TANZANIA SUSTAINABLE SOYBEAN INITIATIVE

REPORT

DEMONSTRATING AGRONOMIC PRACTICES TO FARMERS TO INCREASE SOYBEAN YIELD

2024

SAGCOT
SOUTHERN AGRICULTURAL GROWTH CORRIDOR OF TANZANIA

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1. Introduction

Smallholder soybean farmers in Tanzania achieve low yield in the range of 0.5 – 0.6 t/ha (TSSI, 2023; TSSI 2024); which is below the potential of 2.5-3 t/ha (N2Africa, 2019). The low soybean yields Tanzania have been attributed to many reasons; key among them being the poor soils aggravated by low input, poorly developed agricultural advisory services and farmers in ability to access favorable input and outputs markets (TSSI, 2024; Mutegi et al., 2017).

The yields of soybeans in most parts of Tanzania can increase from 0.5 to 2.5 t/ ha if the recommended steps are followed during their production. These include use of improved seeds, application of little fertilizer like 20 kg P/ ha, rhizobia inoculants and adherence to recommended plant population.

The main aims of demonstration exercise of the Tanzania Sustainable Soybean Initiative (TSSI) were to: To demonstrate the response of soybean to the application of small quantities of P fertilizer, rhizobia inoculant, lime and their combinations ii) to assess the profitability of these inputs and iii) to understand the potential use of above inputs by smallholder farmers in the southern highlands of Tanzania.

2. Materials and Methods

Sites

A total number of 134 demonstration sites were established in the soybean production clusters of 7 major soybean producing regions namely, Songwe, Rukwa, Ruvuma, Mbeya, Njombe, Iringa and Morogoro (TSSI 2024) (Table 1). The

Table 1: Number of demo plots and model farms established by region

Region	*Demo plot target*	*Demo plot established*
Rukwa	18	18
Songwe	34	22
Mbeya	8	8
Ruvuma	42	42
Njombe	14	14
Iringa	18	18
Morogoro	8	8
Total	**142**	**134**

distribution of these demo sites in as shown in Figure 1

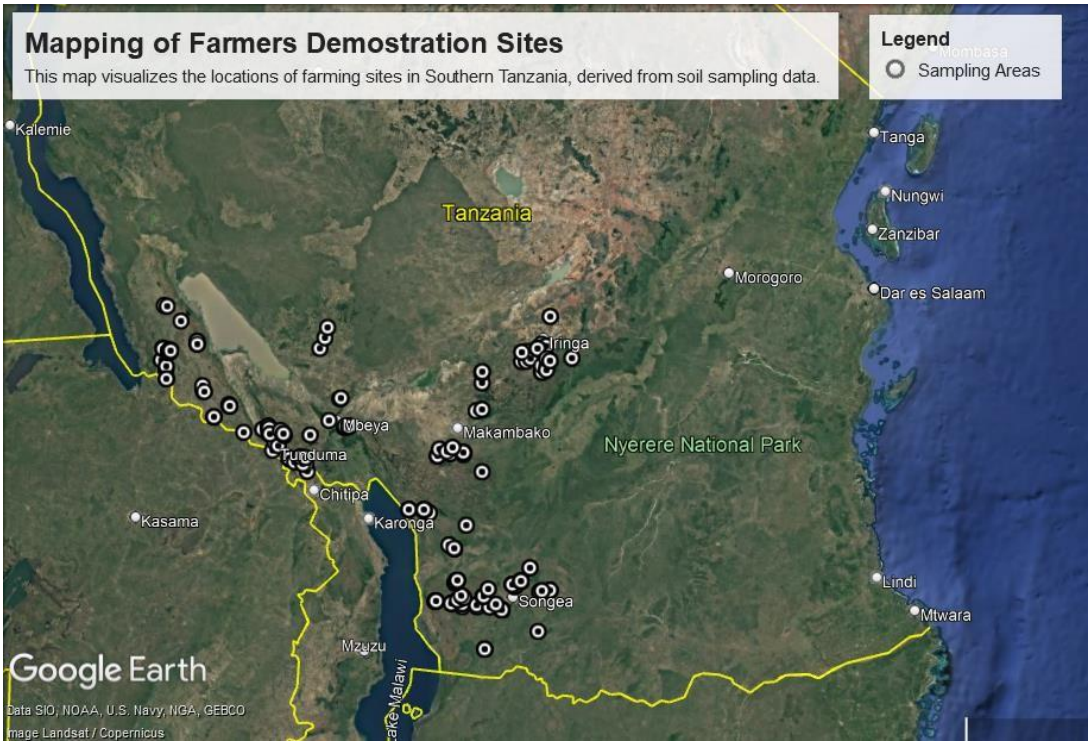

Figure 1: Distribution of demonstration sites in major soybean growing regions

2.1 Treatment tested

A total number of four (4) treatments were demonstrated and repeated at each site/location. They include i) a control of farmer practice (with no inputs applied), ii) Phosphorous (P), iii) inoculant (I) and iv) a combination of inoculant, t and phosphorous (P+I). On sites where soils pH was low (< 5.2) the above treatments were applied with and without lime (at a rate of 2 t/ha) (see treatments 5-8 in Table 1. Such soils were observed on 3 sites in Njombe and 2 sites in Iringa.

The demonstration plots were installed as one replicate per site with a size 10m long and 10m wide (100 m2 per plot). Soybean was plantes at a spacing of 50 cm between rows by 10 cm within row, and two seeds were planted per hole and each plot accommodated 20 lines. Each plot was clearly labeled with the plot number and treatment applied. This was done for both farmers, extension agents and researchers to easily identify which treatment was applied to which plot.

Table1. Treatment structure of the demonstration plots

Treatment	*Lime (L)*	*Inoculant (I)*	*Phosphorous (P)*
T1	X	X	X
T2	X	X	V
T3	X	V	X
T4	X	V	V
T5	V	X	X
TC	V	X	V
T7	V	V	X
T8	V	V	V

Symbol X= without; V = with

P was applied at a rate of 20 kg P/ha; Inoculants at a rate of 250 g /60 kg seed; lime at a rate of 2.5t/ha. P was applied in the form of DAP fertilizer in the planting hole dug 5cm deep then covered with soil before placing the seed on top to avoid direct contact of fertilizers and seed. The input applied per plot of 100m^{2is} indicated in Table 2 and Table 3 respectively.

Table 2: Input required per *100 m^2 plot and per one demonstration plot*

TYPE OF INPUT	AMOUNT PER PLOT	AMOUNT PER DEMO PLOT (KG)
DAP	1.0 (kg)	4.00
INOCULANT	5.0 (g)	0.04
SEEDS	0.6 (kg)	4.80
LIME	25.0 (kg)	100

Planting was done between January and March 2024, depending on the onset of soybean growing season of the regions.

2.2 Engagement of extension agents

The demonstration plots were co-designed, established and manages in partnership with ward and village extension officers in the respective wards/villages. This was to ensure sustainability on the use of promoted technologies by farmers. A total of 121 (70 male and 51 female) extension agents were engaged in promotion and dissemination of soybean improved technologies. The engaged extension agents were trained on soybean technologies and on demo plot establishment, management, data collection and reporting (Figure 2).

Figure 2: Practical session field layout to extension agents in Songwe region

2.3 Farmer participation

Through demonstration plots, a total number of 8,078 (4028 Male and 4050 Female) were reached with knowledge on soybean production (Table 3). 5,023 (2420 Male and 2,603 Female) farmers directly participated in the establishment, management and data collection on demo plots, and 3,055 (1608 Male and 1447 Female) farmers were reached through field day(s) that were organized by TSSI in collaboration with extension around each of the established demonstration plots. Names of participating and their mobile phone numbers were captured and uploaded on the TSSI dashboard.

Table 3: Number of farmers reached by e vent by region and district

Region	*District*	*Demonstration*		*Field day*		*Farmer reach per district*		*Total reach*
		Male	female	Male	Female	Male	Female	
Rukwa	Kalambo	137	40	174	106	**311**	**146**	**457**
	Sumbawanga	34	25	41	34	**75**	**5G**	**134**
	Nkasi	0	0	0	0	**0**	**0**	**0**
	Total reach Rukwa	171	65	215	140	**386**	**205**	**5G1**
Songwe	Ileje	143	288	29	14	**172**	**302**	**474**
	Mbozi	154	170	156	93	**310**	**263**	**573**
	Momba	65	41	84	56	**14G**	**G7**	**246**
	Total reach Songwe	362	499	269	163	**631**	**662**	**12G3**
Mbeya	Chunya	40	31	38	14	**78**	**45**	**123**
	Mbeya	44	39	86	51	**130**	**G0**	**220**
	Total reach Mbeya	84	70	124	65	**208**	**135**	**343**
Ruvuma	Namtumbo	226	230	179	189	**405**	**41G**	824
	Mbinga	192	302	91	92	**283**	**3G4**	677
	Songea	139	113	67	101	**206**	**214**	420
	Total Ruvuma	557	645	337	382	**8G4**	**1027**	1921
Njombe	Njombe	89	115	176	119	**265**	**234**	499
	Wanging'ombe	32	54	44	43	**76**	**G7**	173
	Ludewa	96	50	63	37	**15G**	**87**	246
	Total reach Njombe	217	219	283	199	**500**	**418**	918
Iringa	Iringa rural	261	547	122	266	**383**	**813**	1196
	Kilolo	131	120	110	86	**241**	**206**	447
	Mufindi	48	85	52	44	**100**	**12G**	229
	Total Iringa	440	752	284	396	**724**	**1148**	1872
Morogoro	Kilosa	211	146	59	60	**270**	**206**	476
	Mvomero	378	207	37	42	**415**	**24G**	664
	Total Morogoro	589	353	96	102	**685**	**455**	1140
	Overall reach	**2420**	**2603**	**1608**	**1447**	**4028**	**4050**	**8078**

3. Yield results

3.1 Effect of applied input on soybean yield

Yields from the demo plots varied between farms within and across regions (Table 4). The average yield of 1,121; 1,651; 1,732; and 1,956 kg/ha, with no input, with inoculant, with P-fertilizer and with a combination of P fertilizer and inoculant, respectively. The data indicates that a farmer can increase soybean yield from the current level of 600 kg/ha to above 000 kg/ha by just using improved soybean seed and to over 1500 kg kg/ha by just applying inoculant, P- fertilizers and or their combination.

Table 4: Average soybean grain yield (kg/ha) with and without application of inoculants, Phosphorus and their combination as observed in different by regions

Region	Number of observations	No amendment	With inoculant	With Phosphorous	With inoculant +phosphorous
Iringa	17	1,257	1,490	2,007	2,319
Mbeya	7	1,166	1,762	1,924	2,009
Morogoro	8	1,321	2,249	2,216	2,364
Njombe	12	696	991	1,033	1,075
Rukwa	16	909	1,484	1,023	1,210
Ruvuma	38	1,126	1,504	1,617	1,732
Songwe	12	1,392	2111	2,338	2,907
Average yield		**1,121**	**1,732**	**1,G56**	**1,651**
Std Dev		478	772	834	936

Overall, average yields were higher in Songwe, Morogoro and Iringa, low in Rukwa and lower in Njombe. Lowe yield in Rukwa and Njombe are attributed to higher amount of rainfall that was received in the months of January and February 2024, sooner after planting.

Application of small quantity of lime (2 t/ha) in the broadcasting method increased soybean yield by 5-10%, compared to the control. These results indicated using lime is a promising practice to mitigate soil acidity and in the study area and other areas with similar soil types.

Table 5: Average soybean grain yield (kg/ha) with and without application of inoculants, Phosphorus and their combination with and without lime amendment as observed in different by regions

Region	Number of cases	No lime				With lime			
		Control	Inoculant	Phosphorous	inoculant +phosphorous	Control	Inoculant	Phosphorous	inoculant +phosphorous
Iringa	3	1,257	1,490	2,007	2,319	1,317	1,389	1,911	2,178
Njombe	3	696	991	1,033	1,075	706	1010	1,125	1,161

3.2 Profitability applied input

Based on the yield assessment we attempted to estimate the profitability of applied input on soybeans without consideration of lime (Table 6). The results show that soybean production activity may be economically profitable, and this profitability is determined by several factors among which are good agricultural practices including improved seed, fertilizer, rhizobia inoculants and lime if required.

Table 5: Profitability of using inoculants, fertilizer and inoculant. Estimates are for I ha of land

		Soybean yield (kg/ha) with and without inoculant and fertilizer input			
	Input type	**No input added**	**With In oculant**	**With P fertilizer**	**With Inoculant and P**
Average yield (kg/ha)		1109.64	1655.90	1737.01	1945.15
Yield increment (kg/ha) with input		0	546	627	836
A: Variable cost (TShs /ha	Inoculant	0	20,000	0	20,000
	Fertilizer P	0	0200	,000	200,000
	Total VC	0	20,000	200,000	220,000
B: Fixed cost/acre	Ploughing	140,000	140,000	140,000	140,000
	Planting	100,000	100,000	100,000	100,000
	Weeding	140,000	140,000	140,000	140,000
	Harvesting	80,000	80,000	80,000	80,000
	Threshing+ Dryin g (TShs 10,000 /100 kg	110,964	165,590	173,701	194,515
	Total FC	570,964	625,590	633,701	654,515
Total cost (A+B)		570,964	645,590	833,701	874,515
	Total Revenue TSHs 1000/kg soy bean	1,109,637	1,655,897	1,737,010	1,945,149
	Profit	538,673	1,010,307	903,309	1,070,634
	Profit increment with use of input	0	471,634	364,636	531,961

4. Lesson Learnt

i. Using improved and quality seed could increase soybean by 50% and above. More yield could be achieved by using inoculant, P and their combination.

ii. Application of lime is a promising practice to mitigate soil acidity probably by increasing available nutrients, exchangeable bases hence crop yields. More experimentation is need to establish optimum and profitable rates of lime for soybeans and other crops.

iii. In areas where farmers have been growing maize using P fertilizers, soybean can do better with simply applying inoculant.

iv. In areas with possibilities of growing two crops in a season, farmers prefer early maturing varieties. This was the case in Mbozi and Mbeya, where soybean is relayed with other crops like sunflower and maize.

v. In absence of extensions officers, lead farmers especially youth ages, may would be a solution to obtaining better results and fast data capture from on-farm experiments.

vi. Providing farmers with feedback of data collected in their farm enhances cooperation, trust and [participation in the project.