Appropriate agricultural mechanization for increased crop productivity and income generation in rural Ethiopia

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Objectives

1. To conduct an economic analysis of the impact of mechanization hire services on smallholder farmers;
2. To conduct a cost-benefit analysis from the perspective of the hire service provider under different scenarios of hire service operations and
3. To calculate the break-even points/hour for each machinery.

Methodology and Material

- Appropriate 2WT power source based technologies defined for 3 regions (Adwa, Bako and Debre Markos)
- In partnership with the Ethiopian Institute of Agricultural Research and manufacturers/dealers, technologies have been adapted, designed and tested, validated at farmers level
- Service provider business scheme developed and implemented in 3 regions (Amhara, Oromia and Tigray)
- Research inputs include: 2WT, trailer, direct seeders, thresher, sheller, water pump, reaper harvester
- Trials farms under mechanization versus non-mechanized treatments
- Book record of daily executed activity (fix and variables costs, income and profit)
- Calculation of gross margins per hectare with and without 2WT mechanization of 2WTs and implements.

Results and Discussions

- Maize and wheat growing farmers can generate a higher and positive gross margin by hiring 2WT based technologies (**Tables 1 & 2**).
- The higher gross margin resulted from: 1.) the reduction of cost on ploughing, planting, fertilizer application, threshing and transportation and 2.) the use of 2WTs direct seeder.
- The more range of machineries the farmers (SPs) use the higher the gross margin.
- The direct seeder takes a bigger share in terms of increasing the gross margin (77%, 52% and 45%) by reducing the cost of production and increasing productivity (for wheat) for Mechekel, Adwa and Gudeya Billa woredas, respectively.
- The difference in gross margin among the three-region resulted from; a) difference in crop type (the gross margin for wheat is higher than maize); b) difference in operation costs of without mechanization and c) farm productivity and contract charge per ha is also another factor for gross margin difference.
- Knowing machinery (**Figure 1**) with better gross margin helps farmers to decide or prioritize.
- From hire service provider point of view it is proven to be viable, profitable and generating a high and positive net present value (**Table 2a-b-c**).
- The viability of 2WTs based technologies can be enhanced when service provider purchases 2WT and implements as a combined package for multi-purpose use.
- Agricultural production surplus, effective demand and functional distribution and aftersales are keys to the scaling-up of mechanization.
- Mechanization isa ffordable to the poorest smallholder farmers (via Service Providers, SP).

Table 1 a-b-c: Yields, production costs and gross margins analysis with and without mechanization for **1a-**Mechekel, **1b**-Adwa and **1c**- Gudeya Billa Woredas

1a

Gross Margin for Mechekel woreda (from farmer point of view) - for Wheat crop									
Without Mechanization				With Mechanization					% increase as a result of Mechanization
Yield/ha (ton)	Value of prod ($) /ha	Total Variable cost/ha	Gross margin /ha	Combination of accessory	Yield/ ha (ton)	Value of prod ($) /ha	Total Variable cost/ha	Gross margin/ha	
3.90	1365	666	699	2BFG, Thresher, Trailer	5.10	1785	522	1263	81%
				2BFG and Thresher	5.10	1785	532	1253	79%
				2BFG and Trailer	5.10	1785	540	1245	78%
				Thresher and Trailer	3.90	1365	635	730	4%
				2BFG	5.10	1785	546	1238.6	77%
				Thresher	3.90	1365	642	723	3%
				Trailer	3.90	1365	658	707	1%

1b

Gross Margin for Adwa woreda (from farmer point of view)- for wheat crop									
Without Mechanization				With Mechanization					% increase as a result of Mechanization
Yield/ha (ton)	Value of prod ($) /ha	Total Variable cost/ha	Gross margin /ha	Combination of accessory	Yield/ ha (ton)	Value of prod ($) /ha	Total Variable cost/ha	Gross margin/ha	
3.30	1403	491	912	2BFG, Thresher, Trailer	4.35	1849	437	1412	55%
				2BFG and Thresher	4.35	1849	460	1388	52%
				2BFG and Trailer	4.35	1849	446	1402	54%
				Thresher and Trailer	3.30	1402.5	459	943	3%
				2BFG	4.35	1849	462	1386.9	52%
				Thresher	3.30	1402.5	477	926	2%
				Trailer	3.30	1402.5	473	929	2%

1c

Gross Margin for Gudeya Billa woreda (from farmer point of view)- For Maize crop									
Without Mechanization				With Mechanization					% increase as a result of Mechanization
Yield/ha (ton)	Value of prod ($) /ha	Total Variable cost/ha	Gross margin /ha	Combination of accessory	Yield/ ha (ton)	Value of prod ($) /ha	Total Variable cost/ha	Gross margin/ha	
5.40	891	660	231	Maize seeder, Thresher, Trailer	5.40	891	453	438	89%
				Maize seeder and Thresher	5.40	891	493	398	72%
				Maize seeder and Trailer	5.40	891	517	374	62%
				Thresher and Trailer	5.40	891	587	304	32%
				Maize seeder	5.40	891	557	334	45%
				Thresher	5.40	891	626	265	15%
				Trailer	5.40	891	651	240	4%

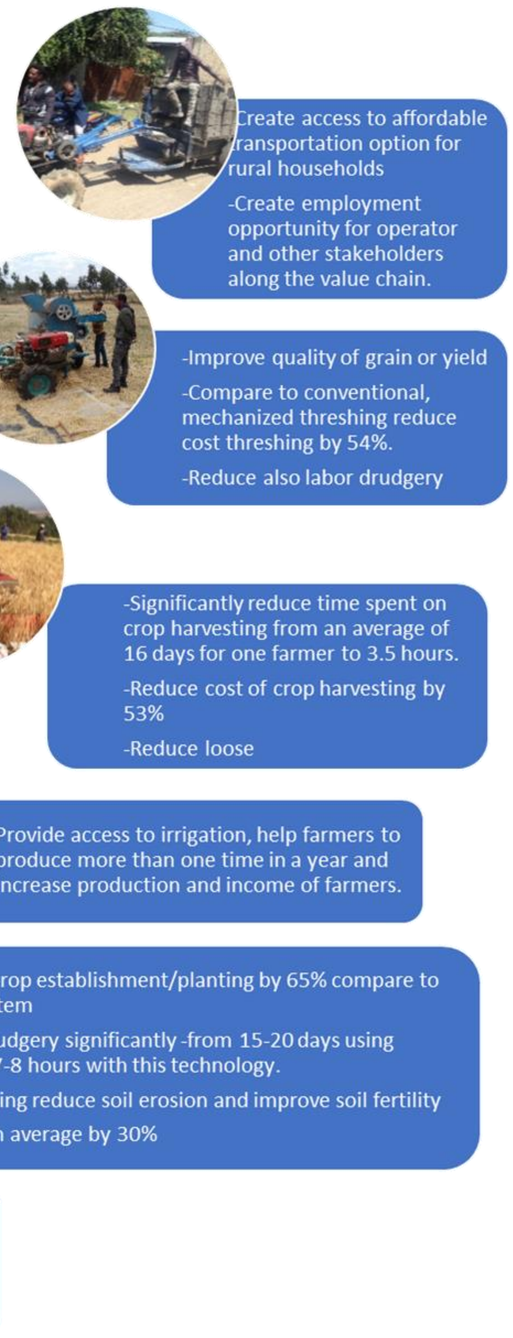

Figure 1: Validated technologies for scaling and promotion

Table 2 a-b-c: Cost-benefit analysis of 2WT based technology (single and combined operations) from service providers' point of view for **2a-**Mechekel, **2b**-Adwa and **2c**- Gudeya Billa Woredas

2a

Indicators	Seeder, thresher, trailer, & water pump (case 1)	Thresher, trailer, and water pump (case 2)	Thresher and trailer (case 3)	Trailer (case 4)	Seeder, trailer, and water pump (case 5)	Seeder, thresher and trailer (case 6)	Seeder and trailer (case 7)	Seeder and water pump (case 8)	Seeder (case 9)	water pump (case 10)
NPV ($)	24,465	19,851	19,507	14,915	19,873	24,122	19,529	1,703	1,360	-27,742
IRR (%)	61%	57%	59%	65%	66%	64%	70%	26%	26%	#NUM!
B/c ratio	1.65	1.65	1.70	1.73	1.68	1.70	1.75	1.18	1.22	0.11
Increase in cost (10%)										
NPV ($)	20,711	16,401	16,381	12,607	16,937	20,692	16,917	750	730	-30,874
IRR (%)	51%	47%	50%	54%	56%	54%	60%	20%	21%	#NUM!

2b

Indicators	Seeder, thresher, trailer, & water pump (case 1)	Thresher, trailer, and water pump (case 2)	Thresher and trailer (case 3)	Trailer (case 4)	Seeder, trailer, and water pump (case 5)	Seeder, thresher and trailer (case 6)	Seeder and trailer (case 7)	Seeder and water pump (case 8)	Seeder (case 9)	water pump (case 10)
NPV ($)	24,976	20,362	19,318	14,725	20,384	23,932	19,340	2,404	1,360	-2,211
IRR (%)	62%	58%	59%	64%	67%	63%	70%	30%	26%	-10%
B/c ratio	1.66	1.66	1.69	1.72	1.69	1.69	1.73	1.25	1.22	0.66
Increase in cost (10%)										
NPV ($)	21,195	16,886	16,168	12,398	17,425	20,476	16,707	1,447	728	-2,862
IRR (%)	52%	48%	49%	54%	57%	53%	59%	24%	21%	-17%

2c

Indicators	Seeder, thresher, trailer, & water pump (case 1)	Thresher, trailer, and water pump (case 2)	Thresher and trailer (case 3)	Trailer (case 4)	Seeder, trailer, and water pump (case 5)	Seeder, thresher and trailer (case 6)	Seeder and trailer (case 7)	Seeder and water pump (case 8)	Seeder (case 9)	water pump (case 10)
NPV ($)	62,081	57,467	57,124	52,532	57,489	61,738	57,146	1,703	1,359	-2,911
IRR (%)	121%	124%	131%	172%	149%	128%	162%	26%	26%	-22%
B/c ratio	2.63	2.76	2.93	3.40	2.93	2.77	3.15	1.18	1.21	0.55
Increase in cost (10%)										
NPV ($)	58,272	53,966	53,950	50,186	54,508	58,257	54,492	742	726	-3,565
IRR (%)	107%	109%	116%	153%	132%	113%	143%	19%	20%	#NUM!