher training for staff members of the stakeholder organizations, enhances monitoring and prediction facilities by installing Automatic Weather Stations, and disseminates scientific outputs to various actors from farmers to policy-makers.

WP5 - Assessment of Ecosystem Pest Management and Pollination

CHIESA involves farming communities at grass-root level as key collaborators. This collaboration is aimed at increasing their knowledge on various functional agro-biodiversity and their effects on productivity and production of selected crops, in the context of climate change. Functional agro-biodiversity in this case refers to the relationship between or status of insect pests and their natural enemies, pathogens, pollinators, soil engineers, decomposers etc.

CHIESA has also selected target crops to feature in the research, namely maize, coffee, avocado and crucifers, all of which are grow at altitudes between 0-2500 meters above sea level, making them ideal for bio-climatic studies.

The purpose of this WP is to increase the knowledge base among the local communities and partner institutions in the three target countries to address climate change issues. Furthermore, research programmes and technologies to assess the risks and impacts of climate and land use change on agro-ecosystems will be initiated and investigated.

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