Pre-proposal submitted to the Hebrew University Center for Sustainability

Optimizing crop-use efficiency and farmers acceptability for low input smallholder farms wheat agro-system

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Research background and rationale

The ever-increasing human population, together with the loss of agricultural land (due to urbanization, industrialization, desertification, and climate change) and diminishing resource availability pose serious challenges to agricultural research. Here we propose a conceptual multi-disciplinary approach (**OptiWheat**) combining genetic-physiology and remote sensing with socio-economic mixed-methods farmers and community assessment tools. This will **set the foundation for optimizing crop-use efficiency and promote climate-resilience wheat cultivars that will enhance the yield stability and agro-sustainability of smallholder farms in developing countries**. This need to enhance yields comes with an urgent need to improve agricultural management and to reduce its environmental footprint (i.e. depletion of soil mineral nutrients, gas emissions, soil erosion, and runoff water). With smallholder farmers producing ~35% of the food consumed in Sub-Saharan Africa, it is crucial to understand which factors contribute to the long-term adoption of new technologies among such farmers in the specific context of wheat farming in Eastern Uganda.

The synergy gained through **OptiWheat** multidimensional genetic-physiology-proximal remote-sensing-breeding approach with socio-economic mixed-methods farmers and community assessment tools promises to provide not only novel climate-resilience and sensory methods that set the foundation for climate-resilience wheat, but also a firm **understanding of factors contributing to the adoption of such methods among smallholder farmers**. As the advantages of the climate-resilience wheat will be presented to the smallholder farmers it might improve their willingness to adopt it. Facilitating efficient use of resources per available unit area will also contribute to reduce the environmental footprint and promote better sustainability. *Our specific objectives*:

a) Define the major traits shaping wheat adaptation to contrasting managements or environmental conditions.
b) Identify factors that affect smallholder farmers' willingness to adopt new technology for wheat farming
c) Developing a holistic approach for optimizing crop resource use efficiency and methodologies for sustainable adoption of relevant optimization methodologies in Eastern Uganda.

Innovation and contribution to sustainability

Wheat is the world's priority grain-crop, and climate-change derive resource depletion, the major limiting environmental factor, are targeted in the proposed study which aims to increase crops sustainable production. The synergy gained through our multidisciplinary genetic-physiological-sensing and mix methods research from community development promises to provide new insight not only on the crop but also on the willingness of farmers to adopt the new technologies. Optimizing the crop resources, with emphasis on soil, water, and minerals, play a key role in sustainable yield production. Moreover, **the advanced phenotyping methodologies could serve breeders and local farmers facing changing environments with new tools**. The proposed **OptiWheat** research will evaluate factors contributing/limiting such acceptance and suggest relevant methodologies for improved adoption among farmers. Wheat was chosen for its high nutritional value, high levels of consumption, and current limited producing capacities in Eastern Uganda, which the Ugandan government is eager to improve.

Methodology and collaboration

A diverse wheat panel will be characterized using classical physiology and advance spectral-sensors alongside high-throughput genomics to identify key traits for future breeding of better resources-use efficiency (i.e. reduce environmental footprint). In parallel, qualitative research tools will be employed with relevant farmers, community institutions, and local agricultural experts. Data will be analyzed through both qualitative content analysis and quantitative methods. The essence of **OptiWheat** project is to **expose the advantages of climate-resilience wheat and advanced techniques to the smallholder farmers as well as understand how to improve their acceptability**. We believe that a joint effort of researchers from different disciplines, yet sharing analogous challenges in promoting wheat sustainability for smallholder farms in developing countries. While finding new technological solutions for breeding climate–resilience crops is essential to cope with resource depletion, the ability to bring these novel technologies to smallholder farmers in developing countries is as important. This project is a promising starting point for future collaboration and generation of joint international grant applications.