Returns to investment in PHM: Benin and Mozambique

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Outline

1. Study objectives
2. Approach
3. Findings
4. Implications for policy
5. Recommendations

Study objectives

- Quantify crop production (maize, beans and cowpeas)
- Quantify post-harvest losses for maize, beans and cowpeas
- Find out the PHLM innovations adoption rate
- Carryout cost-benefit analysis (CBA)
  – hermetic bags
  – metal silos
- Make recommendations on financing

Sources of information

- Official statistics from Ministries of Agriculture
- Research commissioned by Helvetas and FANRPAN
- Internet sources
- Key informant interviews (triangulation)
- Validation workshop (Mozambique)

Cost-Benefit Modelling

- Lifespan of metal silo – 20 years (hermetic bag – 2 years)
- Assumption - project life, 20 years
- Compare treatment (adoption) and counterfactual scenarios
- Compute incremental costs (technology, pesticide)
- Compute incremental benefits (income, savings)

Cost-Benefit Modelling …/2

- Compute the incremental benefits
  - **Scenario A**: Farm sells at harvest: **(LS - HS Price) * QTY Preserved**
  - **Scenario B**: Farmer stores and sells later: **(LS Price * QTY Preserved)**

>> **Scenario B** has higher incremental benefits

>> **Scenario A** is already prudent, reducing losses by selling early

Cost-Benefit Modelling …/3

- Construct incremental cost and benefit cash-flows - 20 years
- Compute discount rate (*r*) using **Ramsey equation**
- Compute cost-benefit indicators
- Conduct sensitivity analysis

Ramsey Equation

- **$r = \rho + \mu g$**

Whereby:

- **r** is the discount rate;
- ρ **is** the rate at which people discount future over present consumption assuming that income is fixed. (ρ) is the product of two elements namely the **risk of catastrophe wiping out the gains from a programme** (L) and the **rate of pure time preference** (δ);
- δ is the **pure rate of time preference** - consumers are impatient and that because there is a chance they could die, would rather consume today not in future;
- μ is the **rate of per capita consumption growth**; and
- **g** is the **elasticity of the marginal utility of consumption** (the percentage fall in the marginal utility when consumption increases by one per cent).

Discount rate: Benin Example

ρ = 0.8% + 0.5=1.3%

- Risk of catastrophe (L) “crude death rate” 8 per 1,000 (0.8%)
- Rate of pure time preference assumed to be 0.5 (DFID Green Book)

μ=2

- Rate of per capita consumption growth (Dasgupta, Partha, 2006 estimates: **2** to 4)

g=5%

- Elasticity of marginal utility of consumption (proxy is GDP growth rate)
- Growth rate for Benin estimated at 5% per year for the foreseeable future

- ***r*** **= 1.3% + 2*5% = 1.3% + 10% = 11.3%**
  - Rounded off to **12%**, more conservative, rain-fed agriculture

Cost-Benefit Indicators Computed

- Net Present Value (NPV)
- Benefit Cost Ratio (BCR)
- Internal Rate of Return (IRR)
- Payback Period
- Breakeven Point

Net Present Value

For calculation of NPV the following formula was used:

$$\mathrm{NPV}(i, N) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

Where:

t – is the time of the cash flow

i – is the discount rate, i.e. the return that could be earned per unit of time on an investment with similar risk.

$\boldsymbol{R_t}$– is the net cash flow i.e. cash inflow – cash outflow, at time t.

Sensitivity Analysis Assumptions

- 20% less benefit from base case
- 20% more benefit from the base case
- 14% discount rate (more risky environment)
- 10% discount rate (assuming less risky environment)

FINDINGS

Validation Meeting Mozambique, March 2017

Benin Indicator Values – H. Bags (Scenario A: Sells)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (CFAF)	-8.43	214.30	93.73
Benefit to Cost Ratio	0.66	2.39	1.61
Internal Rate of Return (%)	Negative	>10,000	465
Payback period (Years)	N/A	5	8
Breakeven point (%)	N/A	42	62

Benin Indicator Values – H. Bags (Scenario B: Stores)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (CFAF)	209.32	986.87	708.63
Benefit to Cost Ratio	1.95	7.41	5.6
Internal Rate of Return (%)	>1,000	>1mln	>500,000
Payback period (Years)	7	1	5.6
Breakeven point (%)	51.5	13.5	18

Benin Indicator Values – Silo (Scenario A: Sells)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (CFAF)	34.3	257.03	136.46
Benefit to Cost Ratio	1.31	3.31	2.28
Internal Rate of Return (%)	18	66	37
Payback period (Years)	11	3	5
Breakeven point (%)	76.5	30.2	45

Benin Indicator Values – Silo (Scenario B: Stores)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (CFAF)	318.45	1,029.06	751.36
Benefit to Cost Ratio	3.87	10.26	7.76
Internal Rate of Return (%)	89	>1,700	1,685
Payback period (Years)	3	1	2
Breakeven point (%)	26	9.9	13

Mozambique Values – H. Bags (Scenario A: Sells)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (MZN)	27.31	43,92	12.87
Benefit to Cost Ratio	2.5	3.42	1.71
Internal Rate of Return (%)	>50,000	>50,000	>50,000
Payback period (Years)	3	3	7
Breakeven point (%)	40	29	58.5

Mozambique Values – H. Bags (Scenario B: Stores)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (MZN)	43.36	152.60	67.25
Benefit to Cost Ratio	3.55	9.4	4.7
Internal Rate of Return (%)	>50,000	>500,000	>500,000
Payback period (Years)	3	1	2
Breakeven point (%)	28	11	21

Mozambique Values – Silo (Scenario A: Sells)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (MZN)	37.97	54.57	23.53
Benefit to Cost Ratio	6.05	8.26	4.13
Internal Rate of Return (%)	>50,000	>100,000	100
Payback period (Years)	2	1	2
Breakeven point (%)	16.6	12	24.3

Mozambique Values – Silo (Scenario B: Stores)

Indicator	Maize	Beans	Cowpeas
Net-Present Value (MZN)	56.83	163.26	67.21
Benefit to Cost Ratio	8.59	22.72	4.7
Internal Rate of Return (%)	200,000	>200,000	>200,000
Payback period (Years)	1	1	2
Breakeven point (%)	11.6	4.5	21.2

Implications of the findings

- PHM technologies are viable
- Viability depends on crop, losses (without), price changes
- Metal silo more viable in long-term
- Start-up costs for metal silo high in ST: 1.5 – 3 times more
- Farmer incomes increase as a proportion of Agri-GDP:
  - Mozambique: 2.77 - 3.87%
  - Benin: 1-2%

Implications of the findings …/2

- Vast potential for private sector to supply technologies
  - – Silo prices can go up 7 times
  - – Hermetic bag prices can go up 3 times
- Key issue is demand stimulation (e.g., social acceptability)
- Major barrier to adoption is initial investment cost

Recommendations

- PHM solutions should be country and context specific
- Disaggregate farmers by production & marketing behaviour
- Promoting PHLM Tech may require financial support
- Link repayment terms for PHLM credit to the payback period
- Blending instruments for financing PHLM can be considered

Recommendations …/2

- Potential role for import tax waivers on hermetic bags
- With 20-40% PHL:
  - Governments to balance investments (yields *versus* PHLM)
  - PHLM to be prioritised as import substitution strategy
- A case for PHLM to be included in farmer input programmes
- Multi-sectoral approach: ***Agriculture-Plus PHLM Strategy***

Thank You!!

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