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What Partnership in Agricultural Technology Pre-scaling up Has Brought about for Agricultural Development: Evidence from North Western Ethiopia

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Abstract
Aimed at assessing realized progresses on production and productivity of selected crops in Metekel zone attributed to partnership for pre-scaling up interventions, the study witnessed increments in area, production and yield of selected crops in Metekel zone between the base year and Triennium Ending 2014. Total cropped area increased by 265% while production volume increased by 465% indicating significant yield gain. From the selected crops yield of maize increased from 19 qt/ha to 33 qt/ha while yield of sorghum increased from 15 qt/ha to 24 qt/ha and that of finger millet from 12 qt/ha to 19 qt/ha. Rice has also gained yield to 29 qt/ha from 10 qt/ha and that of soybean to 22 qt/ha from 14qt/ ha while haricot bean realized yield gain from 6 qt/ha to 9 qt/ha and ground nut achieved exceptional yield gain of 18 qt/ha from 7 qt/ha. The observed yield gains are solely accredited to use of improve agricultural technologies which is manifested in use of improved quality seed and agronomic practices on which the pre-scaling up activities focused through training of farmers and delivery of quality improved seeds of the targeted crops since inorganic fertilizer consumption in Metekel zone was insignificant or nil for most of crops under study. This yield gain then narrowed the yield gap between the zonal average and the expected attainable yield on farmers' field using improved crop technologies. The partnership created between wider arrays of partners under Metekel zone Agriculture Development Partners Linkage Advisory Council and the crucial role played by Pawe Agricultural Research Center as a trainer, source of quality improved seeds and main participant in farmers field follow up as well as quality assurance resulted in the massive yield gain on the selected crops in Metekel zone. The efforts exerted to promote and scale up improved agricultural technologies were fruitful and contextual similar approaches are advisable to change the life of the rural household in the area.
Keywords: Crop technologies, Pre-scaling up, Partnership, Metekel zone

Introduction

Ethiopian Institute of Agricultural Research (EIAR) has spearheaded a shift in its approach to agricultural research for development (AR4D) towards broader partnerships in an innovation systems with a facilitated learning process since technology adoption has been slow, crop yields are very low and the agriculture sector has not seen sustained breakthroughs despite availability of substantial information and knowledge that the research system has developed over the last five decades (Abate *et. al.*, 2011). Accordingly, different initiatives undergone so as to accelerate uptake of on-shelf agricultural technologies and as part of EIAR, Pawe Agricultural Research Center (PARC) has taken this initiative to the highest level through contextualization in favour of marginal and less developed but high potential part of the country, Metekel zone.

Situated in North Western Ethiopia Benishangul Gumuz (BG) region, PARC started agricultural technology pre-scaling up activities mainly on cereals (maize, rice and finger millet), pulses (soybean and haricot bean), oil crops (groundnut and sesame) and animal health (Trypanosomiasis control) in all the seven districts of Metekel zone from 2008 with effective engagement of partners including governmental and nongovernmental organisations operating in the locality.

Sesame technology was the entry and major area of pre-scaling up intervention with 11,418 participants (Atnaf *et. al.*, 2011) followed by soybean with more than 2,300 participants from Pawe and Dangur districts while haricot bean pre-scaling up has been carried out in Mandura, Debate and Bullen and benefited more than 1,600 participates. Similarly, finger millet, the major staple food crop, up-scaled and benefited more than 720 participants in Pawe, Dangur, Mandura, Debate and Bullen districts and maize technologies up scaling reached more than 1,700 participants (PARC, 2014).

PARC's engagement beyond its boundary of technology development and multiplication of initial technologies as a key partner in crop technologies pre-scaling was acknowledged by EIAR, Ministry of

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Agriculture and BG regional Bureau of Agriculture. This study, therefore, aimed at measuring the improvements realized on production and productivity of targeted crops in Metekel zone attributed to partnership for pre-scaling up interventions.

Material and method

Description of target area

Metekel zone is the largest zone of BG region with 7 districts covering 50,380 km^2 with altitudes ranging from 600 to 2671 m.a.s.l. and annual rainfall ranging between 900 and 1450 mm.

The zone capital, Gilgel Beles, is 556 kms away from Addis Ababa. According to CSA (2013) the population projection of of Metekel zone is estimated to be 403,216 which is 41.31% of the population of BG region with highest population of Dibate district followed by Wenbera and Dangur.

Figure 1: Benishangul Gumuz Region, zones and districts

Data and analysis

The study used both primary and secondary data from the year 2007 to 2014 collected from various sources. Data on area, production and yield of selected crops were collected from Metekel zone Agriculture Department and data on inputs distributed and participants in pre scaling up from PARC reports as well as Central Statistics Agency (CSA) reports. In order to measure the changes associated with pre-scaling up, the average of the years 2005 to 2007 expressed as TE2007 representing the pre-intervention or base line year and compared this with the latest results of the three years average 2012 to 2014, expressed as TE2014. Analytical tools like tabular and graphic analysis as well as percentage used to analyse the data set.

Intervention approach

Improved crop technologies of cereals which are food security crops (maize, sorghum, finger millet, rice and wheat) as well as pulses and oilseeds with high market demand (soybean, haricot bean, sesame and ground nut) with attributes of resistance to disease and insect pests, plus improved management packages (including proper land preparation, optimum plant density and timely weeding) were scaled up. Trainings were offered to agriculture experts, development agents and selected farmers. Improved seeds were disseminated mainly from PARC, Community based seed multiplication scheme (CBSMS) and farmer to farmer seed exchange. Periodic evaluation and inspection of farmers' fields were executed by researchers and agricultural experts. Field days and exchange visits were organized at crop maturity stages, and key stakeholders were actively participated. Both local and national media gave extensive coverage and reported several events of the field days.

Partnerships for wider impact

Agriculture Development Partners Linkage Advisory Council (ADPLAC) was the key player in guiding research and development agendas. On its forum various stakeholders created partnership to upscale crop technologies and ADPLAC under its secretary, PARC, has been the front runner in planning, implementation, and monitoring and evaluation of this effort. Members of the advisory council have engaged in discussion and allocated resources once the common plan approved with clearly set roles and responsibilities of each and every stakeholder at different level and stretched effective communication channel.

The partnership for crop technologies scaling up encompasses all key stakeholders including farmers, extension workers, PARC, Non Governmental Organisations (NGOs) and local government administration. PARC provided tailor made training for participant farmers and development agents (DAs), deliver foundation and basic seeds, engaged in monitoring and evaluation (M&E) while farmers provided their indigenous knowledge, land and labour, and also played the role of seed producers under CBSMS; commercial farms were also involved in seed production; NGOs involved in training of farmers and DAs in collaboration with PARC and dissemination of inputs mainly seed; government extension engaged selection of participant farmers, dissemination of inputs, day to day follow up and record keeping as well as M&E while the local administration involved in wider facilitation.

Results and Discussion

Trends in area, production, and yield of selected crops in Metekel zone

Cereals dominated area and production of food grains followed by oilseeds and pulses in Metekel zone. Maize was observed to be the dominant crop in terms of production (25.5%) where as sorghum dominates area (21.1%). Sesame, the major oil crop, has covered about 17% of area but only about 4% of production due to low productivity. Soybean has emerged to be an important pulse which has become popular and expanding recently. Between the period TE2007 and TE2014 Total Cropped Area (TCA) increased more than doubled (265%) while production volume increased by more than fourfold (465%) indicating significant yield gain which is exclusively associated with use of improved agricultural technologies and farm inputs (Table - 1).

Table 1: Trends in area, production and yield of selected crops in Metekel zone

Crop	TE 2007			TE 2014		
	Area (ha)	Production (Qt)	Yield (Qt/ha)	Area (ha)	Production (Qt)	Yield (Qt/ha)
Cereals	73033 (63.7)	920707 (69.1)	12.61	193653 (63.7)	4284476 (69.1)	22.12
Maize	14736 (12.8)	278036 (20.9)	18.87	51433 (16.9)	1580495 (25.5)	30.73
Finger millet	22602 (19.7)	276285 (20.7)	12.22	48228 (15.9)	871585 (14.1)	18.07
Sorghum	14087 (12.3)	209534 (15.7)	14.87	64153 (21.1)	1474505 (23.8)	22.98
Rice	98 (0.09)	942 (0.1)	9.66	1360 (0.4)	38741 (0.6)	28.48
Pulses	9827 (8.6)	63416 (4.7)	6.45	13693 (4.5)	179732 (2.9)	13.13
Soybean	348 (0.3)	4740 (0.3)	13.62	5128 (1.7)	95336 (1.5)	18.59
Haricot bean	7059 (6.2)	43520 (3.3)	6.17	4578 (1.5)	44096 (0.7)	9.63
Oilseeds	26655 (23.2)	138675 (10.4)	5.2	85691 (28.2)	706379 (11.4)	8.24
Sesame	10027 (8.7)	52052 (3.9)	5.19	53727 (17.7)	238849 (3.8)	4.45
Ground nut	1942 (1.7)	14108 (1.1)	7.26	25898 (8.5)	406141 (6.5)	15.68
TCA and total produce	**114599**	**1332134**	**-**	**303965**	**6195592**	**-**

Authors' compilation based on data from Metekel zone Agriculture Department
Figures in parenthesis indicate share from total cropped area and total production

From the base year TE2007 to 2014 yield of maize has increased consistently from about 19 qt/ha to more than 33 qt/ha. Sorghum and finger millet have gained growth in yield from 15 qt/ha to 24 qt/ha for sorghum and from about 12 qt/ha to about 19 qt/ha for finger millet while rice gained yield and reached about 29 qt/ha from about 10 qt/ha between the same periods (Figure - 2).

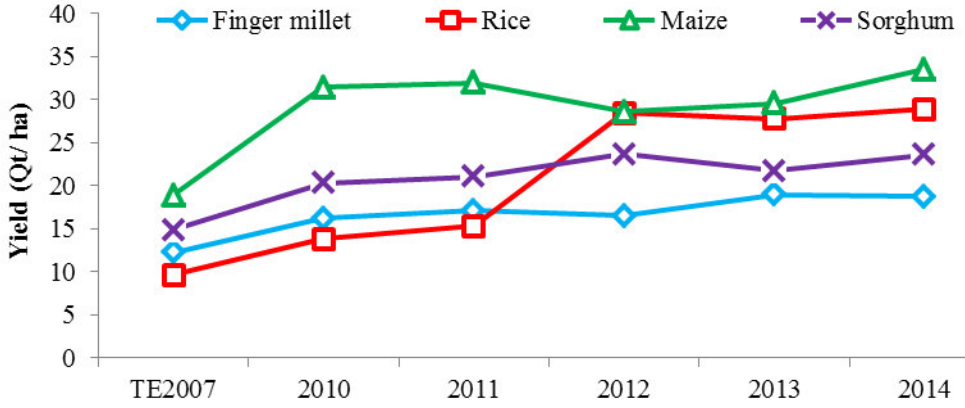

Figure 2: Trends in yield of major cereals in Metekel zone

Soybean and haricot bean are the two dominant pulses in Metekel zone. Between the base year TE 2007 and 2014, soybean has shown substantial increase in yield to reach to about 22 qt/ha from 14qt/ ha while yield of haricot bean has increased from 6 qt/ha to 9 qt/ha (Figure - 3).

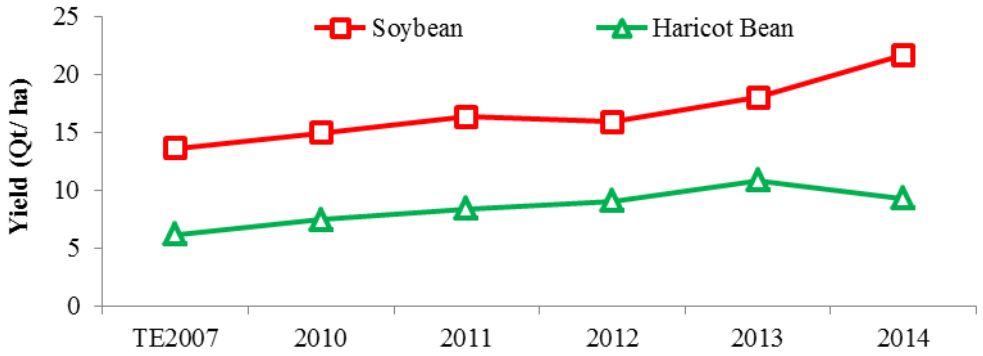

Figure 3: Trends in yield of major pulses in Metekel zone

Of the most dominant oil crops, ground nut has shown yield increment over the years and reached to about 18 qt/ha in TE2014 from about 7 qt/ha in the base year, however yield of sesame has shown both increasing and declining trend (Figure - 4).

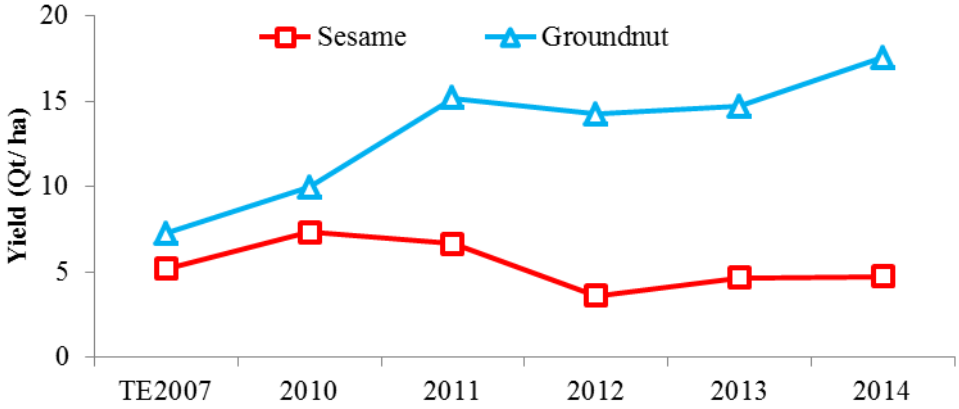

Figure 4: Trends in yield of major oilseeds in Metekel zone

Input use trend in Metekel zone

To have an over view on contribution of agricultural inputs on productivity enhancement, an attempt was made to see inputs, inorganic fertilizer and quality seed, use in Metekel zone between the periods under consideration. According to CSA (2007 and 2014), inorganic fertilizer consumption of Metekel zone has increased from about 7280 quintal in 2007/8 to 9925 quintal in 2013/14 witnessing only 36% increase and the increase in fertilizer consumption was mainly for maize. The fertilizer consumption for cereal crops other than maize observed to be negligible and for major pulses and oilseeds it was observed to be nil. So that, increase in fertilizer consumption has contributed towards gain in yield of maize but not for the rest of the crops indicating the gain in yield of these crops purely due to use of improved seed and agronomic practices which have been the main areas of the ADPLAC intervention (Table-2).

Table 2: Inorganic Fertilizer (UREA and DAP) consumed in 2007/8 and 2013/14 in Metekel zone

Crop type	2007/8			2013/14			Percentage change
	Holder	Hectare	Quintal	Holder	Hectare	Quintal	
All	4,720	3,553	7,280	9878	6314	9925	36
Maize	4,627	3,099	6,792	8498	5313	8517	25
Sorghum	-	-	-	*	*	*	-
Finger millet	-	-	-	*	*	*	-
Rice	-	-		*	*	*	-
Haricot beans	-	-	-	-	-	-	-
Soya beans	-	-	-	-	-	-	-
Groundnuts	-	-	-	-	-	-	-
Sesame	-	-	-	-	-	-	-

Authors' compilation based on data from CSA (2008 and 2014)

Dissemination of improved seeds in Metekel zone

PARC, key partner in the ADPLAC of Metekel zone, has produced and distributed quite substantial quantity of improved seeds over the years. Both basic and certified seeds of finger millet, rice, haricot bean, soybean,

sesame and ground nut for CBSMS, demonstrations and scaling up activities. For most of the years between 2007 and 2014 hundreds quintals of improved seed distributed (Table-3).

Table 3: Crops seeds distributed in Metekel zone from PARC for pre-scaling up activities

Crop type	Quantity of seed distributed (Quintal)					
	2007	2008	2009	2010	2013	2014
Maize	233.22	63.61	251.42	92.91	-	13
Rice	49.14	7.19	48.1	20.02	1.2	11.52
Sorghum	1.5	50.5	24	34.8	-	-
Finger millet	0.79	50.34	36.34	13.61	4.3	5.28
Soybean	359.5	301.81	119.52	33.12	14.27	89.35
Haricot bean	12.75	0	1.85	4.4	3	33.5
Sesame	33.94	28	54.43	130	1.81	4.05
Ground nut	15.5	18.64	21.2	16.69	-	14
Total	706.34	520.09	556.86	345.55	24.58	170.7

Authors' compilation based on data from PARC (2007, 2008, 2009, 2010, 2013 and 2014)

Under CBSMS and Institution Based Seed Multiplication Scheme (IBSMS)[1] different crops seed produced over the years. In 2013 alone about 3279 quintal of different crops seeds produced (Assaye *et. al.,* 2015) and used for technology pre-scaling up in the succeeded cropping season (Figure - 5).

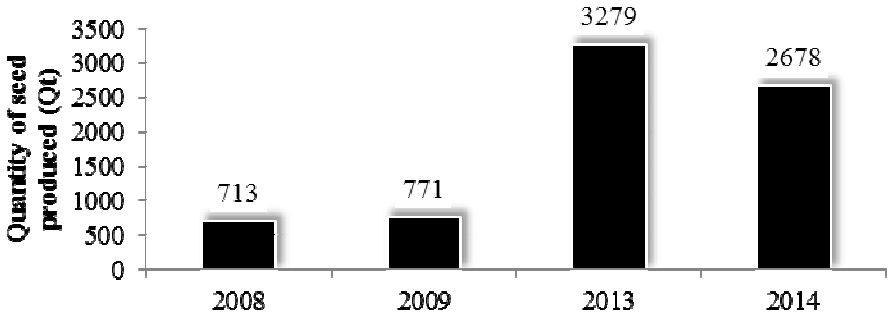

Figure 5: Quantity of seed produced under CBSMS and IBSMS in Metekel zone

Yield gap of selected crops in Metekel zone

During TE2007 a huge yield gap was observed for maize (216% - 321%) and 262% for rice. Yield gap of 133% - 200% calculated for sorghum, 186% for finger millet, 159% for haricot bean and 134% for ground nut. Yield gap has narrowed for all the crops in to consideration except sesame in TE 2014. The decline in yield gap was highest for rice and ground nut (Table-4).

Table 4: Yield Gap of selected crops in Metekel zone in TE 2007 and TE 2014

Crops	Name of variety	Yield Potential (Qt/ha)		Attained yield in TE2007 (B)	Yield Gap		Attained yield in TE2014 (C)	Yield Gap	
		Research field	Onfarm (A)		Quintal (A-B)	% ((A-B)/B)*100		Quintal (A-C)	% ((A-C) /C)*100
Maize	BH540	80-100	60-80	19	41 - 61	216 – 321	31	29 – 49	94 - 158
Sorghum	Emahoy	40-50	35-45	15	20 - 30	133 - 200	22	17 – 23	77 - 105
Finger millet	Baruda	35-40	35	12	23	186	20	15	77
Rice	Pawe-1	40	35	10	25	262	31	4	14
Haricot bean	Awash melka	20	16	6	10	159	10	6	57
Soybean	Belsa-95	31	24	14	10	76	19	5	23
Sesame	Abasena	10	8	5	2	45	4	3	69
Ground nut	Manipiter	22	17	7	10	134	16	1	9

Authors' calculation data from Metekel zone Agriculture Department and PARC

Summary and Conclusions

Between the base year and TE2014, TCA increased by 265% while production volume increased by 465% indicating significant yield gain. From the selected crops yield of maize has increased consistently from 19 qt/ha to 33 qt/ha while yield of sorghum increased from 15 qt/ha to 24 qt/ha and that of finger millet from 12 qt/ha to 19 qt/ha. Similarly, rice has gained yield and reached 29 qt/ha from 10 qt/ha and soybean has shown substantial increase in yield to reach 22 qt/ha from 14qt/ ha while haricot bean realized yield gain from 6 qt/ha to 9 qt/ha. Ground nut has achieved exceptional yield gain of 18 qt/ha from 7 qt/ha.

[1] Seed multiplication of improved varieties through engagement of commercial farms

Since inorganic fertilizer consumption in Metekel zone was insignificant or nil for most of crops under study, the yield gain is solely accredited to use of improve agricultural technologies which manifested in use of improved quality seed and agronomic practices on which the pre-scaling up activities focused through training of farmers and delivery of quality improved seeds of the targeted crops. The yield gain of the selected crops then narrowed the yield gap between the zonal average and the expected attainable yield on farmers' field using improved crop technologies.

To conclude, the partnership created between wider arrays of partners under Metekel zone ADPLAC and the crucial role played by PARC as a trainer, source of quality improved seeds and main participant in farmers field follow up as well as quality assurance resulted in the massive yield gain on the selected crops in Metekel zone. The efforts exerted to promote and scale up improved agricultural technologies were fruitful and contextual similar approaches are advisable to facilitate up take of agricultural technologies and ensure agricultural development and improvement in the livelihood of farmers. Furthermore, similar approaches are advisable to narrow the observed yield gap observed.

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References

Abate, T., Shiferaw B., Gebeyehu S., Amsalu B., Negash K., Assefa K., Eshete M., Aliye S. and Hagmann J., (2011). A systems and partnership approach to agricultural research for development Lessons from Ethiopia, *Outlook on Agriculture,* 40 (3) pp 213–220

Assaye, A., Ayalew, B., Mazengia Y., Melak A., and Teshale, D., (2015). Assessment of Seed Systems in North Western Ethiopia; with Special Emphasis on Community Based Seed Multiplication Scheme, *World Scientific News, 6 (2015)* pp 100 - 110

Atnaf Mulugeta, Kidane Sisay, Melak Adane, Mazengia Yalew and Teshome Dagmawi (2011). Sesame Scaling up, Proceeding of Oil seed conference, Addis Ababa, Ethiopia

CSA (2008). Farm Management Report, Central Statistics Agency, Government of Ethiopia

CSA (2013). Population Projection, Central Statistics Agency, Government of Ethiopia

CSA (2014). Farm Management Report, Central Statistics Agency, Government of Ethiopia

PARC (2007), Pawe Agricultural Research Center Agricultural Economics, Extension and Gender Research Process, *unpublished*

PARC (2008), Pawe Agricultural Research Center Agricultural Economics, Extension and Gender Research Process, *unpublished*

PARC (2009), Pawe Agricultural Research Center Agricultural Economics, Extension and Gender Research Process, *unpublished*

PARC (2010), Pawe Agricultural Research Center Agricultural Economics, Extension and Gender Research Process, *unpublished*

PARC (2013), Pawe Agricultural Research Center Agricultural Economics, Extension and Gender Research Process, *unpublished*

PARC (2014), Pawe Agricultural Research Center Agricultural Economics, Extension and Gender Research Process, *unpublished*