Chapter 6
How Can We Achieve Green Revolution in Sub-Saharan Africa? The Case of Tanzania

Yuko Nakano and Eustadius Francis Magezi

Abstract How can we achieve a rice Green Revolution in Sub-Saharan Africa? In this chapter, we evaluate the progress of the rice Green Revolution and discuss potential policy interventions to achieve it in Tanzania. For these purposes, we summarize four studies that have been conducted by the authors. Especially, we focus on the effectiveness of irrigation, agricultural training, and microcredit for technology adoption and productivity enhancement of rice cultivation. We found a high potential for the rice Green Revolution in Tanzania and that it can be achievable with proper policy interventions. We propose irrigation development and agricultural training as effective means to achieve the rice Green Revolution in Tanzania.

6.1 Introduction

Agricultural development is indispensable for poverty reduction and food security in Sub-Saharan Africa (SSA), where more than half of the population engages in agriculture. Among other crops, the importance of rice has been increasing. Although rice production in SSA doubled from 2008 to 2018, consumption has also been rapidly increasing, resulting in increased imports from Asia. Given that the arable land per population decreases over time due to the population increase, a rice Green Revolution is eagerly anticipated in SSA.

Professor Keijiro Otsuka has led the research project 'An Empirical Analysis on Expanding Rice Production in Sub-Saharan Africa,' funded by the Japan International Cooperation Agency Ogata Sadako Research Institute for Peace and Development (JICA-RI) since 2009. The project's goal is to understand the current status of rice cultivation and identify the strategies to achieve a rice Green Revolution in SSA. The project covers several countries, including Tanzania, Mozambique, Uganda,

Y. Nakano (✉)
University of Tsukuba, Tsukuba, Japan
e-mail: ynakanoyuko@gmail.com; nakano.yuko.fn@u.tsukuba.ac.jp

E. F. Magezi
Tohoku University, Sendai, Japan

J. P. Estudillo et al. (eds.), *Agricultural Development in Asia and Africa*,
Emerging-Economy State and International Policy Studies,
https://doi.org/10.1007/978-981-19-5542-6_6

Ghana, Senegal, Côte d'Ivoire, and Kenya. One of the authors of this chapter (Yuko Nakano) used to be a PhD student of Professor Otsuka and has been working on agricultural development in SSA with him for more than 15 years. The other author (Eustadius Francis Magezi) has recently joined the JICA-RI project, and both authors are responsible for the surveys and analyses in Tanzania.

In this chapter, we evaluate the progress of the rice Green Revolution in Tanzania and discuss potential policy interventions to achieve it. For these purposes, we summarize four studies that have been conducted by the authors. Especially, we focus on the effectiveness of irrigation, agricultural training, and microcredit for technology adoption and productivity enhancement of rice cultivation. Green Revolution is often considered the seed and fertilizer revolution (Gollin et al. 2021). However, as Otsuka and Larson (2016) point out, the importance of basic agronomic practices, such as improved bund construction, plot leveling, and transplanting in rows, which enhance proper water and weed management, should be emphasized.[1] Thus, we focus on the adoption of modern varieties (MVs) and chemical fertilizers and the adoption of improved agronomic practices.

The first study used an extensive dataset collected in three major rice-growing regions in Tanzania (referred to as extensive survey hereafter). We provide an overview of the progress of the Green Revolution from 2009 to 2018 and argued the importance of irrigation for the intensification of rice cultivation. The second and third studies are case studies on the effectiveness of agricultural training (Nakano et al. 2018a, b). We found that agricultural training effectively increased technology adoption and paddy yield in irrigated and rainfed areas. In the last study, we conducted a randomized controlled trial (RCT) to examine the impact of microcredit on rice cultivation technology adoption and productivity (Nakano and Magezi 2020). We found weak or no evidence that improved access to credit enhanced technology adoption or productivity. Based on these studies, we provide policy implications for achieving Green Revolution in SSA.

The structure of this chapter is as follows. Section 6.2 describes the results of the extensive survey. Section 6.3 summarizes the two case studies on the effectiveness of agricultural training, while Sect. 6.4 shows the results of the RCT on the impact of microcredit. Finally, Sect. 6.5 provides the policy implications and concludes the chapter.

6.2 Extensive Survey

The first purpose of this chapter is to evaluate the progress of the Green Revolution in Tanzania. We used a dataset collected in the extensive survey conducted in 2009 and 2018, whose purpose was to grasp the country-wide situation of rice cultivation.

[1] Improved bund construction entails piling soil solidly around the plots, while plot leveling involves flattening the ground for better storage and equal distribution of water on paddy fields. Transplanting seedlings in rows allows rice growers to control plant density precisely and remove weeds easily.

The survey was carried out in 76 villages of six districts in three major rice-growing regions: Kilombero and Mvomero districts in the Morogoro Region, Kahama and Shinyanga rural districts in the Shinyanga Region, and Mbarali and Kyela districts in the Mbeya Region. Ten rice-growing households were randomly selected within each village, resulting in a total number of 760 observations in the 2009 baseline survey. In the 2018 follow-up survey, the same households were revisited, and we interviewed a replacement household if the original household at the baseline was missing. We requested farmers to identify the most important plot for rice production and asked in detail about rice cultivation practices in those plots. After the data cleaning, we obtained an unbalanced, two-year panel data with a total number of 1,448 households.

Table 6.1 presents the changes in technology adoption and productivity of rice cultivation from 2009 to 2018. The results of the *t*-tests mean comparison between 2009 and 2018 are shown by asterisks. An important finding in this table is that the adoption of technologies and paddy yield significantly increased over time in both rainfed and irrigated areas. The adoption of MVs (called SARO 5) increased from 8.9 to 14.4% in rainfed areas and from 31.8 to 57.7% in irrigated areas.[2] Chemical fertilizer use per hectare increased from 8.8 to 24.2 kg in rainfed areas and from 35.4 to 89.6 kg in irrigated areas. Among other improved agronomic practices, the adoption rate of transplanting increased from 29.5 to 42.2% in rainfed areas, while transplanting in rows increased from 29.2 to 43.1% in irrigated areas. Accordingly, paddy yield significantly increased from 1.9 tons per hectare (tons/ha) to 2.3 tons/ha in rainfed areas and from 3.7 to 4.2 tons/ha in irrigated areas.

These results suggest that the Green Revolution in Tanzania is in progress. It is also important to note that the paddy yield of 4.2 tons/ha in irrigated areas is comparable to Asian countries. This shows the high potential of irrigated rice farming in Tanzania, indications that the Green Revolution is already taking place in irrigated areas in Tanzania. The problem, however, is that the ratio of the irrigated plots is still low (18% in 2018). These results suggest the importance of irrigation in adopting improved technologies and yield enhancement.

6.3 Effectiveness of Agricultural Training

The second purpose of this chapter is to find out which interventions can effectively achieve a Green Revolution. This section introduces two case studies that examine the effectiveness of agricultural training, as the knowledge gap is often cited as one of the major constraints to technology diffusion. First, Nakano et al. (2018b) examine the effectiveness of farmer-to-farmer training in the Project for Supporting Rice Industry

[2] SARO 5 (TXD306) has semi-aromatic characteristics and is the most popular MV in Tanzania. It was developed in the government agricultural research institute in Dakawa (ARI Dakawa) and was released in 2002. It is a crossbred variety between Supa/Pyongyang 8 from North Korea and Supa/Subarimati originally from the International Rice Research Institute (IRRI).

Development in Tanzania (TANRICE), conducted by JICA in the Ilonga irrigation scheme in the Kilosa District, Morogoro Region in 2009.

TANRICE offered intensive training on rice cultivation to 20 farmers (i.e., key farmers) at the nearby training institute (Ministry of Agriculture Training Institute—Ilonga) for 12 days. After that, each key farmer was expected to invite five other farmers (i.e., intermediate farmers) to training sessions held at a demonstration plot within the irrigation scheme. Following these sessions, both key and intermediate farmers were expected to disseminate technologies to the remaining farmers (i.e., ordinary farmers).

Table 6.2 reports paddy yield changes and technology adoption for key, intermediate, and ordinary farmers before and after the training. We performed *t*-tests and *chi*-square tests, comparing between key and ordinary farmers and between intermediate and ordinary farmers. The first main finding is key farmers' rapid technology adoption and productivity growth. In fact, the paddy yield of key farmers increased rapidly from 3.1 to 4.4 tons/ha soon after the training and continued to be high, reaching 5.3 tons/ha in 2011. The rapid increase of their paddy yield is attributed to the high adoption rate of improved technologies. Immediately after the training, the adoption rate of MVs for key farmers increased from 46.2 to 69.2%, and chemical fertilizer use from 63.4 kg per hectare (kg/ha) to 115.8 kg/ha. Key farmers also started to adopt improved agronomic practices. The adoption rate of plot leveling increased from 46.2 to 76.9%, while that of transplanting in rows increased from 23.1 to 76.9% in 2009. This suggests that key farmers' performance improved significantly right after the training and remained high afterward.

On the contrary, the increase in yields for intermediate farmers was not rapid. After receiving training in 2009, however, their adoption rates of modern technologies, such as MVs, improved bund construction, transplanting in rows, and the use

Table 6.1 Technology adoption and productivity of rice cultivation in rainfed and irrigated areas in Tanzania (2009 and 2018)

	Rainfed		Irrigated	
	2009	2018	2009	2018
Adoption rate of MVs (%)	8.9	14.4[b]	31.8	57.7[c]
Chemical fertilizer use (kg/ha)	8.8	24.2[c]	35.4	89.6[c]
Share of bunded plot (%)	50.1	59.9[c]	89.0	94.2[a]
Share of leveled plot (%)	55.5	46.6[c]	76.6	67.9[b]
Adoption rate of transplanting (%)	29.5	42.2[c]	92.9	85.4[b]
Adoption rate of transplanting in rows (%)	5.6	6.5	29.2	43.1[c]
Paddy yield (tons/ha)	1.9	2.3[c]	3.7	4.2[b]
Observations	539	618	154	137

Note c, b, a indicate statistical significance at 1%, 5%, and 10%, respectively, in *t*-test comparisons between 2009 and 2018 for each rainfed and irrigated plot of chemical fertilizers also began to increase. As a result, intermediate farmers eventually achieved higher paddy yields than ordinary farmers. Although the effects of training in terms of magnitude and immediacy were much greater for key farmers than for intermediate farmers, as years went by, intermediate farmers were also able to catch up with key farmers.

The paddy yield of ordinary farmers increased slowly from 2.6 tons/ha in 2008 to 3.7 tons/ha in 2012. The increased technology adoption should have contributed to this yield increase. From 2008 to 2012, the adoption rate of MVs for ordinary farmers gradually increased from 26.7 to 32.9%, chemical fertilizer use from 46.5 to 83.2 kg/ha, and the adoption rate of transplanting in rows from 11.1 to 36.9%. Compared to key and intermediate farmers, the change for ordinary farmers was delayed. This lag suggests a knowledge spillover from key and intermediate farmers to ordinary farmers. In fact, the yield gap between key and ordinary farmers widened up to 2.3 tons/ha in 2010. The gap, however, had decreased to 1 ton/ha in 2012. These results suggest that the performance of key farmers improved rapidly, while that of intermediate and ordinary farmers improved gradually, but they eventually caught up with key farmers.

Another notable finding is that key farmers achieved yields as high as 5.3 tons/ha. Again, this shows the high potential of irrigated rice farming in Tanzania and that the rice Green Revolution is achievable as long as proper policy intervention is provided.

Nakano et al. (2018b) further estimated a fixed effect difference-in-differences (DID) model, a propensity score, DID model, and the hypotheses that ordinary farmers caught up with key farmers were supported. By incorporating social relationship variables into special econometric models, the paper found that social relationships played a significant role in technology diffusion. Overall, our results suggest the effectiveness of farmer-to-farmer training for the intensification of rice cultivation, especially in irrigated areas.

Another study on the effectiveness of agricultural training was conducted in Kilombero District, Morogoro Region of Tanzania (Nakano et al. 2018a). Kilombero Plantation Limited (KPL), a large-scale rice milling company, provided agricultural training on a modified version of low-input rice cultivation technologies, known as the system of rice intensification (SRI),[3] to surrounding small-scale farmers. The major recommended practices include (1) use of an MV (i.e., SARO 5); (2) chemical fertilizer use; (3) seed selection method using salty water; (4) straight-raw dibbling or transplanting; and (5) wide spacing of 25 × 25 cm (cm) or more. These recommended practices differ from the original SRI, which prescribes no MVs or chemical fertilizers. Therefore, we call this set of recommended technologies the modified SRI (MSRI).

[3] SRI is a set of low-input irrigated rice cultivation technologies developed during the 1980s in Madagascar. SRI is said to produce higher paddy yields by prescribing (1) raising seedlings in a carefully managed, garden-like nursery; (2) early transplanting of 8–15-day-old seedlings; (3) adopting single, widely spaced transplanting; (4) early and regular weeding; (5) carefully controlled water management; and (6) using compost as much as possible, without adopting new varieties or other purchased chemical inputs.

Table 6.2 Technology adoption and paddy yield by TANRICE training status (Nakano et al. 2018b)

	2008 Pre-training	2009	2010 During training	2011 Post-training	2012
Key farmer					
Paddy yield (tons/ha)	3.07[a]	4.40[c]	4.81[c]	5.34[c]	4.67[b]
Adoption rate of MVs (%)	46.15	69.23[c]	75.00[c]	54.44[c]	66.67[c]
Chemical fertilizer use (kg/ha)	63.42	115.82[c]	137.73[c]	178.26[c]	131.28[c]
Adoption rate, improved bund (%)	15.38[b]	23.08[b]	31.25[c]	40.00[b]	15.38
Adoption rate, plot leveling (%)	46.15	76.92	81.25	86.67	76.92
Adoption rate, transplanting in rows (%)	23.08	76.92[c]	93.75[c]	93.33[c]	92.31[c]
Observations	13	13	16	15	13
Intermediate farmers					
Paddy yield (tons/ha)	2.47	2.57	2.84	4.63[c]	3.93
Adoption rate of MVs (%)	30.43	44.44[a]	54.84[b]	34.38	49.48[b]
Chemical fertilizer use (kg/ha)	22.20[b]	49	79.05	103.85[b]	95.23
Adoption rate, improved bund (%)	13.04[b]	18.52[b]	22.58[b]	33.33[b]	33.33[c]
Adoption rate, plot leveling (%)	43.48 [50.69]	70.37 [46.53]	74.19 [44.48]	79.17 [41.49]	62.5 [49.45]
Adoption rate, transplanting in rows (%)	13.04 [23]	44.44[c] [27]	64.52[c] [31]	45.83[b] [24]	58.33[b] [31]
Observations					
Ordinary farmers					
Paddy yield (tons/ha)	2.57	2.67	2.53	3.58	3.67

(continued)

Table 6.2 (continued)

	2008 Pre-training	2009	2010 During training	2011 Post-training	2012
Adoption rate of MVs (%)	26.67	26.76	32.26	23.62	32.85
Chemical fertilizer use (kg/ha)	46.52	58.31	69.72	85.79	83.16
Adoption rate, improved bund (%)	2.96	4.93	7.74	16.15	11.54
Adoption rate, plot leveling (%)	54.81	64.08	69.03	76.15	66.92
Adoption rate, transplanting in rows (%)	11.11	19.01	25.81	26.92	36.92
Observations	135	142	155	130	130

Note c, b, a indicate statistical significance at 1%, 5%, and 10%, respectively, in *t*-test comparisons between ordinary and key and ordinary and intermediate farmers in each year

The survey was carried out from February to March 2014 and covered the cultivation season from October 2012 to May 2013. We selected three training villages and two nearby villages where no training was held (non-training villages). In each village, we interviewed, on average, 37 training participants and 35 non-participants, generating a total sample size of 283 households. We asked farmers to list all of their farming plots during the interviews. Among those listed, we selected two paddy plots (one MSRI plot and one non-MSRI plot) for plot-level analysis. A plot was regarded as an MSRI plot when farmers reported using the plot for MSRI rice cultivation.

Table 6.3 compares the adoption of technology and paddy yield between trainees and non-trainees in the training village and farmers in the non-training village in 2013. An important finding is that trained farmers achieved an average paddy yield of 4.7 tons/ha in their MSRI plots. This is significantly higher than the yield of 2.9 tons/ha in the non-MSRI plots of trainees and 2.6 tons/ha in the non-MSRI plots of non-trainees in training villages. The high yield in MSRI plots can be attributed to the high adoption rates of technologies in these plots. For MSRI plots, the adoption rate of MV was as high as 90.9%, straight-row dibbling 78.2%, wide spacing 56.4%, and seed selection using salty water 71.8%. After more careful statistical examination, Nakano et al. (2018a) concluded that the adoption of MSRI increases the paddy yield by 1.3–1.8 tons/ha.

On the other hand, the adoption rate of technologies and paddy yield in the non-MSRI plots of trainees or non-trainees in training villages is not significantly higher than the farmers in non-training villages. These observations suggest that spillover effects from trainees to non-trainees are limited. Our field observation tells us that

Table 6.3 Technology adoption and paddy yield by MSRI training status, 2013. (Nakano et al. 2018a)

	Training village				Non-training Village	
	Trainees' MSRI Plot	Trainees' Non-MSRI Plot	Non-trainees			
	(a)	(b)	(c)	(d)	a − b	a − d
Paddy yield (tons/ha)	4.7	2.9	2.6	2.9	1.8[d]	1.8[c]
Share of modern variety (%)	90.9	10.1	5.6	2.4	80.7[c]	88.5[c]
Chemical fertilizer use (kg/ha)	52.4	6.1	2.5	2.5	46.3[c]	49.9[c]
Share of straight-row dibbling (%)	78.2	0	0.8	2.4	78.2[c]	75.8[c]
Share of straight-row transplanting (%)	7.3	0	0.8	1.2	7.3[c]	6.1[b]
Share of plots adopting spacing of 25 × 25 cm or more (%)	56.4	0	1.6	2.4	56.36[c]	54.0[c]
Seed selection using salty water (%)	71.8	3.8	0	1.2	68.0[c]	70.6[c]
Number of technologies adopted	3.7	0.3	0.2	0.1	3.5[c]	3.6[c]
Size of cultivated area (ha)	0.4	1.1	1	1.2	− 0.7[c]	− 0.8[c]
Observations	110	79	126	83		

Note c, b, a indicate statistical significance at 1%, 5%, and 10%, respectively, in *t*-test comparisons between each category

trainees are still at the trial stage and are trying MSRI in a small part of their plots. Given that the survey was carried out soon after the training, whether MSRI would be widely adopted by both trainees and non-trainees is still not conclusive. Further investigation is needed on this issue.

6.4 Impact of Microcredit

Another often cited constraint for technology adoption is the lack of access to credit. Nakano and Magezi (2020) conducted an RCT to examine the impact of microcredit on technology adoption and productivity of rice cultivation. Collaboratively with BRAC, a globally-known microfinance institute, we provided microcredit specifically designed for agriculture to randomly selected farmers in two irrigation schemes in Kilombero District, Morogoro Region in Tanzania in 2012. Eligible farmers were invited to a microcredit program that provided USD 50, half provided in cash and the remaining half as fertilizer vouchers redeemable at a local agrochemical store. Eligible and non-eligible farmers for the BRAC program were randomly selected, while some eligible farmers decided to take loans by themselves (referred to as borrowers).

Table 6.4 shows technology adoption and productivity by household status in the microcredit program. The results of *t*-test comparisons between treatment and control groups and between borrowers and control groups are shown by asterisks. We found that credit borrowers increased the application of chemical fertilizer and adoption rates of improved bunds in their rice plots. The average amount of chemical fertilizer application by borrowers is 78 kg/ha, and the adoption rates of improved bunds are about 13%. However, the borrowers do not achieve higher paddy yield or profit than the control group farmers. The paddy yield for the borrowers is 3.2 tons/ha, while that of control group farmers is 3.1 tons/ha.

Nakano and Magezi (2020) further examined the impact of the credit program on the adoption of technology and productivity of rice cultivation by estimating intention to treatment effect and local average treatment effects. We found little to no evidence that microcredit positively impacted chemical fertilizer use, paddy yield, profit, or total household income. By doing subsample analyses, we also found

Table 6.4 Technology adoption and productivity of rice cultivation by the availability of microcredit, 2012 (Nakano and Magezi 2020)

	Control	Treatment	Borrower
Use of chemical fertilizer (kg/ha)	53.2	61.3	78.0[c]
Modern variety (%)	24.7	23.3	32.7
Adoption of improved bund (%)	6.0	7.8	12.50[a]
Adoption of leveling (%)	38.5	39.0	40.0
Adoption of transplanting in row (%)	13.2	13.2	15.0
Yield (tons/ha)	3.1	3.0	3.2
Income (USD/ha)	896.6	833.1	855.2
Profit (USD/ha)	401.6	403.8	516.5
Observations	182	205	80

Note c, b, a indicate statistical significance at 1%, 5%, and 10%, respectively, in *t*-test comparisons between control group and each category that those with good access to irrigation water did not increase chemical fertilizer application by using credit because their application rate is high even without credit. On the other hand, farmers with poor access to irrigation water increased chemical fertilizer application using credit. However, their paddy yield, income, or profit did not improve. Although it is not conclusive, low fertilizer return may be why credit users with poor access to irrigation water could not achieve high yield even when they increased chemical fertilizer use.

6.5 Conclusion

In this chapter, we summarize four studies conducted by the authors to provide an overview of the rice Green Revolution's progress and determine effective policy interventions to achieve it. The first important finding is that 57.7% of farmers adopt MVs and achieved yields as high as 4.2 tons/ha in irrigated areas in major rice-growing regions in the country. Also, TANRICE key farmers achieved yields of nearly five tons/ha. These results clearly show the importance of irrigation investment. It is also implied that the Green Revolution has already occurred in some limited areas and can be achievable with proper policy interventions.

While our results from the extensive survey suggest the importance of irrigation for technology adoption and yield increase in rice cultivation, it also showed that only 18% of sample plots were irrigated. Observing large differences in technology adoption and paddy yield in rainfed and irrigated areas, irrigation development should be one of the top policy means to achieve a rice Green Revolution. However, the past failure of government-led large-scale irrigation schemes, mainly due to management problems, has caused some pessimism for irrigation investment in SSA. Recently, more attention has been paid to small-scale irrigation development, which is considered more manageable for farmers. However, there is no guarantee that small-scale irrigations are, in fact, effectively managed by the farmers. Whether we should invest in small-scale or large-scale irrigation projects in terms of cost-effectiveness and efficacy of the management is an important issue to be investigated in the future.

While the importance of irrigation development is clear, it may take some time and cost to develop it country-wide. Since more than 80% of rice plots are currently in rainfed areas in Tanzania, we have to find effective means to enhance productivity in these areas. Our results show that agricultural training effectively increases technology adoption and paddy yield both in irrigated and rainfed areas. In fact, MSRI trainees achieved as high a yield as 4.7 tons/ha under favorable rainfed conditions. This suggests that farmers can achieve a high yield even in rainfed areas as long as proper technologies are adopted. These results are consistent with other studies conducted in other African countries under the JICA-RI project. Based on this, our second policy recommendation is to provide agricultural training to fill the knowledge gap.

One concern is whether the farmer-to-farmer extension is effective even in rainfed areas. Our results show that MSRI was not adopted by non-trained farmers in the training villages. Knowledge spillover may not easily occur in rainfed areas with more heterogeneous agroecological conditions, and paddy fields are more geographically widespread than in irrigated areas. This point, however, is still not yet answered since our survey was conducted soon after the training, and spillover effects may take some time to occur. Since the costs to provide training to all the farmers in SSA are enormous and unrealistic, we need to seek a cost-effective extension method especially suitable for rainfed areas. This point also should be a future research question. The enhancement of local government extension agencies' capacity and research institutes that can modify the technologies suitable for local contexts will also be an important issue in this regard.

Contrary to expectations, it was found that microcredit did not affect technology uptake and productivity of rice cultivation positively. Nakano and Magezi (2020) found that the increased fertilizer use did not enhance paddy yield or profit for these farmers with limited access to irrigation water. These results may imply that improving credit access is not the first priority in achieving a rice Green Revolution under the current situation in Tanzania.

Although not conclusive, low yield response rates to chemical fertilizer application can be one of the possible reasons for the ineffectiveness of credit. If this is the case, improving the returns to chemical fertilizer by enhancing access to irrigation facilities or technical training should be done before improving access to credit. This is in line with the argument of Otsuka and Kijima (2010), who emphasized the importance of agricultural training before the development of the input market. Note, however, that this does not deny the importance of the credit market in the future. If the returns to chemical fertilizer are improved and demand for chemical fertilizer increases, access to the credit market may become important.

We found a high potential for the rice Green Revolution in Tanzania, and it can be achievable with proper policy interventions. Among other policy interventions, we propose irrigation development and agricultural training as the effective means to achieve the rice Green Revolution in Tanzania. Our discussion would also have implications for other SSA countries facing similar problems as Tanzania.

Recollections of Professor Keijiro Otsuka

I am fortunate to work with Professor Otsuka, who shares my interest in poverty reduction and agricultural development in Sub-Saharan Africa. When I was a Ph.D., student, he made an enormous effort to revise my thesis written in my poor English. I totally owe what I am today to Professor Otsuka and would like to show my sincere gratitude and respect to him. I shall try to contribute to academia and the development of strategies for poverty reduction and agricultural development in SSA by doing quality research—*Yuko Nakano.*

For my Ph.D., studies, I started doing research under the JICA-RI project. Professor Otsuka's advice and comments are always of great help, and I sincerely appreciate him. I will continue working hard in my research to contribute to finding solutions to developmental challenges, especially in Africa.—*Eustadius Francis Magezi.*

References

Gollin D, Hansen CW, Wingender AM (2021) Two blades of grass: the impact of the green revolution. J Polit Econ 129(8):2344–2384

Nakano Y, Magezi EF (2020) The impact of microcredit on agricultural technology adoption and productivity: evidence from randomized control trial in Tanzania. World Dev 133:104997

Nakano Y, Tanaka Y, Otsuka K (2018a) Impact of training on the intensification of rice farming: evidence from rainfed areas in Tanzania. Agr Econ 49(2):193–202

Nakano Y, Tsusaka TW, Aida T, Pede VO (2018b) Is farmer-to-farmer extension effective? the impact of training on technology adoption and rice farming productivity in Tanzania. World Dev 105:336–351

Otsuka K, Kijima Y (2010) Technology policies for a green revolution and agricultural transformation in Africa. J Afr Econ 19(Suppl. 2):60–76

Otsuka K, Larson DF (2016) In pursuit of an African Green Revolution: views from rice and maize farmers. Springer, Heidelberg