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Climate-smart *Brachiaria* grasses for improving livestock production in East Africa

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Introduction

Climate change is a global phenomenon with severe negative impacts on poor people in developing countries (Morton 2007). Across many parts of Africa, rural poor communities rely for their survival on agriculture and livestock, which are amongst the most climate-sensitive economic sectors. Climate-smart agriculture helps farmers to increase food production, become more resilient to climate change and reduce greenhouse gas (GHG) emissions. The main anthropogenic GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O); they are critically important for regulating the Earth's surface temperature. Inadequate quantity and quality of feed are major constraints to livestock production, particularly during the dry seasons across Africa.

The overall objective of this interinstitutional program is to increase feed availability in action areas of the target countries in East Africa (e.g. Kenya, Rwanda) by use of climate-smart *Brachiaria* forage grasses (Rao et al. 2011) for increased animal productivity and for generation of extra income by smallholder farmers. An innovative programmed approach will be used to reintroduce to Africa high quality, persistent and productive *Brachiaria* genotypes, that were selected and improved in Latin America (Miles et al. 2004). These forage grasses will help alleviate feed shortages, increase income of resource-poor farmers, improve soil fertility, adapt to and mitigate climate change, increase milk and beef production, and as a result improve livelihoods and protect the environment.

The program uses trans-disciplinary research by integrating modern tools and technologies to identify and disseminate *Brachiaria* cultivars that are adapted to climate change through endophytes (biological protection agents), that improve adaptation to drought stress and also have the potential to mitigate climate change through carbon sequestration in soil and reduction of emissions of both methane and nitrous oxide.

Methods

The program is focused on 4 major outputs:

- The role of endophytes in improving adaptation of *Brachiaria* grasses to climate change (drought) determined and novel methods to detect endophytes developed;
- The contribution to mitigation of climate change by *Brachiaria* grasses adapted to drought and low soil fertility quantified;
- Improved *Brachiaria* grasses integrated into mixed smallholder crop-livestock systems, their role in improving milk and meat production in grazing and cut-and-carry forage systems determined and their impact in reducing land degradation assessed; and
- Systems for the creation of forage seed production and marketing enterprises for poor farmers, mainly females, established.

At each step of the program, implementation, monitoring and evaluation will be applied to ensure that generated technologies are delivered to end users.

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Results

Output 1: Role of endophytes

The role of endophytes in improving adaptation of *Brachiaria* grasses is being investigated at the BecA-ILRI Hub, CIAT and Grasslanz Technology Ltd. The preliminary results from isolation and determination of endophyte metabolites in culture and in planta will be presented. This will be followed by the development of an efficient inoculation process to test the impact of endophytes on biological nitrification inhibition (BNI) and nitrous oxide (N_2O) emissions from *Brachiaria* grasses under greenhouse conditions and to identify the most promising lines for testing under field conditions. The impacts of endophyte infection on forage yield and forage quality of promising *Brachiaria* grasses during drought stress under field conditions will also be investigated.

Output 2: Mitigation of climate change

Ten cultivars and 80 germplasm accessions of different *Brachiaria* species have been sent from Colombia to New Zealand, Kenya and Rwanda for agronomic evaluation based on abitioc (drought and low soil fertility) and biotic stress conditions to quantify their adaptation to and mitigation of climate change.

Output 3: Role in improving milk and meat production

Selected *Brachiaria* grasses are being integrated into mixed smallholder crop-livestock systems in Rwanda and Kenya. *Brachiaria*-based rations are fed to dairy cows and beef cattle in communal feedlots using cut-and-carry forage systems and milk and meat production plus environmental benefits are being recorded.

Output 4: Forage seed production enterprises

After evaluation of *Brachiaria* genotypes with farmer participation, a farmer cooperative to produce and market *Brachiaria* seed will be established in Rwanda and Kenya, where female farmers will also be involved.

Conclusions

This research for development program is being implemented by 5 institutions, namely ILRI (the BecA-ILRI Hub) in Kenya, CIAT in Colombia, KARI in Kenya, RAB in Rwanda, and Grasslanz Technology Ltd in New Zealand. If the research is successful, novel methods for detecting endophytes to improve adaptation of *Brachiaria* grasses to climate change, especially drought stress, will be developed. Adoption of this technology will improve feed availability for smallholders in Kenya and Rwanda, while mitigating climate change through improved carbon sequestration and reduced emissions of methane and nitrous oxide.

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