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RESEARCH ARTICLE

Participatory On-farm evaluation and Demonstration of Maize with Haricot Bean Inter-Cropping practices in Debub Ari Woreda, South Omo Zone

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Abstract: Demonstration of improved maize haricot bean intercropping was conducted with aim of creating farmers' awareness and popularizing the technology in Zomba and Pilla kebele. Totally, 20 farmers were participated on demonstration of improved maize and haricot bean intercropping practices. On each farmer's and FTC fields sole maize, sole haricot bean and maize with haricot bean was cropped at recommended spacing on plot size of 10m x 20m area for each of the cropping plot. On-farm training was provided to 64 farmers at both kebeles' FTCs, and field day was organized at crops maturity stage in both kebeles. Totally 129 farmers and key 16 stakeholders were participated in the event. Farmers' preferences and crops yield data were collected. Simple descriptive statistics and cost benefit analysis were used to analyze the data. Farmers' preference evaluation results showed that intercropping of maize with haricot bean was preferred than sole cropping of the crops due to land use efficiency, though the average yields, of sole cropping exceeded the intercropping of both crops. On average 5.99 and 1.86 tons ha^{-1} of sole maize and haricot bean yield were obtained respectively, whereas, an average yield of 4.89 and 1.46 tones ha^{-1} were obtain from intercropping of the crops respectively. The intercropping of maize and common bean enhances effective land utilization with LER of more than 58% in both Kebeles. So, the practice of intercropping was recommended for further scale up in the areas with similar agro-ecology.
Keywords: demonstration, intercropping, land equivalent ratio.

INTRODUCTION

Intercropping is commonly used agricultural cropping practice and is growing more than one crop in same land and season (Tamiru H., 2013). There are many justifications for farmers to adopt intercropping (Mahapatra SC, 2011). One way towards better farming is to look for the most effective associated cropping of leguminous crops with non-leguminous one (Berglund P 2004). In intercropping, growth and yield of legumes will be less than the major crop (SAS, 2002). The overall arrangement and the relative proportion of component crops are important in determining yields and production efficiencies of cereal legume intercrop systems (Willey RW and Osiru DS, 1972, Dahmardeh *et at*., 2009).

Mixed cropping is one among different kinds of intercropping system, and it has being commonly practiced in South Ari district. Farmers in the area have commonly practiced intercropping of maize and sorghum with haricot bean in the area, even though productivity of the crops is not as expected. After broadcasting of maize or sorghum, small amount at highly scattered broadcasting of haricot bean on the field of maize or sorghum is most commonly used practice in the area. To improve land productivity and production of maize with haricot bean intercropping in the area, JARC conducted field experimentation of row intercropping of the crops in South Ari woreda in 2015. According to the field experiment result report higher yields were obtained from one to one ratio of maize with common bean intercropping compared to conventional monoculture and mixed intercropping practices. Therefore, this demonstration was conducted to enhance farmers' awareness and demand on improved practice of row intercropping of maize and haricot bean in the area.

2. METHODOLOGY

2.1 DESCRIPTION OF STUDY AREA

Debub Ari woreda is one of the eight woredas' in South Omo zone with an area of 1,520 km2 and bordering with Semen Ari woreda in North, Mago national Park in South, Salamago woreda in west, Malle woreda in east and BenaTsemay woreda in South East. The traditional agro-ecologies; Dega, woina-dega and kolla are 30, 65 and 5 percent respectively of the total areas. The woreda has a rain fall pattern of bimodal type / Belg = February – April and Meher = July – September.

The major crops grown in the mid land areas of Debub Ari woreda are cereals (maize, sorghum, wheat and teff), pulse and oils (common bean and ground nut) root and tuber (Enset, taro, sweet potato, cassava and yam), fruits (avocado, banana, mango, and papaya), coffee and spices (coffee, cardamom, ginger and turmeric) and vegetables (cabbages, onion, beet root, garlic, hot pepper, tomato, carrot) in respective order of their total production and potential.

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2.2 SITE AND FARMER SELECTION

The demonstration was conducted in Pilla and Zomba kebeles of Debub Ari woreda. Site selection was undertaken by researcher jointly with district office of agriculture and natural resource management based on availability of land and production potential of the area for maize and common bean crops. 10 participant farmers were selected based on willingness of farmers to participate, availability of land and the representativeness of farmers land from each keble. 30% female farmers were considered as host participants. A FREG containing 32 (M- 29 F-3) members was also established in each of the selected Kebele.

2.3 IMPLEMENTATION PROCEDURES

Both theoretical and practical training was given for participant farmers and FREG members in both kebeles. BH-546 variety of maize and Hawasa Dume variety of haricot bean were planted in three plots. Sole cropping of the crops were undertaken at plots size of 10m*20m for each , and also the same plot size land was used for intercropping of maize and haricot bean demonstration. A spacing of 75cm an 25cm between row and plants respectively for sole maize, 40cm and 10 b/n row and plants respectively for sole haricot bean and for intercropping maize was planted in spacing of 80 and 25cm and one row haricot bean in 10cm plant spacing in between maize rows. Seed rate of 25 kgh^{-1} and $80kgh^{-1}$ of maize and haricot bean was used respectively. Fertilizer rate of 100kg h^{-1} NPS and 100kg h^{-1} Urea were used for maize crop.

2.4 METHODS OF DATA COLLECTION AND DATA ANALYSIS

Grain yield and biomass data was collected from all demonstration plots through harvesting the sample yield. Also farmers' preference data was collected using check lists. A simple descriptive statistics such as; minimum, maximum, mean and percentage, and land equivalent ratio equation and cost benefit analysis was used to analysis data by aid of SPSS software.

Land equivalent ratio (LER) was calculated by the formula:-

$$\text{LER} = \frac{Yim}{Ysm} + \frac{\text{Yicb}}{\text{Yscb}}$$

Where; Yim = yield of intercropped maize Ysm = yield of sole maize

Yicb = yield of intercropped common bean Yscb = yield of sole common bean

A LER greater than 1.0 implies that for that particular crop combination, intercropping yielded more than growing the same number of stands of each crop as sole crops. A LER of less than 1.0 implies that intercropping was less beneficial than sole cropping (Onwueme and Sinha, 1991**).**

Cost benefit analysis was also calculated by using CIMMYT partial budget analysis. Thus, net benefit analysis is calculated by subtracting the total cost from the gross benefit i.e.

$$NB = TR - TC$$

Where NB=Net Benefit; TR=Total Revenue and TC=Total Cost (CIMMYT, 2004).

3. RESULT AND DISCUSSION

3.1 TRAINING

Practically, on-farm training was given to farmers, members of FREGs and DAs of kebeles to create awareness and improve associated skill gap on improved agronomic practices of maize and haricot bean production. Totally 64 (M-53 F-11) farmers and Keble DAs were participated on training undertake at FTCs demonstration site of the kebeles. The training was mainly focused on implementation of agronomic practices as well as practice of row intercropping.

3.2 FIELD DAY

At physiological maturity stage of the crop, field day was organized at both Kebeles' demonstration sites by JARC in collaboration with zonal and district level agriculture development offices. Field day participant were actively participated, visited the fields performance of the crops and shared experience among each other's. Besides, farmers, agricultural experts and other key stakeholders were got awareness on new practices of row intercropping technology. About 145 participants (129 farmers from all category including FRGs/FREGs members and follower farmers, 12 DAs and supervisors, 4 agricultural experts from zone and district and 6 researchers) were participated on this filed day event. Discussion was organized at FTCs of the kebeles and all field day participants were actively participated and enhanced awareness on the row intercropping practices. Accordingly, farmers had reported that during harsh condition, there is a chance of getting yield from one crop when we practice intercropping rather than sole cropping.

Figure 1: photos taken during conducting field and discussion in Debub Ari woreda.

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3.3 YIELD PERFORMANCE OF THE DEMONSTRATION ON FARMERS' FIELD AND FTCS

Table 1: Yield performance of the demonstration

Kebele	Statistics	Yield in tons ha^{-1}			
		SM	IM	SHB	IHB
Zomba	Minimum	4.980	3.890	1.600	1.18
	Maximum	7.035	6.150	2.110	1.79
	Mean	6.043	4.973	1.881	1.50
	St. Deviation	0.71	0.78	0.17	0.18
Pilla	Minimum	5.230	4.200	1.625	1.14
	Maximum	7.150	6.000	2.200	1.84
	Mean	5.949	4.797	1.846	1.42
	St. Deviation	0.63	0.53	0.19	0.19

Where**; SM**: sole maize, **IM:** intercropped maize, **SHB**: sole haricot bean, **IHB:** intercropped haricot bean

Yield performance result of the demonstration indicated that, average grain yields obtained from maize and haricot bean in sole cropping were higher than the average yield obtained from maize- haricot bean intercropping in both Pilla and Zomba kebeles under farmers management practices as showed in the table 1 above.

3.4 LAND EQUIVALENT RATIO AND YIELD ADVANTAGES OF INTERCROPPING

A yield advantage of intercropping can be indicated by using different methods, among which land equivalent ratio (LER) is the most commonly used to indicate the biological efficiency and yield per unit area of land as compared to mono-cropping system. A LER greater than 1.0 implies that for that particular crop combination, intercropping yielded more than growing the same number of stands of each crop as sole crops. A LER of less than 1.0 implies that intercropping was less beneficial than sole cropping (Onwueme and Sinha, 1991**).**

Therefore; $\text{LER} = \frac{Yim}{Ysm} + \frac{\text{Yihb}}{\text{Yshb}}$

Where; Yim = yield of intercropped maize Ysm = yield of sole maize

Yicb = yield of intercropped haricot bean Yshb = yield of sole haricot bean

Zomba Kebele

LER $= \frac{Yim}{Ysm} + \frac{\text{Yihb}}{\text{Yshb}} = \frac{49.73}{60.43} + \frac{14.98}{18.81}$

$LER = 0.82 + 0.79$

$LER = 1.61$

This indicates that, the land needed to produce the same amount of product in sole is 1.58 ha. So the intercropping of maize and haricot bean can increase land productivity by 58%.

Therefore in both Kebeles, the productivity is increased by intercropping than sole production. Thus, the productivity was increased by more than 58% in both Kebeles. So this enhances efficient land utilization.

3.5 PARTICIPATORY EVALUATION AND FARMERS' PREFERENCE

Table 2: Farmers' preference of crops field performance

Measurement level		Measurement criteria							
		BMSM	BMIM	BMSHB	BMIHB	MRSM	MRIM	MRSHB	MRIHB
Excellent	f	13	22	25	9	20	23	18	0
	%	38.2	64.7	73.5	26.5	58.8	67.6	52.9	0.0
Good	f	16	12	9	13	11	9	16	18
	%	47.1	35.3	26.5	38.2	32.4	26.5	47.1	52.9
Poor	f	5	0	0	12	3	2	0	16
	%	14.7	0.0	0.0	35.3	8.8	5.9	0.0	47.1

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Where, BMSM: Biomass of sole maize, BMIM: Biomass of intercropped maize, BMSHB: biomass of sole haricot bean, BMIHB: Biomass of intercropped haricot bean, MRSM: Moisture resistance of sloe maize, MRIM: Moisture resistance of intercropped maize, MRSHB: moisture resistance of sole haricot bean and MRIHB: moisture resistance of intercropped haricot bean.

Where, BMSM: Biomass of sole maize, BMIM: Biomass of intercropped maize, BMSHB: biomass of sole haricot bean, BMIHB: Biomass of intercropped haricot bean, MRSM: Moisture resistance of sloe maize, MRIM: Moisture resistance of intercropped maize, MRSHB: moisture resistance of sole haricot bean and MRIHB: moisture resistance of intercropped haricot bean.

Participatory field performance evaluation was conducted to identify the best performed cropping practices among the demonstrated practices. Thus, farmers evaluated the technology based on the pre-selected preference criteria such as; biomass yield, moisture resistance, number of cobs per plant for maize, cob size, number of pods per plant for haricot bean, yield of sole cropping and intercropping. As indicated in the table 2 above, sole cropping has good biomass than intercropping. The biomass of Maize in the table above is 38.2% and 47.1% excellent and good respectively for sole maize and 64.7% & 35.3% excellent & good respectively for intercropped maize. So this indicates that intercropped maize have preferable biomass than sole because high biomass is used as animal feed in the area. The biomass of intercropped haricot bean is not as much preferable than sole because 35% of the respondents reacted as poor biomass.
In moisture resistance for maize, there is no moisture influence on both sole and intercropped maize. But moisture has an effect on haricot bean. As indicated in the table 2 above 47% of the farmers reacted that, intercropped haricot bean was susceptible to high moisture. Thus, the intercropped haricot bean is affected by dew maize at high moisture season.

Table 3: Farmers' preference of crops yield and yield components performances on the fields

Statement		Measurement criteria								
		No.CPPSM	No.CPPIM	CSSM	CSIM	No.PPPSHB	No.PPPIHB	YSM	YSBHB	YI
Excellent	f	20	18	14	23	24	7	11	12	24
	%	58.8	52.9	41.2	67.6	70.6	20.6	32.4	35.3	70.6
Good	f	12	11	14	7	10	15	23	22	10
	%	35.3	32.4	41.2	20.6	29.4	44.1	67.6	64.7	29.4
Poor	f	2	5	6	4	0	12	0	0	0
	%	5.9	14.7	17.6	11.8	0.0	35.3	0.0	0.0	0.0

Where; **No.CPPSM:** number of cobs per plant of sloe maize, **No.CPPIM:** number of cobs per plant of intercropped maize, **CSSM**: cob size of sole maize, **CSIM**: cob size of intercropped maize, **No.PPPSHB:** number of pods per plant of sole haricot bean, **No.PPPIHB:** number of pods per plant of intercropped haricot bean, **YSM**: yield of sole maize, **YSHB**: yield of sole haricot bean and **YI**: yield of intercropping

The other preference criteria were number of cobs per plant and pods per plant for maize and haricot bean respectively. As indicated in the table above, there is slight difference in preference of sole and intercropping maize based on no. of cobs and cob size per plant.
In haricot bean, most farmers (70.6% and 29.4% excellent and good respectively) preferred sole haricot bean in no. pods per plant. About 35.3% of the farmers responded the number of pods per plant for intercropped haricot bean is poor in comparison with sole cropping. In preference criteria of yield, farmers evaluated their performance and they preferred the performance of sole cropping as compared with the performance of individual crop in the intercropping. But even if the performance of sole cropping is preferable than the individual crop in the intercropping, they appreciated the yield of intercropping. Because the total yield of both crops in the intercropping is greater than the individual sole crop since they cover the same area.

3.6 COST BENEFIT ANALYSIS

Table 4: Profitability of the technology

Item		Unit	Unit price		Quantity on each variety		
			Maize	C. bean	SM	SHB	Intercropping (maize + Haricot bean)
Average yield per ha		Ton	-	-	5.998	1.864	4.889+1.463
Sales in kg		Birr	7000	9000	41,986	16,776	34,223+13,167=47,390
Total gain					41,986	16,776	47,390
Item cost		Unit	Quantity	Unit cost	Total cost for each crop		
					SM	SHB	intercropping
Seed cost	Maize	Kg	25	36	900	0	900+1500=2400
	Haricot bean	Kg	100	15	0	1500	
Fertilizer cost	NPS	Kg	100	13	1300	0	1300
	Urea	Kg	100	12.6	1260	0	1260
Labor cost	Land preparation(3x)	Oxen (pair)	24	100	2400	2400	2400
	Sawing	Person	16	35	560	560	560
	1st and 2nd weeding	Person	40	35	1400	1400	1400

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	Fertilizer application	Person	20	35	700	700	700
	Harvesting and trashing	Person	40	35	1400	1400	2100 (40*35)
Total cost					**9,920**	**7960**	**12,120**
Total Revenue					41,986	16,776	47,390
Net benefit (total gain-total cost)					**32,066**	**8,816**	**35,270**

Where; **SM:** *sole maize and* **SHB:** *sole haricot bean*

In agricultural sector farmers' desire were increasing production and productivity of their farm and getting high farm incomes. Farmers can increase their productivity by efficient utilization of existing resource and farm inputs. By optimum usage of existing resource, farmer can get **35,270** ETB from a hectare of land by intercropping. Otherwise, in sole cropping farmer can get a net benefit of 32,066 from sole cropping of maize crop or 8,816 ETB from sole cropping of haricot bean from the same farmland. So intercropping of maize and common bean production is profitable than producing in sole.

4. CONCLUSION

The practices of mixed cropping of maize with haricot bean was commonly used by farmers in the areas, though productivity of the crops were low due to inappropriate spacing between plants and row, poor field managements and low farm inputs. Hence, the aim of this demonstration was to create awareness and improved practical skill gaps of farmers in the areas. Training was provided to 64 farmers and DAs of the kebeles, and 145 farmers and FREG members, 16 DAs and experts were participated on the field day demonstration conducted in both Pilla and Zomba kebeles.

According to yield and yield components results, the better grain yields were obtained from sole cropping of maize and haricot bean in both kebeles. The average grain yield of 6.043 and 5.949 t/ha yields of maize were obtained in zomba and Pilla kebeles respectively, and average yield of 1.881t/ha in Zomba and 1.846 t/ha Pilla kebeles were obtained from sole cropping of haricot bean. Although, sole cropping practice had better in grain yields of both crops, land equivalent ration result showed that, intercropping of maize with haricot bean increases land productivity by 61 and 58% over sole cropping of the crops in Zomba and Pilla kebeles respectively. Besides, majority of participant farmers preferred intercropping of maize with haricot bean compared to sole cropping of the crops.

Therefore, appropriate use of row intercropping of maize and haricot bean improves farming household's income and productivity of their land. So that, Debu Ari woreda agricultural office should scale up row intercropping practices of the crops in areas with similar agro-ecologies.

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REFERENCES

1. Berglund P. (2004). Farming practices and crop production 4, 2.
2. Dahmardeh M, Ghanbari A, Syasar BA, Ramrodi M. (2009). Effect of inter-cropping maize with cowpea on green forage yield and quality evaluation.Asian Journal of Plant Science 8,235-239.
3. Mahapatra S.C. (2011). Study of grass-legume intercropping system in terms of competition indices and monetary advantage index under acid lateritic soil of India. American J. Exp. Agric. *1*,1-6.
4. Statistical Analysis Software (SAS) (2002). User"s guide Version 9.2. SAS Institute, Inc., Cary, NC, USA.
5. Tamiru H. (2013). Maize productivity as affected by intercropping date of companion legume crops. Peak J. Agric. Sci. 1, 70-82.
6. Willey R.W, Osiru D.S. (1972).Studies on mixtures of maize and beans (*Phaseolus vulgaris*) with particular reference to plant population. The Journal of Agricultural Science*79*,517-529.

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CONFLICTS OF INTEREST

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