Promising business cases and their greenhouse gas emissions for potato smallholders in Kenya

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Scenarios

Scenario 1: Supply chain with own saved seed Shangi variety, from smallholder to retailer and manual farming (reference situation)

Scenario 2: Supply chain with certified seed Shangi variety, from smallholder to retailer and manual farming

Scenario 3: Supply chain with "Clean Seed", from smallholder to retailer, mechanized ploughing but non-mechanized harvesting

Scenario 4: Supply chain with certified seed Shangi variety, from smallholder to retailer and mechanized farming for main activities

Activities

Activity	Scenario 1 (reference)	Scenario 2	Scenario 3	Scenario 4
Farm				
-Getting seed	Home-saved	Buying certified seed	Buying clean seed	Buying certified seed
-Stubble cleaning	By hand	By hand	By hand	By hand
-Plough	oxplough	oxplough	Mechanized (hired)	Mechanized (hired)
-Seedbed preparation	By hand	By hand	By hand	By hand
-Fertilizer	DAP at 150 kg/ha	DAP at 500 kg/ha	DAP at 500 kg/ha	NPK 16:8:22
-Planting	Home seed, by hand	Certified seed, by hand	Clean seed, by hand	Certified seed; mechanized (hired)
-Plant protection	3 sprays of Ridomil / Mancozeb	4 sprays of Ridomil / Mancozeb	11 sprays of Ridomil / Mancozeb	Mixed sprays for 8 weeks
-Cultivation	By hand	By hand	By hand	By hand
-Harvest	Fork jembe/casual labour	Fork jembe/casual labour	Fork jembe/casual labour	Mechanized (hired)
-Water supply	Rainfed	Rainfed	Rainfed	Rainfed
Transport (broker/trader)	Uncooled 10 T truck for 250 km	Uncooled 10 T truck for 250 km	Uncooled 10 T truck for 250 km	Uncooled 10 T truck for 250 km
Market (retailer / wholesaler)	Selling / no storage	Selling / no storage	Selling / no storage	Selling / no storage

Clean seed

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Relevant issues for GHG calculation

- Calculation set up is backwards, based on 1000 kg regular sales of potato at retail level
- Loss plays an important role, and is incorporated in 2 ways:
  - a) difference between loss and damaged (damaged is sold at lower price)
  - b) cut, green potatoes are considered as loss
- Part of production is used for seed and home consumption
- Coolfarmtool is used for GHG emissions of fertilizer and crop protection

GHG emissions in kg CO_2-equivalent

Activity	Scenario 1 (reference)		Scenario 2		Scenario 3: Clean Seed		Scenario 4	
Farm								
-Getting seed	Home-saved	52	Buying certified seed	22	Buying Clean seed	31	Buying certified seed	10
-Stubble cleaning	By hand	-	By hand	-	By hand	-	By hand	-
-Plough	oxplough	-	oxplough	-	Mechanized (Hired)	2	Mechanized (hired)	1
-Seedbed preparation	By hand	-	By hand	-	By hand	-	By hand	-
-Fertilizer	DAP at 150 kg/ha	178	DAP at 500 kg/ha	144	DAP at 500 Kg/ha	172	NPK 16:8:22	85
-Planting	Home seed, by hand	-	Certified seed, by hand	-	Clean seed, by hand	-	Certified seed; mechanized (hired)	1
-Plant protection	3 sprays of Ridomil / Mancozeb	14	4 sprays of Ridomil / Mancozeb	10	11 sprays at different stages of the crop development cycle	16	8 weeks mixed sprays	11
-Cultivation	By hand	-	By hand	-	By hand	-	By hand	-
-Harvest	Fork jembe/casual labour	-	Fork jembe/casual labour	-	Fork jembe/Casual labour based on man-days	-	Mechanized (hired)	1
-Water supply	Rainfed	-	Rainfed	-	Rain-fed	-	Rainfed	-
Transport (broker/trader)	Uncooled 10 T truck for 250 km	24	Uncooled 10 T truck for 250 km	24	Uncooled 10 T truck for 250 km	24	Uncooled 10 T truck for 250 km	19
Market (retailer / wholesaler)	Selling / no storage	-	Selling / no storage	0	Selling / no storage	-	Selling / no storage	-
Total		267		199		245		126

final result on GHG emissions per scenario for production of 1 ton of marketable potatoes

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Results

Results	GHG (kg CO_2-eq) per ton edible potatoes at retailer	Difference GHG with reference scenario	Average losses in kg to get one ton of edible potatoes at the retailer	Difference losses with reference scenario	Difference profit with reference scenario
scenario 1	263	0%	257	0%	0%
scenario 2	195	26% ↓	257	0%	55% ↑
scenario 3	195	26% ↓	257	0%	
scenario 4	128	51% ↓	75	71% ↓	460% ↑

Tabel 2: Results on GHG emissions and losses based on backward calculations (the arrows point at significant reductions)

Results overview	yield at farm level (t/ha)	losses farm level (%)	losses until consumer(%)	available for human consumption at retail level(t/ha)
scenario 1	8.3	13.4%	14.3%	7.01
scenario 2	16.1	13.4%	14.3%	13.59
scenario 3	13.1	13.4%	14.3%	11.23
scenario 4	21.6	3.7%	4.7%	20.64

Table 3: results on yield, losses and food security

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Conclusions

- Enormous reduction in loss and GHG emissions between scenarion 1 and 3 (around 50%)
- GHG emission drop of 25% when applying certified seed
- Double an triple impact on food security for scenario 2 and 3 respectively
- Huge positive impact on profit

Overall: Positive impact on many indicators

Remarks

- All results will be further elaborated in a policy advice and a scientific article

Thank you

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Estimate your food products' climate impact through our ACGE calculator
https://ccafs.cgiar.org/agro-chain-greenhouse-gas-emissions-acge-calculator

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