ATSAF - CGIAR++ Junior Scientists Program Final Report

Name of student: Marvin Ebot Kedinga
University: Justus-Liebig-University Giessen
Supervisor at University: Dr. Nadia Keudel
International Agricultural Research Center: The Alliance of Bioversity International (Bioversity) and the International Center for Tropical Agriculture (CIAT)
Country: Rwanda
Supervisor at IARC: Dr. Eluid Birachi
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Title: The Impacts of Transaction Cost on the adoption of bean Varieties in the Southern Highlands of Tanzania.

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1 Introduction

I am Marvin Ebot Kedinga, a student at the Justus Liebig University of Giessen, Germany. I am currently finishing up my Master's thesis. The title of my master thesis is "The impact of transaction costs on the adoption of bean varieties in the southern highlands of Tanzania." Within this research, the study's main objective was to examine the impact of transaction costs on the adoption of bean varieties in the Southern Highlands of Tanzania. Mainly to address the central question of this research, "What are the impacts of transaction cost on the adoption of bean varieties?". Having this objective and research question in mind, I arrived at the ATSAF - CGIAR++ Junior Scientists Program in cooperation with GIZ (The Deutsche Gesellschaft für Internationale Zusammenarbeit).

My project was undertaken in Rwanda with the International Center for Tropical Agriculture (CIAT) in Kigali, Rwanda. I flew into Kigali, Rwanda, on November 8th, 2021, and started the project on November 9th, 2021. I did an average of 40 hours a week for 128 hours. The author concluded the project on December 1st, 2021. The significance of my Rwanda trip in a broader context is vital as the introduction of new technology seems to provide the potential to significantly enhance the productivity and profitability of small-scale farmers. By way of agricultural research and development, examining and understanding the role of transaction cost in adopting the different bean varieties are critical steps in establishing and driving a research agenda and formulating programs and interventions that target and meet the needs of farmers.

2 Activities At the International Agricultural Research Center (IARC)

2.1 Understanding the data

Generally, as a first step in dealing with quantitative data, I had to know why the data was collected. I should know where the dataset came from, if any changes have been made to it, whether it has missing values, understand the causes and patterns of the missing data, and why and what is the unit of analysis. It is of utmost importance to gain familiar context and insights about the nature of the data and the study areas, which was potentially helpful for the further steps in the data analysis process. It was equally important to understand the meaning of the data in terms of culture, politics, and economy. While understanding the data, I began to explore the data's intrinsic and extrinsic characteristics, such as usability, usefulness, and relevant contextual issues, including values, customs, and norms. Understanding the context helped me add a

dimension and a layer of information. It was an essential activity as my supervisors insisted on understanding the data since I was not there for the data collection.

2.2   Data preparation

The data used for my study was provided by my supervisor, Dr. Eluid Birachi of CIAT, Rwanda. However, Dr. Enid Katungi of Pan-Africa Bean Research Alliance of the Alliance of Bioversity International and CIAT had the data. They do much research on the adoption of legumes, especially beans, in different Eastern and Southern African countries. My supervisor, Dr. Eluid Birachi, was at the forefront, ensuring I received the data from Dr. Enid Katungi. During the interaction between my supervisor and Dr. Enid, they decided we had a meeting where I had to present my thesis proposal. This meeting was meant to discuss my proposal in more detail and to see if the data they have suits my objectives regarding the variables I need. The communication with my supervisors was so helpful that they made me keep brainstorming and most often liaise with the breeders and other stakeholders involved in the data collection. Unfortunately, I could not meet with smallholders because of the COVID-19 pandemic.

Nevertheless, with the help of some CIAT- Rwanda staff, I could interview a few farmers to find out the reality in the field. Some CIAT-Rwanda staff helped me translate some responses from respondents in the questionnaire since it was in their local dialects. While in Rwanda, I held weekly meetings. The first meeting with my supervisor from Germany and Dr. Eluid was to discuss and plan how I would work on the data. The second weekly meeting was to discuss regularities and irregularities and see the possibility of obtaining more data. The third meeting discussed what I had achieved so far with the data.

As I was in possession of the CIAT-PABRA data set, I had to integrate the data, transform the data, and reduce the data. The objective was to recombine data from different sections of the data set and generate a new ordered list of elements/variables. I further went on to transform the data to suit the purpose so it could answer the problem or my research question. For example, I normalize the syntax and structure data or generate new value pairs. I also transformed the data based on defined mapping tools. I selected and processed a better data selection, dealing with missing numbers, resolving discrepancies, and eliminating outliers. The difficulty I faced in this activity was identifying inconsistencies in the questionnaire since I was not in the field for data collection. I also faced internet challenges in using the software for this task. In solving the difficulty of inconsistencies, CIAT-Rwanda staff helped me as they helped me translate the local languages into English. With the internet challenges, I had to switch to the internet provider before having stable internet connectivity.

2.3   Data visualization and communication

I depicted the data or information on graphs or other visualization types to see the connections between variables. The goal of this activity was to determine trends and patterns. I also visualized the data set in the form of charts and graphs so that communicating the findings of the data would be easier. Visualizing the data also helped one decide relationships (correlations), investigate networks, and schedule. Through data visualization, I got familiarized with data tools that can help in creating powerful reports and dashboards. I faced the challenge of translating the local languages to English, where I could identify patterns and trends in the data set. It was not easy to get the exact message respondents were trying to pass through. CIAT-Rwanda staff was of help to me in overcoming this challenge.

2.4   Data modelling

Here, I diagrammed extensive information or smaller pieces to express the relationships between the various sections of the data sets. The objective of data modeling was to identify the model that best fits or answers the author's research question. In the same light, the author found the best-performing model to create the most effective way of storing information while maintaining complete access and reporting. It was complex activity as it entailed good internet coverage, and connectivity was a challenge at the time of the project. For this activity, my supervisor guided me as it entailed more experience. He provided some guide manuals and literature to go about this activity.

2.5   Pictures of the IARC
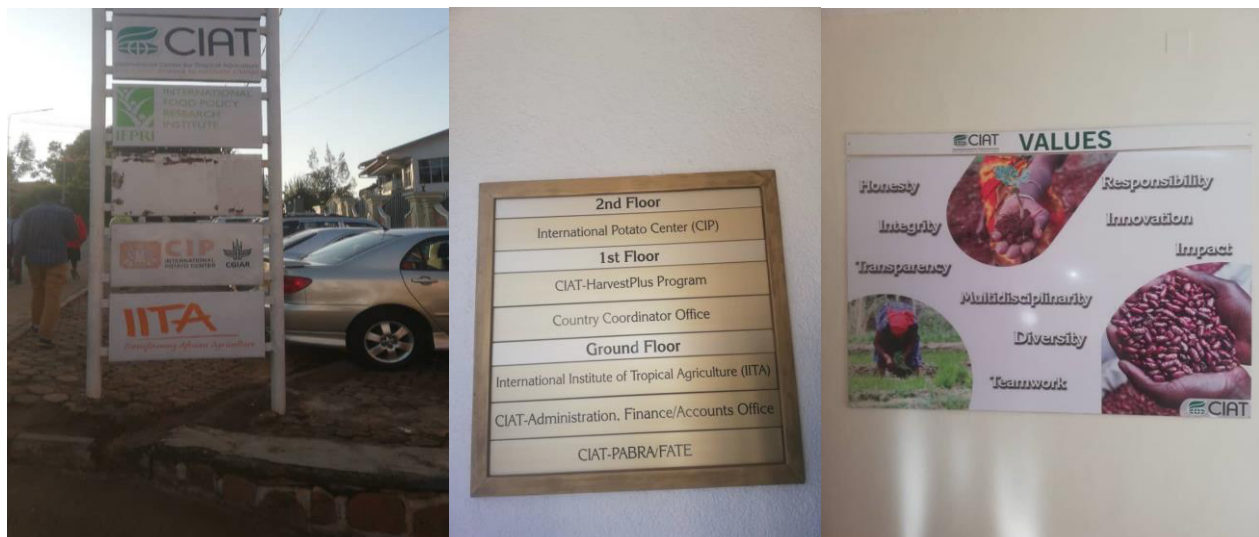
3 Activities Carried Out After My Trip from Rwanda (Remotely supervised project)

3.1 Develop a theoretical and conceptual framework

Here, I dug deep into literature and empirical studies on agricultural technology adoption in general and in Africa and began recognizing the key concepts. I also considered what has been done by other researchers and what has not been done regarding my study. This activity was vital as it helped pull out concepts, theories, and already existing frameworks elucidated in the consistent literature. This activity was challenging as it needed more time and little expertise. I held several meetings with my supervisors via zoom because they were all interested in it, which helped. It usually takes a couple of weeks. My supervisors advised me always to be open, flexible, and expect random changes as a young researcher. This was a smooth but time-consuming activity. My supervisor pinpointed some examples from literature and empirical studies of how to develop a theoretical and conceptual framework, all of which can suit my study.

3.2 Variable selection

After going through the literature, I could then identify many essential variables in determining the adoption of improved agricultural technology. Because the following variables keep emerging, I have decided to incorporate them in my framework: household characteristics variables such as age, gender, household size, etc., production and marketing, institutional, farm, and wealth variables matter for households' adoption choices. I consulted my supervisors to get their opinions and suggestions for this activity. This was a smooth activity where I did not face any challenges.

3.3 Feedback and progress tracking

It was also a vital activity as I agreed with my supervisors to have weekly meetings to evaluate and track my progress. As I have always sought to do research properly and increase my knowledge, I further discussed my work with a couple of Ph.D. students around my department for constant advice and insights. This was a challenging task because it was not easy to schedule time for meetings for feedback. After all, we all had opposing programs, so we had to find the most suitable time to hold meetings.

3.4 Proper data cleaning

It was the most important and challenging activity I faced. I had to get familiar with Stata (statistical software package) as it was the first time, I came across this software. I had to generate a Stata do-file where I did the data cleaning. I created another Stata file where I merged the different files

at the household, plot, and community levels. I reclassified the improved varieties from the questionnaire in the different plots (plot one, plot 2, plot three, and plot 4), and I labeled values for the improved varieties. I further reclassified the other varieties in the questionnaire if they were improved or not improved (local). I generated the adoption status variable. I further identified the plots with only beans in the file where we have the plot area occupied by beans. I created and merged plot ids where we have a plot area occupied by beans with the plot-level data files (plot id and varieties). I ensured that all files and necessary folders I created for data analysis were in place. The difficulty I faced with this activity was how to get the Stata software package. With the help of my supervisor, my university offered to install a Stata software package.

Moreover, even after having the Stata software, it was challenging to use it for the first time. I solved this challenge by going through videos on YouTube and attending a few seminars on Stata by my university. My supervisor also sent me some good documents to enhance my knowledge.

3.5 Data analysis

Here, after cleaning the data and making it ready for analysis, I had a meeting with my supervisors to evaluate the data cleaning process. The meeting was successful because I had some insightful suggestions and comments from them, which I implemented. I later tried my variables with the double hurdle model in Stata to see my analysis's preliminary results and findings. As I mentioned earlier, I am an intermediate Stata user, and I was bound to make several mistakes. This was the most challenging task I have faced so far. Some of the most critical variables had a lot of missing observations, so I had to drop these variables from my analysis. I further faced the challenge of not having significant independent variables in the model. After meetings and the exchange of emails with supervisors and friends, I also did more research to see how to deal with these challenges. Finally, I did my analysis, and I had some exciting results which answered my research objectives. I discussed the results with my supervisors. We agreed on the results of the analysis.

3.6 Results interpretation

After obtaining my results based on Stata output, I started with the results interpretation and thesis writing.

4 Key Findings of Research

The following are the most significant findings from the results of the analysis. This study followed the double hurdle econometrical analysis to find the answer to our research question. The double hurdle model has been used to assess the determinants of smallholder adoption choices and intensity of adoption. However, the selected variables were based on a theoretical basis and move

forward to go through studies on technology adoption in Tanzania and a bunch of empirical literature on technology adoption in agriculture in Africa to see what has been done. It helped me choose my variables.

Building on the two-step double hurdle model, we examined the role of transaction cost in adopting improved bean varieties in the southern highlands of Tanzania. The present research is based on small sample size. Our analysis demonstrates a small significance of transaction costs regarding the adoption of improved bean varieties and the intensity of adoption. Firstly, on the one hand, our findings answer the underlying objective of this thesis, explaining that fixed proxied transaction cost (education of household head) negatively affects the decision or not to adopt improved bean varieties at a significant level. Precisely saying, education was observed to influence adoption negatively, and this can be explained by the fact, in the context of Tanzania, precisely the southern highlands, a great majority of the farmers obtained less education (primary education) which is a challenge to assimilate new technology.

Secondly, our same regression analysis also pointed out the other determinants of adoption and the intensity of adoption. We are precisely saying that household size has a lower probability of adoption; however, a positive influence on the intensity of adoption. In the same regard, gender of household head, experience in bean farming, and area of cultivation all had a positive influence on the decision to adopt improved bean varieties, nevertheless, a negative effect on the intensity of adoption.

In addition, institutional social capital factors influence the decision to adopt and the intensity of adoption. Training in bean farming, membership in farmer organizations, and access to agricultural credit positively influence the adoption decision. However, membership in farmer organization and access to agricultural credit negatively influences the intensity of adoption.

5 Justification of a Short Stay Abroad

Students supported by the Junior Scientist Program are expected to spend time at the CGAIR center exclusively for research. However, in February 2021, following an update on the website, students can work on the already collected dataset due to the outbreak and rise in the number of COVID-19 cases. While working on the dataset, students should keep in mind that if the COVID-19 situation gets better and people are allowed to travel, students will go to the field for project-based scientific work at an international Agricultural Research Center (IARC).

I was already in contact with my supervisor at CIAT-Rwanda to see the possibility of obtaining data from them. They do much research on the adoption of legumes, especially in different Eastern

and Southern African countries. After thorough discussions and meetings with my supervisor and his institution, they agreed on me to use the 2016 and 2017 CIAT-PABRA data set. My supervisor at the IARC agreed to host me when the COVID-19 situation got better.

6   Conclusion

I had a fantastic experience, although for a short time, in Kigali, Rwanda. My knowledge of project-based scientific work was greatly enhanced. Researching the practical experience in project-based scientific work and analyzing the CIAT-PABRA dataset will help me carry out agricultural research in the future.

Living in Rwanda, learning a new culture for a short period, and working with CIAT-Rwanda staff and colleagues from different nationalities and backgrounds will put me in good stead if I find myself in any multi-national organization. I also want to thank the ATSAF - CGIAR++ Junior Scientists Program for giving me this funding opportunity, as I was able to work with data sets. Moreover, the funds took care of me throughout my stay in Rwanda. I would not hesitate if I had to do it all over again.