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Council for Tropical and Subtropical Agricultural Research

ATSAF - CGIAR++ Junior Scientists Program
Final Report

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Country: Rwanda
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Start and end date of remotely supervised project: since Sep 2021
Title: New analytical approach to improve potato breeding by additional inclusion of environmental and farmers data (socio-economic; participatory experiment - Tricot approach).

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Thankfully, because of the ATSAF Junior Scientists Program, I could go on a research trip in Rwanda and Kenya. My research target country is Rwanda, but I visited Kenya to work with my supervisor and CIP potato team (Rwanda: 5, Nov 2021 to 5, Feb 2022, Kenya; 5, Feb 2022 to 1, Apr 2022). The experience in Rwanda and Kenya was terrific. It enlightened me academically, but it also taught me international cooperation with diverse people and global citizenship. Before starting the report, I have to confess one thing. Although I had lots of literature review and studied Rwanda and Kenya, embarrassedly, my other knowledge of Africa had not enough. I had tended to generalize African countries by ignoring each country's characteristics because of my biased thinking, such as patronizing or watching them as study subjects only. However, it didn't take long to break my narrow perspective. I saw Rwandan and Kenyan dreams from farmers' hands covered with dirt, felt vivid energy from their prospective young scientists and heard the song that opens the dawn from students. These things, which I experienced, did not differ from us and reminded me that every living soul on the earth is part of great humanity. This paper would like to express what I learned and felt at the CGcenter, CIP, during ATSAF's support.

- In Rwanda

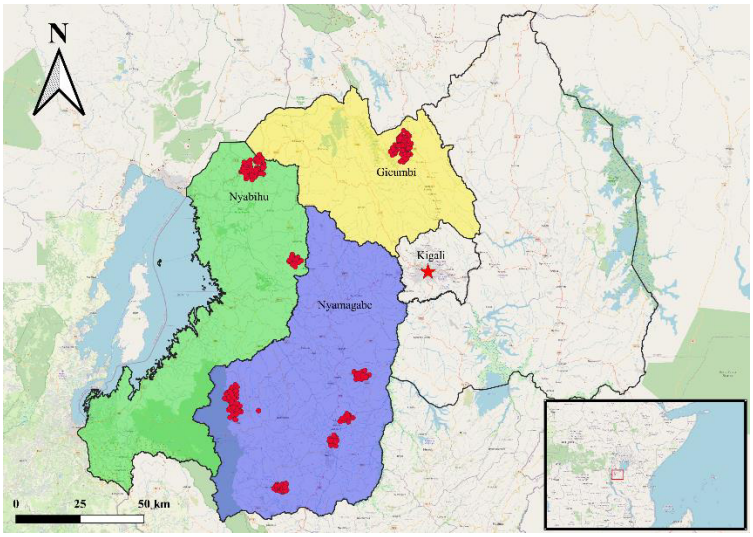

Figure 1. Tricot research site in Rwanda; Nyabihu district (green area, in Western Province), Gicumbi district (yellow area, to due-north of Kigali,), Nyamagabe district (blue area,in the south-west of Rwanda). Red dots mean location of participated farmers' households. Red star located capital of Rwanda, Kigali.

Unfortunately, the Triadic comparisons of technology options (tricot) project was finished in September 2021, so I did not have a chance to join the data collection. Instead, I had spent most time analyzing data and managing data quality because of a few inconsistent data and errors. I had to check precious institution documents and conversate with Rwanda CIP colleagues to conduct work. In addition, my supervisors and I had regular meetings every Thursday through zoom meetings to solve my problem and report my work progress. Even though my work mainly required spending lots of time in front of the computer, it was not easy to work. Using R software was not familiar to me at the beginning. However, from those works, I practiced R software and learned how to organize plans with people who have diverse cultural backgrounds. Especially learning how to interact with CIP staff socially was a precious lesson that is quite hard to experience from university.

Furthermore, The CIP offered an outdoor excursion to show how the agency is working on field projects and make me better understand Rwanda's potato production. The first excursion was about fertilizer assessment by using the tricot method. Although the project that I visited as a form of the excursion was quite different from my project, I was able to talk to participants in the citizen science project. I only asked a few farmers about

farming and the life of farmers in Rwanda, but their stories were attractive to catch my attention. They mentioned willing to adopt new varieties, but it is hard to attain input resources; fertilizer, Fungicide, and others regularly. However, farmers expressed positive behavior to participate in the project and favored attaining knowledge from their experience. Like Antle and Crissman (1990)[1] argument, this was a great opportunity to confirm that local smallholders/conditions quickly adopt new technology when observing their neighbors or experiencing it rather than just transmitting detailed education and technical knowledge.

Picture 1. A photo of a visit to a Rwanda potato farm

The second excursion was visiting Rwanda Agricultural Board's (RAB) in Musanze. RAB is one of the research partners with CIP. RAB missions are developing agriculture and animal resources through research, agricultural and animal resources extension to increase agricultural and animal productivity and their derives. Therefore, RAB in Musanze is in charge of potato seed multiplication and variety development. Consequently, it was an excellent chance to know how Rwanda's potato supply chain started and how they breed potatoes. In addition, I listened to issues of Rwanda's potato production. According to RAB staff, Musanze RAB produced virus-free potato tubers. Still, few private companies are involved in the potato supply chain because the cost of seed tubers is expensive, and companies are reluctant to spend money by storing potatoes during the dormancy or multiplication process. Additionally, he noted that it is difficult to accurately determine the seed potato demand in the market because the demand for seed potatoes varies from year to year.

[1] Antle, J.M., Crissman, C.C., 1990. Risk, efficiency, and the adoption of modern crop varieties: evidence from the Philippines. Economic Development and Cultural Change 38 (3), 517–537.

Picture 2. Photos were taken by the Rwanda Agricultural Board, Musanze. The first picture shows RAB workers classifying potatoes by size. Pre-war, there was a machine that automatically classify potatoes by size but now people do instead of the machine. It shows dramatically result of losing technology. The picture of the middle is a potato flower that is used for breeding. Third picture is about produced seed potato.

Picture 3. Photo with CIP Rwanda team

- In Kenya

After finishing data quality management, I moved to Kenya to meet Dr. Thiago Mendes, my CIP supervisor, because it was necessary to discuss how to make Best Linear Unbiased Prediction (BLUP) with on-station data (breeders data).

Staying in Kenya, Dr. Thiago Mendes suggested that I find information on the linear model. As a result, I made the BLUP model for numeric data of traits and the general linear mixed model (GLMM) for ordinal data of traits. Finally, I could prepare data set to use it, as item covariates, in the Plackett luce model. Plackett luce model can compute item ranking by using the linear function of item covariate. This method explains whether players' natural ability (called player-specific predictor variables or item covariates) influenced player performance in ranking or not. In other words, the model can tell how much the potato's genetics influenced the farmer's choices. Not only this, the placket luce model based on tricot can represent environmental, social, and economic reasons

for which certain regions or groups of farmers display heterogeneous varieties preference rankings when factors applied external covariate into the model. It means that breeder can use placket luce model results as both feedback to modify potato varieties' product profiles and, at the same time, as foundation data to build specific area varieties' product profiles.

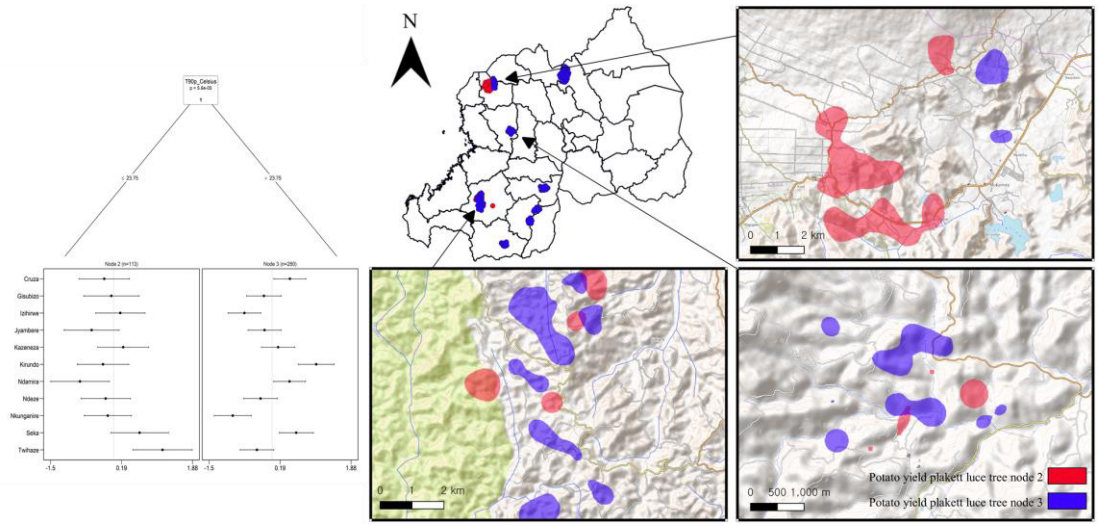

Figure 2. result of Plackett luce tree model about yield. the model shows different area farmers' preference ranking depending on temperature. this picture visualized the result on the map.

Consequently, the experience of data analysis and working with international scientists in CIP Kenya and Rwanda gave me a strong desire to pursue the path of agricultural science after graduation. Also, my experience with the tricot model motivated me to study more about citizen science in agriculture or participation breeding. I have no doubt that this experience will allow me to successfully complete my master's thesis. Once again, I would like to thank the ATSAF team for giving me this opportunity.

Picture 3. Photos about evaluating potatoes in a breeding trial