

Trial Focus



Photo 1. Bountiful tomato harvest, Tanzania. Photo by the authors.

Balanced Fertilization: A Boon for Tanzania's Vegetable Farmers

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Background

Fertilizer use is below recommended rates in most of sub-Saharan Africa, contributing to poor crop yields and poverty. Farmers in Tanzania have low levels of fertilizer use, hence low productivity. Tanzanian farmers apply only 10 kilograms of fertilizer per hectare, in contrast with Brazilian and Indian farmers, who apply 175 and 165 kilograms per hectare, respectively. In addition to the low fertilizer use, Tanzanian farmers mostly apply only N and P nutrients, while other essential nutrients like K, S, Ca, Mg and micronutrients are neglected. In this light, adoption of a balanced fertilizer approach can increase yields, profits, and improve living standards among farmers in Tanzania.

The Project

The first year of the USAID-funded project, Mboga Na Matunda (“fruits and vegetables”), which started in February of 2018, successfully came to an end in March 2019. The purpose of the work was to strengthen the fertilizer input supply system and increase the yields of smallholder horticulture farmers in the farming regions of Iringa and Mbeya in Tanzania. The

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objectives were to increase agro-dealers' knowledge of fertilizer products and smallholder farmers' access to affordable and quality fertilizer products; facilitate training on balanced fertilization and available fertilizer products; and enable the adoption of appropriate fertilization practices by farmers (especially women and youth). The target of the project was to reach 3,000 farmers by setting up 30 demonstration plots and to connect the farmers to a distribution network through local agro-dealers.

Demonstration plots

In order to achieve the project aims, lead farmers were identified in the target regions to establish demonstration plots of at least $\frac{3}{4}$ acre in size. Farmers with greenhouses were sought in particular to demonstrate how to incorporate fertilizer within their irrigation systems. A total of 30 demonstration plots (15 in Mbeya, 15 in Iringa) were established (see Fig. 1), producing tomatoes (17 plots), potatoes (5 plots) or onions (8 plots). Soil analyses were conducted at each demonstration site to guide the fertilizer regimens (products and quantities) used at the demonstration plots.

Plots were divided into two sections, each 0.15 hectares in size. On one side, the farmers applied their normal fertilization regime (farmers' practice, FP), while on the other, ICL¹ fertilizers were applied

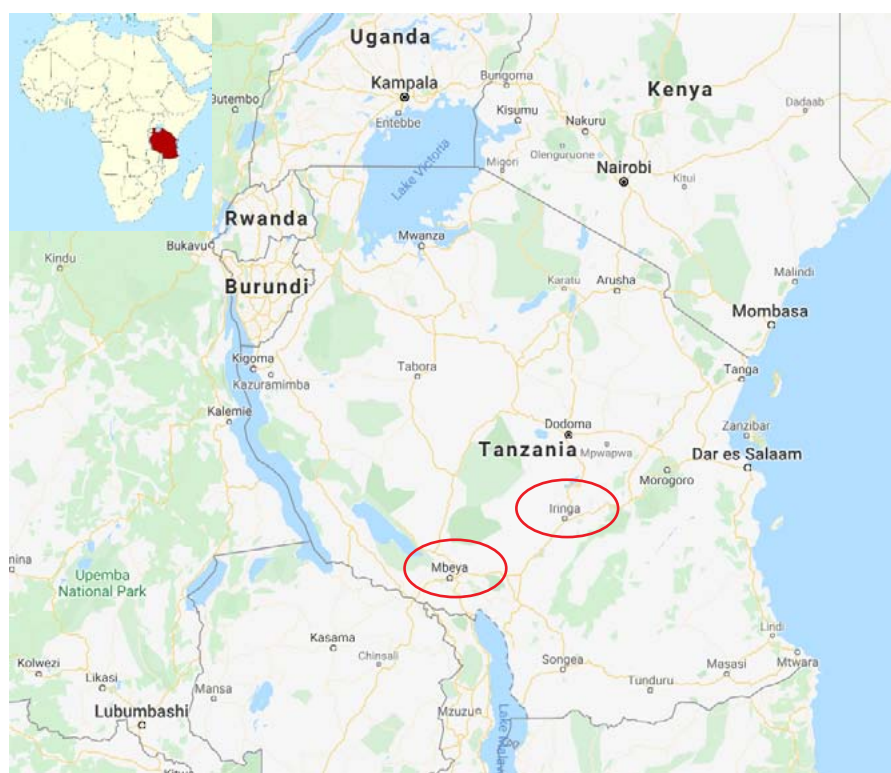


Fig. 1. Location of the 30 demonstration plots: 15 in Mbeya and 15 in Iringa regions in Tanzania. Source: Google maps.

based on an improved fertilization regime (improved fertilizer practice, IFP) as shown in Table 1. The fertilizer used in the IFP is a blend of controlled nitrogen which allows for farmers to apply all the basal fertilizer at planting with no topdressing needed. In comparison, the farmers practice includes one top-dressing fertilizer application for onions

and potatoes and three top-dressings for tomatoes. For onions and potato, FP treatment included only N and P nutrients while IFP treatment included five nutrients (N, P, K, S and Mg). For tomato crop, FP treatment included N, P, Ca and B while IFP treatment included seven nutrients (N, P, K, S, Mg, Ca, B and Zn) (Table 2).

Table 1. Fertilizers applied to the demonstration plots (kg ha^{-1}) in the two treatments: Farmers' practice (FP) and improved fertilizer practice (IFP).

Treatment Application	DAP	CAN	Urea	Calcium nitrate + boron	Agromaster ¹	Polysulphate ²
	Basal at planting	1 st top dressing	2 nd top dressing	3 rd top dressing	Basal at planting	Basal at planting
<i>kg ha⁻¹</i>						
Onions and potatoes						
FP	125	125	0	0	0	0
IFP	0	0	0	0	275	0
Tomatoes						
FP	125	125	60	60	0	0
IFP	0	0	0	0	275	60

¹Agromaster is a compound fertilizer which combines controlled release nitrogen with other nutrients. In these plots, Agromaster 16:10:22 was used.

²Polysulphate: Natural multi-nutrient fertilizer containing 48% SO_3 , 14% K_2O , 6% MgO and 17% CaO .

¹ICL Fertilizers is one of the world's largest fertilizer companies. ICL provides farmers, growers and manufacturers with a range of plant nutrition solutions: potash, Polysulphate, phosphoric fertilizers, phosphoric acid, specialty fertilizers, phosphate rock and tailor-made compound fertilizers.

Table 2. Nutrients applied to the demonstration plots (kg ha^{-1}) in the two treatments: Farmers' practice (FP) and improved fertilizer practice (IFP).

Treatment	Nutrient application							
	N	P ₂ O ₅	K ₂ O	MgO	SO ₃	CaO	B	Zn
----- kg ha^{-1} -----								
Onions and potatoes								
FP	53.9	56.3	0	0	0	0	0	0
IFP	39.2	24.5	53.9	7.35	31.8	0	0	0
Tomatoes								
FP	61.2	56.3	0	0	0	15.3	0.18	0
IFP	39.2	24.5	53.9	7.35	31.8	10.4	0.49	0.49

All other practices, such as weeding, crop protection and irrigation were standard across the two sections. All required inputs were provided by ICL for the full (0.30 hectares) plot and to ensure robustness of the experiment, the company monitored the activities on each plot closely from the onset (land preparation) to the conclusion (harvesting).

Results

From the results of the demonstration plots, the following observations were made:

- a) The yields of the IFP treated plots for all three crops (onions, potatoes and tomatoes) were higher across all plots than those of the FP treatment (Figs. 2, 3 and 4). Increases in onion yield varied at the different farms from 29% up to 73%, for potato from 40% up to 88% and for tomato from 30% up to 82%.
- b) Average yields of IFP treated plots were significantly higher than FP treatment for all three crops. The average increase in yields was 46% for tomatoes, 47% for onions and 57% for potatoes (Fig. 5).

- c) The cost of inputs in the IFP treatment was higher than in the FP treatment, however, the return on investment (ROI) was higher at IFP as shown in Table 3. A calculation on the value:cost ratio (VCR) based on every extra US\$1 spent on fertilizer showed that the farmer was getting US\$6 more for onions and potatoes and US\$11 more for tomatoes.

Training

Seven training sessions were provided at the inception of the project in order to sensitize farmers and create awareness about fertilizer products. Additionally, at least three training were held at each demonstration plot, which aimed to teach farmers basic crop nutrition methods and showcase the difference between an improved fertilization regime and more traditional practices by demonstrating the difference in crop growth and production level. The training were conducted during crop establishment and crop growth, and field days were held in each plot at the crop harvesting stage. A total of 3,375 farmers were trained.

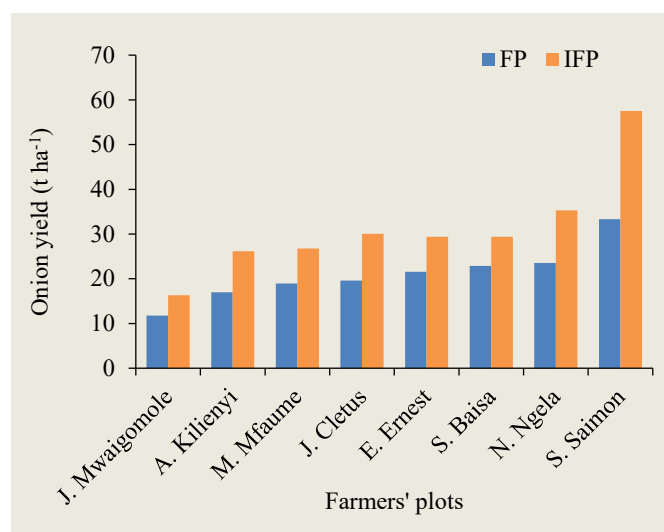


Fig. 2. Effect of the two treatments (farmers' practice (FP) and improved fertilizer practice (IFP)) on onion yield (t ha^{-1}) at eight demonstration plots.

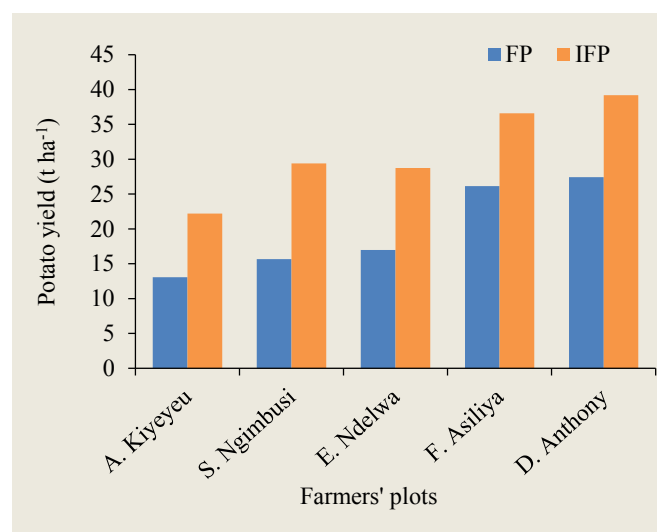


Fig. 3. Effect of the two treatments (farmers' practice (FP) and improved fertilizer practice (IFP)) on potato yield (t ha^{-1}) at five demonstration plots.

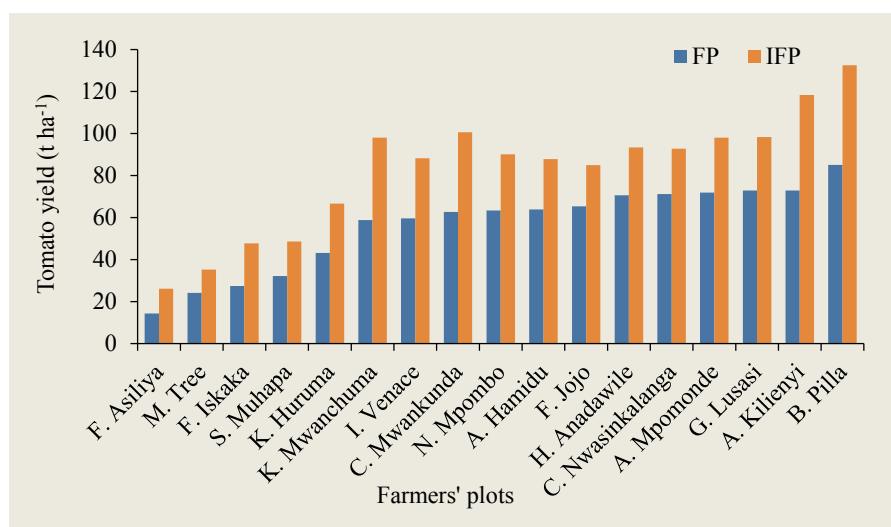


Fig. 4. Effect of the two treatments (farmers’ practice (FP) and improved fertilizer practice (IFP)) on tomato yield (t ha⁻¹) at 17 demonstration plots.

products for farmers. These training were conducted at the individual level for all identified agro-dealers and staff at their outlets and culminated in two joint training – one in Iringa and another one in Mbeya. These agro-dealers were linked with Tanzania Crop Care Ltd, a large fertilizer distributor, and a system was established by which these agro-dealers would receive products to promote in their respective areas.

Conclusions

The targets of the USAID-funded project were successfully met and farmers greatly benefited from the introduction and penetration of a balanced fertilization approach in Iringa and Mbeya, with significant increases in yields and profits.

Distribution channels

Under the project, 45 agro-dealers were identified and trained on the use

of fertilizer products and fertilization techniques to increase their ability to recommend specific techniques and

Given the success of the project, USAID has decided to extend the funding for one more year – from July 2019 to August 2020.

Table 3. Economic calculations for three crops under each of the two treatments: Farmers’ practice (FP) and improved fertilizer practice (IFP).

Crop	Fertilizer cost		Income		ROI		% ROI	VCR
	FP	IFP	FP	IFP	FP	IFP		
	-----USD ha ⁻¹ -----							
Onions	182	331	1,878	2,784	1,696	2,454	45	6
Potatoes	199	337	1,485	2,354	1,286	2,017	56	6
Tomatoes	206	387	4,506	6,582	4,301	6,194	44	11



Photo 2. Farmer examining his crop; Tanzania. Photo by the authors.



Photo 3. Farmers’ training; Tanzania. Photo by the authors.

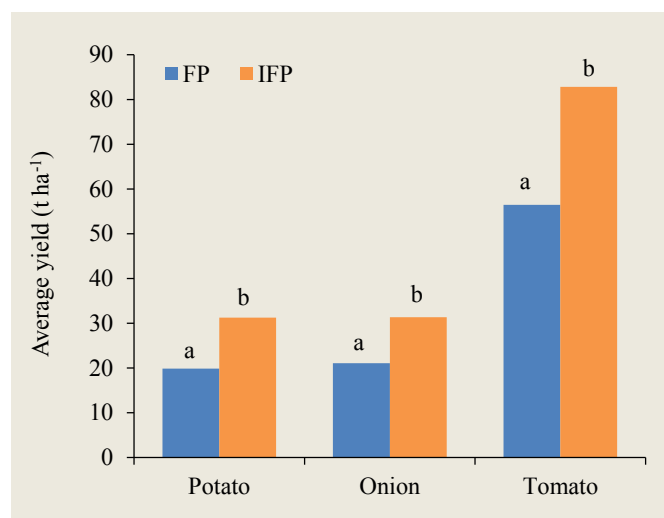


Fig. 5. Average yields of the three crops under the two treatments: Farmers' practice (FP) and improved fertilizer practice (IFP). Different letters above bars indicate significant differences among treatments ($p < 0.05$).

Acknowledgement

The activities of this project were made possible through an award granted to ICL Fertilizers under Fintrac's contract with the US Agency for International Development (USAID) in Tanzania (#AID-621-C-17-00001), Feed the Future Tanzania – Mboga na Matunda.



Photo 4. Happy farmers after harvest; Tanzania. Photo by the authors.

The report "Balanced Fertilization: A Boon for Tanzania's Vegetable Farmers" also appears on the [IPI website](#).