De-carbonizing the post-harvesting phase of the agri-food chain

Viability and smart business modeling

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Is a decentralized RE system competitive?

Solar cold storage

Technology	LCOE
Diesel generator	0.43 USD
Solar PV, with lead-acid batteries, replacement all 6-7 years	0.33 USD
Solar, with lead-acid batteries, replacement all 3 years	0.43 USD
Solar PV, with lithium-ion batteries	0,28 USD
Solar thermal storage	0,35 USD

YES

!!

Of relevance:

- Battery management
- Selection of storage technology

Why is a smart business model needed?

The challenges:

- Clients are remote
- Limited ability-to-pay of customers
- Limited access to finance of customers
  (lack of track record, lack of collateral etc.)
- Upscaling is challenging, as transaction costs of business development are high

Key features of a business model

Customer Value	➢ **Impact for the customer? Monetary and non-monetary benefits? Expected increase of income? Income increase in short, medium and long-term?** e.g. increase of income through reduction of post-harvest losses, higher prices at which the products (veg, fruits, fish, milk etc.) can be sold etc.
Costs	➢ **Cost level of technology? CAPEX and OPEX ? Maintenance/ replacement requirements?** ➢ **Cost reduction potentials? (local manufacturing, economies of scale etc.)** ➢ **Finance costs (loan conditions etc.)**
Revenues	➢ **Single or multiple revenue streams?** (e.g. in case of biogas, revenues from sales of slurry as fertilizer can also be generated; surplus solar power can be used for phone charging) ➢ **Payment scheme:** asset sales, leasing/ rental, service fees/ownership model? ➢ **Fixed or dynamic pricing** (negotiations) ➢ **Payment method** (e. g. mobile)
Partners	➢ **Partners for distribution?** ➢ **Partners for installation/ maintenance?** ➢ **Strategic partners for ensuring the sustainability?** (e.g. for solar chillers it makes sense to cooperate with dairy farming extension service providers or input providers to ensure the required quantity and quality of milk

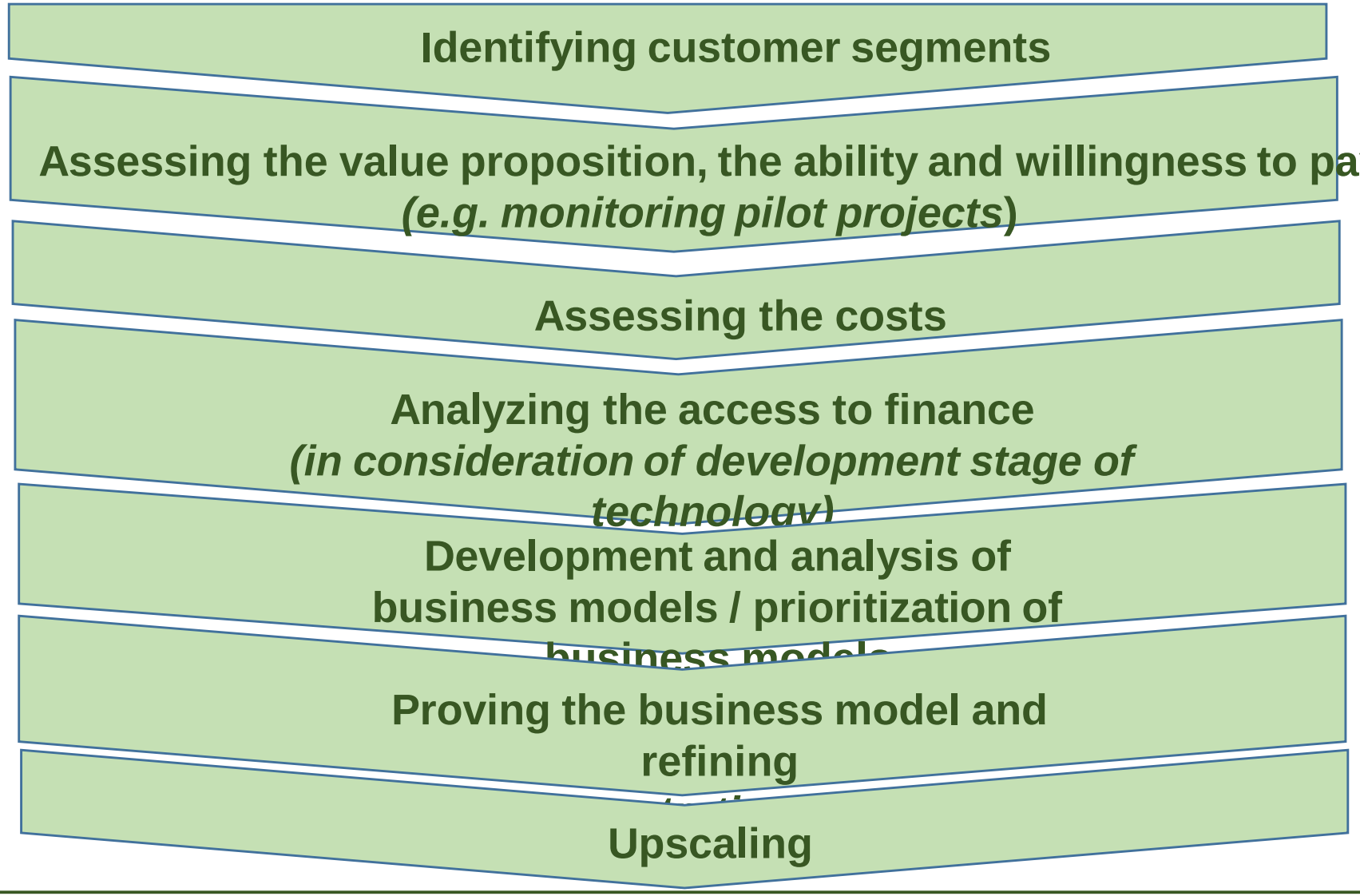
Which are possible smart business model?

Financial risks

Business Model	Description
Fee-for-service	➢ The supplier invests in the systems and operates them ➢ For the service (cooling, drying etc.), the users pay a fee
Lease-to-own/ hire-to-purchase/ supplier credit	➢ The supplier leases/ rents out the system to users' organizations such as a cooperative or to a third-party who wants to be a service provider ➢ The investor (users' organization/ third-party) pays a fixed leasing fee/ rental fee to the supplier ➢ The investor re-finances the payments through the revenues from a service fee
Franchising model	➢ The supplier sells the DRE systems to franchisees ➢ The franchisee pays for the system directly or through a loan from a bank/ supplier ➢ The franchisee finances the payments through a service fee, which the individual users pay ➢ The franchisee pays a franchising fee to the franchisor, who provides the franchisee with the business development & marketing concept and supports them to develop the projects

Speed of upscaling

How to come to a smart business model?



Example I: Solar cold storage

Main features:

- Cold room: 10 x10 x 7 feet, insulated panels for about 2 tons of perishable food in plastic crates, stacked on the floor
- Refrigeration unit: 24/7 refrigeration using a climate-friendly R290 propane refrigerant.
- Solar energy: solar panels on the roof (5.5 kW), to operate the cold room (760 W charge) in all weather conditions; 20 kWh batteries.

Value proposition

- Higher prices for products: Traders and farmers must sell a large portion of perishable products at a lower price to avoid damage to the products before they are sold. With storage, they can store the products and sell the stored products as fresh products.
- Reduced post-harvest losses/reduced spoilage: Traders and farmers cannot sell some of their products because of the spoilage.

Example I: Solar cold storage (cont.)

INPUT DATA

Parameter	Value
System costs	28,500 USD
Cooling fee	100 N (0,27 USD)
Utilization rate	110% (based on daily records)
Interest rate	20%

KEY PERFORMANCE INDICATORS (KPI)
(Fee-for-Service model/ ownership model)

KPI	Value
Project IRR	48%
Net Present Value	76,315 USD
Debt Service Coverage Ratio	1,36
Payback period	3 years

- System is tested and proven in Nigeria
- Commercial viability with current business model (fee-for-service/ ownership model) is robust (*see KPIs),* at least on markets *(for cooperatives the viability could not be analyzed yet)*
- A utilization of at least 93% is required (110% over the whole yr. observed)
- For upscaling, other business models such as franchising are advisable. This requires an increase of cooling fee to at least 135 Naira (0,37 USD), which is affordable.

Example II: Solar dryer *(cacao value chain)*

Value proposition

- Reduction of losses, which amount to around 5-10%
- Mores sales due to shorter drying time (6 days instead of 10 days/ batch) >> 30 batches can be dried instead of 18 batches
- A premium of 0,08 – 0,15 EUR/ kg is paid for cacao dried in a solar dryer because of enhanced quality

Example II (cont.): Solar dryer *(cacao value chain)*

INPUT DATA

Parameter	Value
System costs	4,500 EUR
Operation costs/ yr	334 EUR
Drying capacity per batch	1350 kg
Drying time	6 days/ batch (instead of 10)
Drying fee	0,04 EUR
Number of batches, yr	30 (instead of 18)
Utilization rate	100%
Interest rate	20%

KEY PERFORMANCE INDICATORS (KPI) (Fee-for-Service model/ ownership model)

KPI	Value
Project IRR	11%
Net Present Value	210 EUR
Debt Service Coverage Ratio	0,20
Payback period	6 years

- System is tested in Cameroon
- Commercial viability with current business model (fee-for-service/ cooperative model) is not viable (*see KPIs),*
- **A drying fee of at least 0,08 EUR is required** to make the investment viable and bankable (IRR 61%, DSCR 1,08). This increased fee is affordable!

Example III: Solar milk cooling system

Value proposition

- **Regular/ predictable income also for the evening milk**. This income can be saved, as it is paid weekly or monthly. The money can be invested in improving the dairy farming, e.g. through AI, storage of feed for the drought, planting own feed etc. This advantage can compensate the lower price, which the cooperative pays.

- **Saves time/ avoids hassle to sell the milk to hawkers, neighbours; encourages to do more intensive dairy farming**

- **The capacities of the bulking entity gets strengthened**, so that it can
  - provide a platform for exchanging experiences about dairy practices.
  - make services available which can help to grow and to do serious dairy farming (e.g. AI services, training on dairy farming practices (breeding, feeding etc.))

Example III: Solar milk cooling system (cont.)

INPUT DATA

Parameter	Value
System (retail) price	2,000 USD
O&M costs	1,320 USD/ yr
Utilization rate	60%
Loan ratio	100%
Interest rate	14%

KEY PERFORMANCE INDICATORS (KPI) (Fee-for-Service model/ ownership model)

KPI	Value
Project IRR	-61%
Net Present Value	-1778
Debt Service Coverage Ratio	-0,11
Payback period	

- Demonstration projects show a utilization ratio of only 60% and a profit margin of only 0,15 EUR by average, so that the investment is not viable *(see table above).*
- System is viable only under optimal conditions *(in context of West-Kenya),* i.e. full utilization with 40 l milk collection and a profit per liter milk of 0,20 EUR.
- **Options for reaching commercial viability**:
  - Price of the system has to be reduced tremendously
  - Maintenance costs halved (25 USD instead of 50 USD/ month) + full utilization @ 0,15 EUR profit margin/ l milk + 20 % equity finance
  - Support is needed for convincing the farmers to drop milk/ Cooperation with extension service providers

Key success factors

- **De-mystifying ideas** about market potential through **careful and intensive field work** (*e.g. myth of high evening milk losses due to lack of milk cooling, myth that seasonality kills the case);* **careful assessment of added value**

- **Simulating the commercial case as much as possible in a demonstration project** *(i.e. payments of customer can be used to cover transaction costs of a partner, e.g. resources for coordinating and monitoring the demonstration project)*

- **Involving the finance sector as early as possible** *(for learning about the finance policy of institutions, informing them about viability, building up confidence and fighting the mis-perception of risks)*

- **Involving the private sector as early as possible** *(if possible already for the demonstration project)*

Thank you very much!

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Viability of an investment: Definition of Key Performance Indicators

Key Performance Indicator	Description
Project Internal Rate of Return (IRR)	▪ Shows the attractiveness of a project or investment ▪ It is the interest rate at which the net present value of all the cash flows (both positive and negative) from a project or investment equal zero, i.e. that it is the **calculated interest rate on the investment**. ▪ It should be higher than the interest rate on savings in a bank account
Net Present Value (NPV)	▪ It is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. ▪ If the **NPV is positive (>0),** an investment is profitable.
Debt-Service-Coverage-Ratio (DSCR)	▪ It shows, whether the investor is able to serve the debt, generally spoken to fulfil his payment commitments, comprising the principal loan payment and the interest rate. ▪ It is the ratio of the earnings (before tax and interest rate, after depreciation) over the complete loan redemption (loan payment + interest rate) ▪ A project/ investment is considered to be bankable, if the **DSCR > 1**
Payback period	▪ It shows how many years are needed to recover the investment through the annual cashflow. ▪ It is calculated on basis of the **annual net income (after** depreciation, interest rate and