REPUBLIC OF GHANA

MINISTRY
OF
FOOD AND AGRICULTURE

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Adaptation of agriculture/ farming systems to climate change: *exploring genetic options*

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Outline

01 **Introduction**

02 **Developing the appropriate strategies (*Genetic Improvement Technology*)**

03 **Contribution of Genetic Improvement**

04 **Concluding Remarks**

Introduction

Farmers and Commodities (Plant Genera)

90-95% of farmer population (Small-scale)

Cereals

Maize, Rice, Sorghum, Millet

Legumes

Soybean, Groundnut, Cowpea, Common Bean, Bambara nut, etc.

Vegetables

Tomato, Pepper, carrot, Okra, leafy vegetables, etc

Roots & Tubers

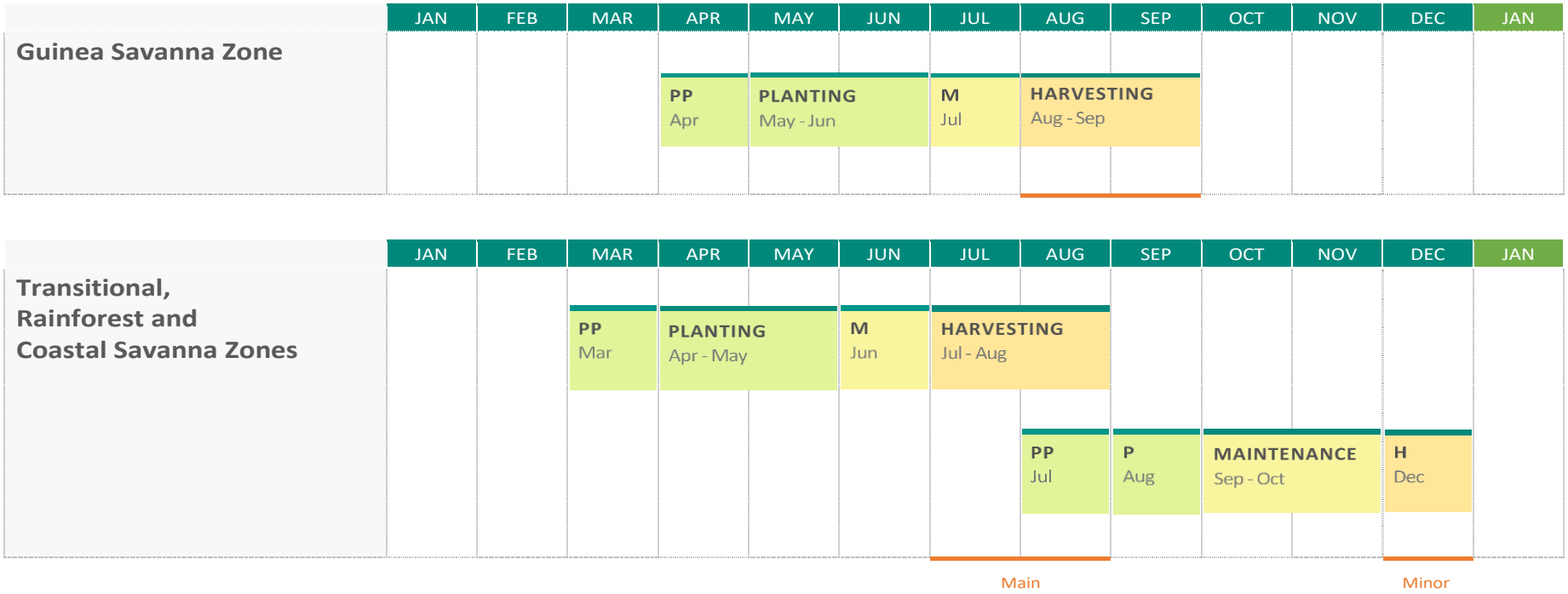
Cassava, Sweetpotato, Yam, Cocoyam, Taro, Frafra Potato

Introduction Con't

A typical crop cycle in Ghana

MAIZE CROP CYCLE

Annual Crop
Harvested 4 months after planting



ACTIVITIES

PP - Pre-planting: Land preparation
P - Planting
M - Maintenance: Weed control, Pest & disease control, Fertilizer application
H - Harvesting

NOTES

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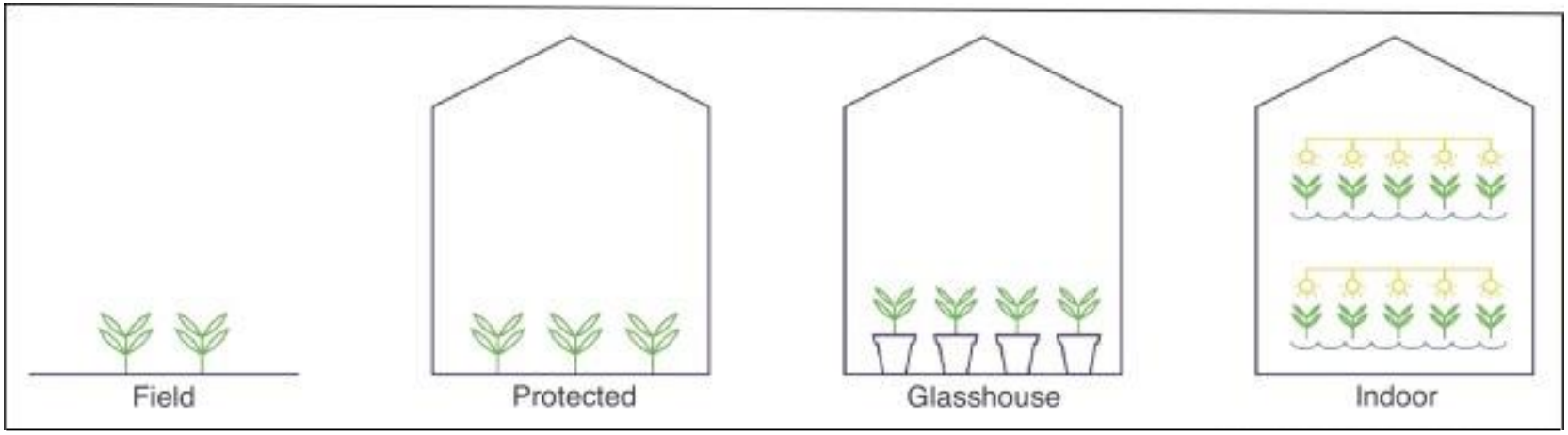
Developing the appropriate strategies 1

The adaptation of agriculture or making agriculture resilient to climate change requires the implementation of a myriad of complementary strategies:

- moving agriculture to new locations to follow environmental change
- adopting protected agriculture by partially or completely controlling the environment.
- Utilizing environments hitherto classified as not useful for agriculture to mitigate climate change effects
- Developing new agronomic packages for crops to mitigate climate change effects

Developing the appropriate strategies 2

Manipulating production/agronomic systems



Source: Current Opinion in Plant Biology, 2020

Developing the appropriate strategies 3

- Utilization of underutilized crop species to be able to contribute to climate adaptation and mitigation
- Domestication of new species and the improvement of existing ones to adapt to climate change effects
- Extensive use of wild relatives of crops capturing much more of the available climate smart plant biodiversity into elite genotypes.
- Strengthening gene banks to preserve important genotypes for future utilization
- Accessing UPOV PLUTO database to support breeding

Using the appropriate Genetic Tools to mitigate climate Change

Genetic improvement of crops as a key strategy to adapt to mitigate climate change effects:

- *Genomic tools for plant genome analysis have continued to improve rapidly.*
- *Crop improvement needs to use genomic tools to design and then deliver the required genotypes to fit changing and hitherto difficult environments.*
- *Genomic tools can be used to incorporate new traits from wild relatives to elite genotypes*
- *Genomic tools such as* TALEN, CRISPR/Cas-technique or base editing can be used to improve wild relatives of crop species to make them usable

Genetic improvement technology

Traditional Crop Modification

selective breeding and hybridization

Genetic Engineering

High yielding, pests and diseases control, manipulation of genome for improved varieties, including farmer preferred traits (PVS, PVB)

Genome Editing

Removal of genes responsible for deleterious traits affecting storage Nutrient uptake

Genetic technologies that have been applied in plant improvement in Ghana and elsewhere

Technology	Contribution to crop improvement
Phenotypic selection	Eco-geographical adaptation
Cross breeding/hybridization	High yield increases, agronomic improvement and adaptation to climatic fluctuations and mitigation
Genetic manipulation	Reduction of dependency on agrochemicals (e.g. Bt Cowpea, Bt cotton, etc.)
Molecular markers	Resistance breeding (e.g. fall armyworm, drought, salt tolerance, aflatoxin accumulation resistance, etc.)
Genomic Selection	Increased rate of genetic gain (e.g. Food crop , forest trees and animal breeding)
Gene editing	Novel products (e.g. Golden rice, Tomato, Maize, Wheat, etc.)

Conclusions

- Future food production will rely on the continued development of new crop varieties
- Underutilized crop species will need research attention to be able to contribute to climate adaptation and mitigation
- Domestication of new species and the improvement of existing ones to adapt to climate change effects
- Extensive use of wild relatives of crops capturing much more of the available climate smart plant biodiversity.
- Strengthening gene banks/treaty on Convention on Biological Diversity (CBD)
- Accessing UPOV database to support breeding

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