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Editorial

I hope that all of you are having a productive spring break/semester. The current issue features two contributions. First, Yuko Nakano discusses fieldwork and survey practices, such as sampling, randomized control trial (RCT) implementers, Institutional Review Board (IRB), computer-assisted personal interview (CAPI), and enumerator training, based on her experience in Sub-Saharan Africa. This follows up on Yuki Higuchi's article on exploratory fieldwork, which appeared in the last issue of JADE Letter. Yuko provides a wide range of useful information and practical advice that I believe will help graduate students and young researchers design and implement their fieldwork and surveys. Second, Ken Miura provides a nice literature review on weather risk management among Sub-Saharan African farmers and introduces his fascinating RCT in Zambia. This is a very important topic under climate change. His project illustrates the practice of RCT discussed by Yuko in a specific context, providing young scholars with valuable lessons for their research design and RCT. As such, Yuko and Ken's contributions are linked thematically and methodologically. Here, I have experimented with this first attempt to connect the two articles in JADE Letter. I believe it has worked very well thanks to the effective interactions of the two authors with shared research interests and experience, which exemplifies the complementarity among JADE members. Any comments on the current issue and suggestions for future issues are welcome. Enjoy reading!

Yoshito Takasaki, Editor, JADE Letter

JADE 2024

The Sixth JADE Conference will be held jointly with the Institute of Developing Economies (IDE) at JETRO Headquarters (Roppongi, Minato-ku, Tokyo) on April 13-14, 2024. Visit the JADE website for the conference program and registration.

Economic Fieldworks Part 2[1]

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Introduction

The greatest allure of field research lies in sitting with research subjects (in the author's case, African farmers), engaging in conversations, and deriving research themes and hypotheses from these interactions. Translating field observations into data, and discussing them with policymakers and other researchers are, above all, enjoyable. In my case, it would not be an exaggeration to say that I write papers and secure research grants just because I want to talk to African farmers.

Although field research is an enjoyable endeavor, its implementation requires immense energy and substantial administrative work. Here, following the article by Dr. Higuchi featured in JADE letter no. 7, I share my experiences regarding (1) sampling and power calculation; (2) negotiations with the implementers of the randomized control trial (RCT), such as non-governmental organizations (NGO) and aid agencies; (3) applying to the Institutional Review Board (IRB) and writing the pre-analysis plan (PAP); (4) programming computer-assisted personal interview (CAPI) (if used); and (5) enumerator training and implementation of the survey. Since Dr. Higuchi has explained the most exciting part of the field survey (i.e., establishing hypotheses and developing questionnaires), I focus more on the practical side of the field survey, which is less exciting (at least to me) but necessary and important in the field survey.

Sampling and Power Calculation

While developing hypotheses and designing questionnaires are major activities in the field, sampling is also another important activity. Sampling should be considered alongside identification strategies, making sampling one of the highlights of field activities. The first step is to determine the target area in accordance with the research objectives. For a case-study investigation, one may sample a relatively small area. If one desires to collect data representative of a broader region, the target area will have to be expanded. For example, I studied the impact of agricultural training on the technology adoption and productivity of rice cultivation in Tanzania. Naturally, the target area must have the potential for rice cultivation and the technologies taught should be suitable for the study sites. After selecting the target area, a list of villages should be obtained, and (in many cases, randomly) select sample villages. You may use census or other previous national-level surveys for this. Then, you will select a sample (in my case) of farmers within a village. In some cases, there is no formal list of farmers in the village. Although conducting a village census is ideal in this case, we may ask village leaders to create a list

[1] I highly appreciate useful comments from Dr. Takeshi Aida, Keitaro Aoyagi, Yuki Higuchi, and Ken Miura. Their constructive comments and discussions made me the biggest beneficiary of this article. I am also grateful to Prof. Yoshito Takasaki, who gave me a great opportunity to write this article and excellent comments. I am thankful to Prof. Keijiro Otsuka, Kei Kajisa, and other collaborators who gave me opportunities to conduct field surveys.

of farmers if there are budget constraints.

Furthermore, a prominent issue within the sampling process is "whom to ask and what to ask them." For example, in Nakano, Tanaka, and Otsuka (2018), the impact of agricultural training on the technology adoption and productivity of rice cultivation was explored. Local interviews revealed that the trainees differentiated between the plots where they adopt new technologies and where they do not. Thus, two plots per farmer were sampled to estimate the difference-in-differences model, comparing the performance between the adopting and non-adopting plots of trainees, and plots of non-trainees.

If a RCT is to be conducted, one must consider which interventions would be effective and academically interesting. In addition, listening to research subjects and understanding their livelihoods are crucial for designing effective interventions. You also need to decide the level of randomization (e.g., individual or village level) and perform power calculations to determine the sample size. Here, previous studies or observations of the preliminary survey can offer valuable guidance on deciding the necessary values to compute the sample size, such as outcome variance, effect size, and take-up rate. You also need to consider the proportion of samples assigned to the treatment group. If a clustered RCT is to be conducted, you need to calculate intra-cluster correlation coefficient (ICC), and decide the number of clusters and average number of units per cluster. Duflo, Glennerster, and Kremer (2007) and the website of the Abdul Latif Jameel Poverty Action Lab (J-PAL) provide useful information for power calculations.[2]

Sampling may sometimes be constrained by budgetary and other limitations related to project implementation. For instance, spillover is a significant issue when evaluating the impact of agricultural technology training. The effectiveness of the training may be underestimated if information flows from participants to non-participants. The standard approach to tackle such issues is to conduct village-level randomization. However, budgetary and other limitations, such as the capacity of implementing partners or their project plans, sometimes make it impossible to conduct a village-level RCT. In such cases, careful consideration of the research design within a village is necessary to minimize information spillover. A good example of such an approach is Takahashi, Mano, and Otsuka (2019), who have conducted a uniquely designed individual-level RCT to estimate the impact of agricultural training in Cote d'Ivoire. They initially request trainees to refrain from divulging the taught technologies to other farmers in the first year, but then promote farmers exchange information in the next year so that they could estimate both the direct and spillover effects of agricultural training.

While it may not be the strength of an author, it may be possible to find an opportunity for natural experiments.[3] Discovering such situations is possible by actively listening to people's stories in the

[2] https://www.povertyactionlab.org/resource/power-calculations#section-practical-tips (latest access on Feb 14, 2024).

[3] Fuje (2019) examines the impact of fossil fuel subsidy reforms on market integration, and the welfare of grain producers and consumers by exploiting the removal of subsidies in Ethiopia as a natural experiment. Jones and Salazar (2021) examine the impact of infrastructure improvements on maize market integration by exploiting the construction of a road bridge over the Zambezi River as a quasi-natural experiment. These are good examples of natural experimental studies in the context of agricultural development in Sub-Saharan Africa.

research area and can be one of the most important benefits of going to the field. For example, Kuroishi and Sawada (2024) exploit natural disasters in Japan and the Philippines to analyze whether and for how long preferences are affected by extreme events. Their study is also a good example of combining satellite imaginary data and lab-in-the-field experiments, which has become a popular trend in recent development economics studies.

Regardless of the type of study conducted, it is ideal to have an idea of the identification strategies and estimation methods by the time sampling is completed. For example, if you are to use an instrumental variable (IV) approach, you may need to collect data on potential IVs in the field. In addition, one should be clear about their contribution to the literature before starting the survey. Failure to do so may lead to difficulties after data collection, which is a lesson I have learned from my bitter experiences.[4]

Negotiation with Implementors for Randomized Control Trial

When conducting an RCT, it is sometimes necessary to negotiate with organizations that implement interventions, such as NGOs or aid agencies. Research cooperation often involves a significant amount of effort but usually has little direct benefit for such organizations. Therefore, to gain their cooperation, it is crucial to persuasively explain how beneficial your project is to society or that organization. For instance, for aid agencies, a significant advantage lies in being able to showcase the effects of their aid globally with objective evidence based on rigorous empirical analyses. Moreover, if the project does not function effectively, the next steps to improve it can be investigated. Sometimes, the objectives of an aid project and one's research may not align. For example, the aid project may promote the spillover of agricultural technologies, whereas spillover is not desirable for an impact evaluation. In such cases, the non-negotiable aspects of your research should be identified first and then proceed with the negotiations while remaining flexible on other points.

In some cases, project implementers may propose conducting an RCT. Here, you do not need to convince them to cooperate in your research project and may be able to save implementation costs for interventions. It is more important to elicit their interest and determine the research design in a manner that respects the objectives of the project. In any case, one should ensure beforehand that even if the research results turn out to be negative for the aid project, these results will be disclosed because it is a scientific project.

There are many different situations and relationships between researchers and project implementors. In each case, the points of contention are different. Still, academic interests should be balanced with the objectives of the project and the interests of practitioners through careful conversations; this is where the skills and convictions of the researchers are tested. After the agreement, detailed discussions are held about the actual implementation of the project and cost sharing. Because

[4] In one of my RCT surveys, I could not pin down the novelty of my research deeply before the survey began. Consequently, when I submitted the paper to a journal, it was rejected due to a lack of novelty being pointed out and I am currently revising the paper.

these details are often critically important in the research context, it is essential to carefully consider and decide on each detail through deliberation.[5]

Ethical Review, Research Permit, and Pre-Analysis Plan

In recent years, ethical reviews at IRB have become common when conducting both experimental and non-experimental studies. In some cases, submission of a paper to a journal is not allowed without an ethical review certificate. I have interacted with two institutions: the ethical review committee of my affiliated institution and ethical review board of the country where the research is conducted. In both cases, detailed research plans (including research themes, sampling methods, estimation methods, expected results, and contributions), questionnaires, and consent forms from respondents must be submitted. After submitting the necessary documents, the author receives comments from the committee, modifies the research plan, and if deemed sufficient, obtains approval from the review committee.[6]

You also need to obtain the country's research permit. The research plan and other necessary documents are submitted here as well. For example, in Tanzania, review committees meet every 3-4 months to deliberate on the feasibility of research. Obtaining ethical review and research permits may unexpectedly take time; therefore, early application is recommended once the decision to conduct research is made. The actual process of conducting research varies by country; however, when starting research, it is common to visit relevant institutions, such as district offices, with the obtained research permit, and a formal letter stating the purpose and duration of the research. Subsequently, introductions are made to village chiefs or local workers, finally allowing the research to proceed.

Recently, research register has also become necessary, such as at the American Economic Association's registry for randomized controlled trials (AEA RCT registry), especially when conducting an RCT survey.[7][8] The advantages include enhancing the credibility of your research by showing the procedures in advance, reducing the possibility of generating false positives due to multiple hypotheses testing, and publishing results, even if insignificant results are obtained, thus reducing publication bias. Additionally, it contributes to meta-analyses which combining multiple

[5] I collaborated with Building Resources Across Communities (BRAC), one of the largest microcredit organizations, to examine the impact of microcredit on technology adoption and productivity of rice cultivation. We had a very detailed discussion, such as on the interest rate, loan size, who bears the implementation costs, and the possibility of the side selling of in-kind credit (fertilizer), all of which have crucial meaning from both academic and practical perspectives (Nakano and Magezi 2020).

[6] The rigorousness and type of comments received from the reviewers during the ethical review significantly differ depending on the institutions and committee members. For example, in Uganda, the review process was quite rigorous, and we needed to submit a document similar to a pre-analyses plan (including estimation models, variables used, and power calculations) during the ethical review.

[7] https://www.socialscienceregistry.org/site/about (latest access on Feb 14, 2024).

[8] According to other JADE members' experience, referees pointed out that their non-RCT experimental study was not pre-registered when they submitted their study to a journal. Probably, the registration of non-RCT studies may become popular in the future, although, to the author's knowledge, there are still limited options for registration platforms for non-RCT studies. For further discussion on PAP for observational research, please refer to Burlig (2018).

research outcomes. The procedure for the AEA RCT registry is not complicated, is free, and you just need to submit your research protocol.

In addition, it has recently become popular to prepare a PAP that contains detailed information on how researchers plan to conduct the study and analyze the resulting data. You can register PAPs, for example, at the AEA RCT registry at the time of registration or add it later. Olken (2015) and Ofosu and Posner (2023) provide useful discussions on the advantages and costs of PAP. In addition, the J-PAL website and a presentation for a tutorial session at the second JADE conference by Dr. Shuhei Kitamura provides detailed information on study registration and PAP.[9]

Computer-Assisted Personal Interview

In recent years, the use of CAPI for questionnaire development has become increasingly prominent. The primary advantage of CAPI is its ability to prevent transcription errors during data entry, but its routing and validation functions are also significant. Routing enables the interviewer to guide the respondent to the next question based on their response to a particular question. This prevents enumerators from asking wrong questions and avoids inconsistencies in responses. Validation involves conducting simple calculations using questions and immediately notifying if there are abnormal values, thereby reducing anomalous data. Other benefits of CAPI include easy collection of GPS coordinates, taking pictures, designing A/B tests (e.g., asking for willingness to pay by showing the options randomly), and pre-loading the data collected in previous surveys to collect panel data. The data can also be checked frequently during the survey, and CAPI is useful for monitoring enumerators during the survey.

Although Survey Solutions is offered by the World Bank for free, one needs to prepare the server by themselves. The author opted not to utilize Survey Solutions owing to reported challenges in server configuration, but chose Survey CTO because of its user-friendly interface and the absence of a complex server setup despite its fee-based structure. Additionally, although open-source ODK offers both paid and free versions, the authors have never utilized it and are uncertain about its user-friendliness. Creating a CAPI questionnaire is a relatively straightforward task but can be time-consuming. Outsourcing can be considered if it is feasible. If questionnaire development is outsourced, you may respect the preferences of your counterparts in the selection of software. While CAPI proves to be a highly beneficial tool, precautions must be taken against power outages during the survey, which can impede enumerators from charging their tablets, as well as ensuring reliable Internet access for data uploading and addressing the procurement of tablets in the survey country.

Enumerator Training and Implementation of the Survey

[9] https://www.povertyactionlab.org/research-resources?view=toc (latest access on Feb 14, 2024). The presentation slides are available on the website of Dr. Shuhei Kitamura: https://sites.google.com/site/shuheikitamura/home (latest access on Feb 14, 2024).

Although one can refer to the detailed process of creating a questionnaire in Dr. Higuchi's paper, the questionnaire should be pre-tested well before training the enumerators. In the author's experience, training consists of 1 to–2-day classroom training and 2 to–3-day field training. In classroom training, enumerators are gathered in a room, and the intent of the questionnaire is explained in detail. During field training, actual interviews are conducted with farmers to ensure that both farmers and enumerators understand the intent of the questions. If the situation permits, it is recommended to interview those who are similar to, but out of your sample so that observations are excluded during training. It is ideal to conduct training to the extent that different enumerators would obtain the same answers if they interviewed the same person. If necessary, one may need to add modifications to the questionnaire. In particular, attention must be paid not only to questions but also to the choices to finalize the questionnaire (increasing answers such as "others, specify" requires coding and will make your life difficult later). This becomes even more crucial and difficult when conducting a field experiment, which involves more complicated procedures and requires a deeper understanding of the intention of the project by field staff.

The survey is only implemented after all these preparations. During the survey, one must check data quality and consistency. You must share inconsistent answers with the enumerators so that they go back or make a phone call to farmers and correct mistakes as much as they can. One may be able to clean the data later (by dropping or winsorizing observations with erroneous values), but this deteriorates the quality of the data. Therefore, it is important to collect as much accurate data as possible in the field.

During the survey, managing personnel, funding, and resources (e.g., vehicles) is necessary. Additionally, if RCT or experiments are conducted in the field, close monitoring is required during the intervention or experiments. In my doctoral and postdoctoral periods, I and my assistants executed these tasks in the field ourselves. However, recently, I have been outsourcing them to private companies. Outsourcing the implementation of the survey significantly saves your time, although you still need to prepare for the contract with them. However, this is possible only with trustworthy and experienced counterparts.[10] For this, I recommend talking to researchers with survey experiences in the country of interest. In any case, establishing trust with local collaborators and enumerators is crucial. I would not hesitate to treat them dozens of beers, if necessary.

Concluding Remark

One of the most important benefits of being in the field is that you can be more confident in interpreting your results by matching field observations with the analysis results. In addition, field observations

[10] In Tanzania, my former research assistants at the International Rice Research Institute established private survey companies. Further, in Uganda, a former enumerator in RePEAT surveys repeatedly conducted by GRIPS established a private company. The long-term relationship with them enabled us to outsource the survey activities confidently. In other countries, I am working with governmental organizations, but they also have long-term relationships with my co-investigators. I highly appreciate their dedication to our projects.

may provide an alternative explanation when you face counterintuitive results, which may lead to new discoveries.[11] For example, in my RCT, I found an insignificant impact of microcredit on chemical fertilizer use or paddy yield. Thanks to field observations, we could conduct subsample analyses and found different patterns in areas with and without good access to irrigation water, which provides a better explanation and understanding of the results (Nakano and Magezi 2020).

Designing research, creating questionnaires, and conducting training in the limited time, budget, and infrastructure constraints in the hot and sandy African field is a challenging experience that tests both physical and mental stamina, but is fun. In addition, during the actual implementation of the survey, numerous issues arose (e.g., no fuel station in the rural area for survey cars), and we solved them while laughing or crying together with local collaborators. It is undoubtedly a valuable experience not only for my research but also for my growth, and it is one scene of my youth. Although I discuss the survey procedure at length, the best way to learn it is to work with experienced researchers. Therefore, please talk to them about seeking such opportunities. Young researcher collecting data and gaining field experience is a win-win situation not only for them but also for experienced researchers who have money but no time.

Finally, with the understanding and cooperation of my family, coauthors, and supporting staff, I have continued field surveys, even bringing my child along. I honestly felt worried about bringing a small child to a developing country with underdeveloped medical facilities, and personally funding the child's travel expenses was a significant economic burden. Recently, rules allowing the use of research grants to cover children's travel expenses have been introduced, led by institutions such as the University of Tokyo and Kyushu University.[12] I sincerely hope that such support systems will become widespread in the future. While individual research styles and life priorities vary, I feel more than happy if my personal experience could slightly "nudge" the young researchers to go to the field. Please feel free to talk to me if you have any questions regarding my field experience.

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[11] My favorite example is the study by Prof. Otsuka in Ghana, where he found that investment in cacao trees enhanced women's tenure security, and thus, women actively participated in the cultivation of cacao, while people believed that the weak property rights of women hindered their long-term investment including agroforestry (Quisumbing et al. 2001; Otsuka 1999).

[12] https://www.u-tokyo.ac.jp/gen01/reiki_int/sochosaitei/utss-308.pdf (latest access on Feb 14, 2024) https://danjyo.kyushu-u.ac.jp/support/taidou.php (latest access on Feb 14, 2024).

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Interviewing farmers in Madagascar

With South Sudanese refugees in a refugee camp in Uganda

Sorghum as Insurance against Changing Climate Risk

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Weather Risk and Climate Change

African farmers make their living under an uncertain production environment. Interannual climate variability and frequent extreme weather events are constant production risks in their rainfed farming systems. Furthermore, climate change has emerged as a new challenge for African agriculture. Extrapolated predictions by researchers exhibit pessimistic views about the economic impacts of future climate scenarios on African agriculture (e.g., Kurukulasuriya et al., 2006; Hultgren et al., 2022). Expected changes in weather patterns include frequent and prolonged droughts, changes in the timing and amount of rainfall, rising temperatures, and increasing extreme weather events such as cyclones and floods. Moreover, increasing climate uncertainty complicates the formation of expectations in farmers' agricultural decision-making.

Given the urgent pressures from climate change, stakeholders in Sub-Saharan African countries must adapt their agricultural systems to changing weather risks. Farmers' adoption of new agricultural technologies and adjustments in farming practices are warranted to manage climate risks. To aid these transitions, national agricultural research systems must invest in public R&D and modify newly available technologies developed by international agricultural research to reflect local agroecological conditions (Macours, 2019). Innovations in government policies are also required to drive farmers' shifts towards climate-smart systems and the diffusion of suitable technologies by lifting external constraints (Lybbert & Sumner, 2012). Here, I discuss current evidence regarding risk-mitigating products and risk-reducing technologies to adapt to climate risks.

Risk-Mitigating Financial Products

Insurance is a risk-spreading financial product across spaces to enhance resilience to weather shocks. In particular, innovations in index-based insurance, where payouts are based on observed index values that are highly correlated with insured shocks, were expected to be a promising alternative to traditional indemnity-based insurance products for the following three reasons (Robles, 2021):

1. Minimizing information asymmetry problems (moral hazard and adverse selection);
2. Saving administration and loss verification costs; and
3. Disbursing compensation quickly and timely.

The primary goal of agricultural insurance is to stabilize consumption in the aftermath of the insured shocks. Additionally, uninsured risk is an often-quoted external constraint behind the low adoption of seemingly promising technologies. Thus, insurance can broaden farmers' capacity to undertake production risks by easing risk constraints. Previous empirical tests for this theoretical prediction generally confirm the favorable effects of risk-mitigating financial contracts on agricultural investments (e.g., Karlan et al., 2014; Lane, 2023).

Despite its promising features and high expectations among donors and researchers, the reported coverage levels of index insurance are too low to smoothen household income and consumption (Robles, 2021). In particular, observed insurance demands among smallholders are highly price elastic; thus, widespread use is only possible with substantial subsidies and government support. Basis risk—the mismatch between the insurance payout and individual production loss—is one of the innate drawbacks of index products, which can offer another explanation for their low take-up (Kodama et al., 2023). Although new advances in high-resolution satellite data, picture-based damage assessment using smartphones, and crop weather modeling based on machine learning may reduce basis risks, a sustained demand for index insurance has not yet emerged among smallholders in developing countries.

Risk-Management Agricultural Practices

Some climate risks are within farmers' control, to a certain extent, by taking risk management actions before they materialize. For example, crop and plot diversification strategies can cushion production shocks caused by localized weather. Such ex-ante risk management behavior helps smooth future income across states of the world at the expense of the higher expected profits achieved by specialization. Another example is planting crops or seed varieties that can tolerate climate shocks. As such, farmers' allocation of productive resources towards risk management farming practices has the potential to shield their livelihoods from increasing climate risk.

However, the literature suggests that undertaking various adaptation measures is infrequent and, if any, is insufficient to offset climate impacts (Kala et al., 2023). My recent research with Soyoka Okamura and Chieko Umetsu also reports underinvestment in self-insurance strategies among Zambian farmers. Using nationally representative data, we investigate farmers' agricultural production responses to climate risks, measured by historical rainfall variations. The results show little evidence of crop and plot diversification strategies in response to defined weather risks (Okamura et al., 2024). Despite the expected welfare gains from reducing income variance, adaptation measures for crop production are generally limited. Exploring the potential hindrances to ex-ante risk management strategies is a promising future research avenue.

Sorghum as a Risk-Reducing Technology

Practical solutions to climate change risks include the use of new agricultural technologies to reduce downside risks by minimizing crop damage after a shock. Early international agricultural research focused on boosting productivity by using yield-enhancing technologies. However, farmers' objectives may not be consistent with the yield-enhancing objectives of the innovative technology developed from the agricultural R&D process (Macours, 2019).

Emerick et al. (2016) provide encouraging evidence supporting the transition towards emphasizing

risk considerations. They test an interesting hypothesis: reducing downside risks in one dimension invites new risky investments in other dimensions, enhancing overall farm productivity even in average years. Their field experiment investigates this by distributing a new rice variety with flood-tolerance to farmers in India for free. Their results confirm the positive crowding-in effects on other farm investments, such as the scale of cropping and fertilizer, and report higher overall yields even in normal years among new rice seed variety recipients. Thus, crops resilient to poor weather conditions have the potential to function as insurance products.

Sorghum is the Zambian counterpart to the flood-tolerant rice variety in India.[13] Sorghum is a low-risk, low-yield crop in Zambia. In particular, because of its mild water requirements, sorghum is less rainfall-sensitive than other major cereal crops such as maize, the staple crop in the country. Okamura et al. (2024) statistically confirm this drought tolerance feature of sorghum crops by linking rainfall estimates to historical crop yield data. Nevertheless, there is little evidence for growing drought-tolerant crops, such as sorghum and millet, in high climate-risk regions across the country (Okamura et al., 2024). This null relationship is a puzzle to be explored by our ongoing research project.

Field Survey on Farmers' Demand for Sorghum in Zambia

The ongoing research project with Chieko Umetsu and other collaborators examines the potential of sorghum as insurance against drought risks in Zambia.[14] This study is conducted in Sinazongwe district, Southern Province. This region is prone to droughts and experiences the highest rainfall variability in the country. There is a single rainy season and irrigation is unavailable, except at a few sites near Lake Kariba. Thus, climate risks threaten food and nutrition security in rain-fed farming systems in the area.

Sorghum is suitable for local agro-climatic environments and is not new to local farmers; more than 50% of the sample households have grown it at least once in the last ten years at the baseline survey. Nevertheless, only 13% of farmers kept sorghum seeds at baseline, with most of them being traditional white sorghum. As such, the primary hurdle in disseminating sorghum is limited access to new seeds (Umetsu & Miura, 2023). Local agro-input dealer shops rarely sell seeds, whereas farmers maintain early maturing local varieties in the community. Besides this fundamental supply constraint, bird-inflicted crop losses are expected to be substantial. The considerable labor burden of scaring birds is a discouraging factor in growing sorghum. The motivating question for the project is whether relaxing

[13] In the Zambian context, another example of variance-reducing technologies can be short-duration varieties because quicker crop cycles can minimize the probability of erratic rainfall patterns affecting production (Macours, 2019). Shortening the "lean season" is another benefit for consumption. Planting early maturing varieties would also work as a risk-coping mechanism in the aftermath of climate shocks because farmers can replant it after the first planting if the latter is unsuccessful owing to dry spells in the early production stage.

[14] Our research protocol was approved by the Institutional Review Board (IRB) of the Graduate School of Agriculture, Kyoto University, in August 2022 (R4-3).

these impediments encourages farmers to take up sorghum.

To answer this question, the sample households were randomly assigned to two groups: 406 households who were freely given the red sorghum variety (ZSV36R), and 440 households who were freely given the white sorghum variety (ZSV17).[15] Seed quantities are the same at 2.5 kg in both groups. While both improved varieties are suitable for food, bird-inflicted crop losses would be minimal for red sorghum relative to white sorghum because it contains bitter tannins in the seed coat. Other production features (e.g., maturity and potential grain yield) are comparable according to Zambia Seed Company Limited (Zamseed), which supplies these sorghum varieties in the country. Thus, ZSV36R is a new technology that improves bird damage resistance for most local farmers in our research context.[16]

We collected baseline information from 846 households and distributed improved sorghum seeds in September 2022. We did not set up a pure control group (i.e., households receiving nothing) to prioritize the ethical concerns of within-village inequalities caused by the experimental design and control for income effects. Thus, the treatment effect will capture the effect of bird-resistant sorghum relative to standard sorghum. Randomization was conducted at the household level. While the common concern for household-level randomization is uncontrolled interactions (e.g., swapping varieties among villagers) within the village, such spillovers were not observed during fieldwork and were not self-reported in the follow-up data. A follow-up survey was conducted from June to July 2023 to collect information on agricultural practices during the 2022/23 rainy season. We were able to follow-up with 795 households.

One of our research aims is to investigate who prefers which sorghum variety for production. Local farmers are interested in diverse traits, ranging from production- (e.g., tolerance to production shocks and maturing duration) to processing/consumption-side attributes (e.g., taste and poundability) (Lunduka et al., 2012). Consumption attributes can be particularly influential for net food buyers and autarchic farmers. Furthermore, locals may find cultural value in sorghum.

Using Best-Worst Scaling (BWS) techniques, we elicited farmers' preferences towards attributes of sorghum. The unique feature of our approach is that we asked them about seven sorghum traits each that would be important from the standpoint of producers and consumers. The respondents were asked to choose the most (best) and least important (worst) attributes from the four given attributes. This question was repeated for seven different choice sets.

[15] The original sampling frame comes from 996 households interviewed with the Zambia Statistical Agency (ZamStats) in April 2022. While we planned equal cell sizes for each treatment arm, the resultant allocation ended with disproportionate proportions due to attrition.

[16] As far as we know, there is only one traditional red sorghum variety (Kasili red).

Based on the BWS scores, defined by the difference between the number of times the attribute was chosen as "best" and the number of times it was chosen as "worst," the resulting ranking of production attributes at baseline is: 1. high drought resistance; 2. suitability for food; 3. high bird resistance; 4. high-quality seed; 5. early maturing; 6. high yield; and 7. high revenue.[17] Overall, the farmers' preferences mirror the role of sorghum as a low-risk/low-return food crop. Additionally, the ranking highlights resistance to bird attacks as an essential element in the sorghum variety choice. This overall ranking changed for some attributes in the follow-up survey after introducing improved sorghum, while drought resistance continued to be the most valuable characteristic for local farmers.

Then, what happened to the actual take-up of sorghum? In contrast to prior expectations, the planting rates for sorghum seeds were extremely high at 97% for red seeds and 93% for white seeds among the 795 follow-up survey respondents. These high adoption rates indicate a strong demand for improved sorghum seeds among local farmers. However, our initial analysis plan (i.e., statistically examining the determinants of take-up) would have to be altered because of these (unexpected) high adoption rates. One possible direction is to investigate the impact of growing experiences on preferences for traits and perceptions towards sorghum production. Factors that determine future adoption (e.g., preferences for bird resistance) can be compared between red and white sorghum farmers. In addition, such an almost perfect compliance situation makes analyzing the reoptimized input allocation after introducing new technologies valid for the entire population, instead of a subsample of compliers. Preliminary results suggest that, as expected, the labor time for scaring birds was much shorter among red seed recipients than among white seed recipients. Finally, as Takahashi et al. (2020) point out, the benefits of such stress-tolerant crops and varieties could be difficult to see if normal years continue. Thus, among other research questions, examining dynamic adoption behavior is fascinating. After conducting the endline survey in July 2024, we will explore outstanding questions and evaluate the variance-reducing potential of sorghum.

Overall, accounting for targeted farmers' heterogeneous preferences, introducing locally relevant agricultural innovations is critical for building local and sustained resilience under volatile and uncertain production conditions (Lybbert & Summer, 2012). In addition, a comprehensive understanding of new technologies for climate change should be facilitated by providing empirical evidence on the consequences of their adoption in real-world settings and comparing them to their potential observed in controlled agronomical trials. My ongoing research will contribute to this essential scientific process by providing evidence from the field.

[17] A similar ranking for consumption-related traits at baseline is as follows: 1. high nutrition; 2. high preservability; 3. long-lasting feeling of satiety; 4. good taste; 5. suitability for brewery; 6. less bitterness; and 7. short milling time. This ranking was changed for some attributes at the follow-up survey after growing sorghums while keeping high nutrition as the most preferred attribute.

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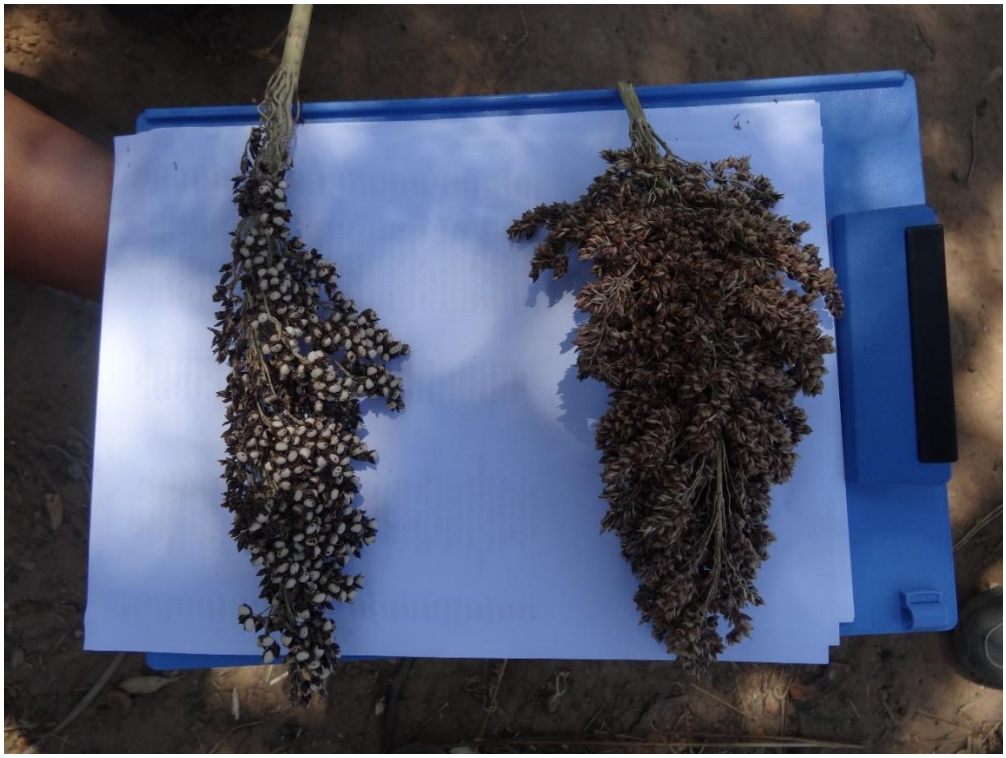
A survey village



The white (left) and red (right) sorghum varieties kept by a local farmer.

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