CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems
LED BY: IWMI International Water Management Institute
BRIEF

A Framework for Business Model Development for Incentivizing Adoption of Solar Pumps

Business models to support development of agricultural water management

Making the irrigation development sector more sustainable requires integrating more business-oriented thinking and market-driven mechanisms into irrigation investments. Many past development- and public sector-led investments in irrigation have failed, often due to being economically unviable. However if the right incentives are in place, with links to local businesses, employment opportunities and market expansion, irrigation investments become more financially attractive, which increases the chances of sustainable irrigation investments in the future.

The business model concept allows for analyzing and identifying irrigation investment potential at different scales and from different investor perspectives. A business model represents a market-driven approach to achieve direct benefits alongside societal goods such as meeting development targets around food supply, equity in development and environmental preservation.

Solar pump irrigation business model framework

The CGIAR Research Program on Water, Land and Ecosystems (WLE) and the International Water Management Institute (IWMI) have developed a framework and methodology for creating business models for solar pump irrigation systems for development. Sustainable business models for solar-powered pumps for irrigation analyze both internal and external environments within the context of the small-scale irrigated production sector. This business model framework enables the development of different investment scenarios from the point of view of various potential investors, whether within or external to the existing solar pump value chain.

PHOTO: JEFFERY M WALCOTT/IWMI

"A business model is the way by which a business creates and captures value within a network of producers, suppliers and consumers." – MIT Sloan

This business model framework outlines the following main components to consider for development and analysis of viable and sustainable business models:

1. Environmental sustainability
2. Suitability mapping, using biophysical and infrastructure criteria
3. Economic sustainability
4. Financing mechanisms
5. Institutional, policy, regulatory environment
6. Technology supply chain
7. Social inclusivity

Each of these categories and their systematic linkages is examined within the overall business model framework. Social inclusivity cuts across all the other components. Criteria related to gender, youth and equality are considered in each of the categories. The components and the inter-relationships between them are depicted in Figure 1.

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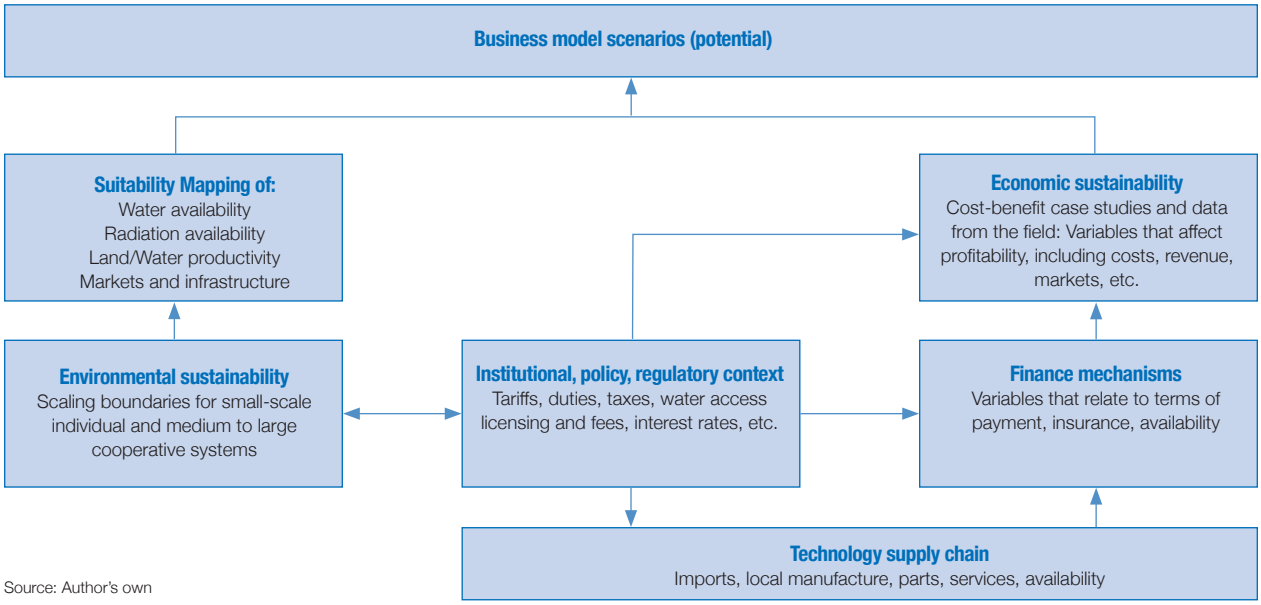
Figure 1. Framework for development of business models for solar-powered irrigation.



Source: Author's own

An environmental sustainability assessment grounds the business model to understand the biophysical boundaries, including the institutions and policies that regulate the solar technology in the context. The environmental sustainability then informs a suitability mapping process, which identifies the areas in which solar pump irrigation will be most viable, based on natural resource availability and market access. At the same time, the overall institutional, policy and regulatory context is outlined to identify the presence or absence of supporting factors for developing the solar irrigation market. This is closely tied to the finance mechanisms, as credit institutions and policies are often regulated and guided by government.

The institutional, policy and regulatory environment, as well as the financial context, influence the degree to which a technology value chain is developed. These factors contribute, alongside the biophysical suitability, to the economic sustainability of solar irrigation as a business. Case studies in areas mapped as suitable for solar irrigation provide data to assess the costs, benefits and returns on investment. Finally, the information and analysis across components enables generation of potential business model scenarios. Each of the components is explored further below.

Environmental suitability

Environmental sustainability is critical in the analysis of viability for solar pump irrigation. The promotion and scaling-up of any business model for solar pumps needs to take into consideration the scaling boundaries for small-scale individual systems and medium- to large-scale cooperative systems. Cheaper and increasingly more powerful solar-powered water pumps to intensify crop production can have environmental costs. At the same time, solar pumps as an alternative to fossil fuel or electric pumps can have potential environmental benefits by lowering the carbon footprint of food production.

In this framework, environmental sustainability is linked to the institutional, policy and regulatory component because policy and regulation may limit negative environmental externalities or may encourage positive environmental externalities. The particular environmental context may also shape national policies and regulations. For this reason, trade-offs need to be included in the analysis, including costs to mitigate any potential negative environmental impact. The environmental context and boundaries underpin the suitability analysis.

Suitability mapping: Biophysical and infrastructure-related feasibility

The business model framework also includes assessment of the biophysical opportunities and constraints for the business venture in solar pump irrigation. To start with, a constraints analysis can exclude unsuitable areas for any of the given input parameters e.g., specific land use such as forests, or limited amounts of sunshine, such as below 13,000 kWh per m^2 per year. Areas characterized by one or more constraints are excluded from further suitability

analysis for the technology. Next, the remaining areas can be reclassified into various degrees of suitability, depending on slope, solar irradiation and water source availability, as well as market and road infrastructure related to input and output markets. Suitability maps can be developed to indicate the potential area in which solar pump irrigation can be scaled, and even the potential size of the technology market. Therefore, suitability maps are central to developing and assessing the viability of solar pump business model scenarios.

Economic sustainability

In addition to the criteria described above, an attractive and viable business model aims to promote an economic return on investment. The financial viability of the proposed solar pump business model can be explored using cost-benefit analysis, which provides basic operational and financial information about profitability. The cost and revenue model is also linked to the financing, institutional and regulatory factors, because it uses information on market and financial drivers (e.g., interest rates, insurance, payment schedules, licensing fees, taxes, etc.) that emerge from those sectors.

Financial viability for solar pump irrigation also depends on the objectives of the business implementer. The objective may be a comparative increment in economic benefit, but does not necessarily imply profit maximization. Technology suppliers, domestic solar pump distributors, individual or groups of farmers, irrigation service providers all have different investment options and potential returns. Investors such as donors and governments might also support social business models that have multiple aims, such as improved livelihoods of smallholder farmers, improved health and nutrition, or reduced agricultural greenhouse gas emissions.

Financing mechanisms

Financing and sourcing investment capital is essential to scaling up solar irrigation technologies. Factors related to financial resources should be considered, including a) financing mechanism options available and suitable for key actors in the value chain; b) level of awareness about the technology and market among financial institutions; c) interest rates; d) terms of borrowing and payment; and e) insurance availability. Different financing mechanisms include national direct and indirect support programs such as credit guarantee funds, value chain financing, price smoothing, green funds, among others. While the financial context is influenced by the institutional, policy and regulatory context, finance options also have a strong effect on profitability and on the potential expansion of the solar irrigation technology.

Institutional, policy and regulatory environment

The institutional and regulatory environment is composed of existing policies, as well as the formal and informal rules of operation. It shapes the macro-economic factors related to credit terms, interest rates, low-cost financing, tax exemptions, and import duties that have great implications for the economic viability of a business. In this regard, the development of sustainable business models for solar pumps requires understanding

- The institutional landscape: Organizational and institutional arrangements that exist or have potential within the location in question, particularly related to incentives, partnerships and risks;
- The regulatory and administrative context: Existing regulations and their implications for technology, location and viability of business;
- The investment climate: Factors related to institutions and regulations that influence the probability of private sector engagement, particularly where the market is less developed or in fragile states.

Technology supply chain

To examine the potential for a solar irrigation pump market, it is important to identify the key economic actors in the sector, their roles, activities they engage in, market inefficiencies, market structure (e.g., level of competition) and financing options. This component of the analysis is linked to the regulatory, policy and institutional context component, as it is critical to consider the presence or absence of supportive mechanisms in policies and institutions available to actors in the solar irrigation value chain. The supply chain also relates to the finance mechanism component of the business model framework because the various actors' ability to invest and operate is influenced by financial regulations, finance products, and terms and conditions of credit.

The solar pump irrigation business model framework examines the presence or absence of pump, panel and accessories manufacturers, technology suppliers, supply chain system integrators, distributors and dealers, and financing organizations. It also considers existing and potential human resource capacity in relation to the market, e.g., the capability and reach of post-market service providers for maintenance and repair.

Social inclusivity

The framework includes consideration of the social dimension of solar pump irrigation development in the assessment of potential business model scenarios to deliver for investor priorities. Investors may seek

an environmental and economic sustainable business model that can also achieve increased equitability or employment. For example, gender equity may be a policy priority with related financial incentives to support women entrepreneurs and farmers. In other cases, gender relations may disadvantage women, such as barriers for access to information, markets and income from investments. Youth is another group that might experience barriers: they may have limited access to land and assets. Alternatively, youth may be able to access special support to engage in farming, such as credit products, that open up new opportunities.

Potential of solar irrigation business models

The approach laid out in this framework ensures that solar irrigation business models scenarios are environmentally and economically sustainable. It also guides investment to operate within the institutional and regulatory guidelines in a given context. The approach allows interested investors to assess the financial sustainability and viability, scalability, social impact and related environmental impact. The business model scenarios generated need to be tested and data used to rank investment options according to the objectives of different investors. This enables refinement for future investments, including identifying which key actors could effectively engage at different points in the market and what partnerships could facilitate market development. Such an approach can foster sustainable intensification of agricultural through solar pump irrigation.

Acknowledgments

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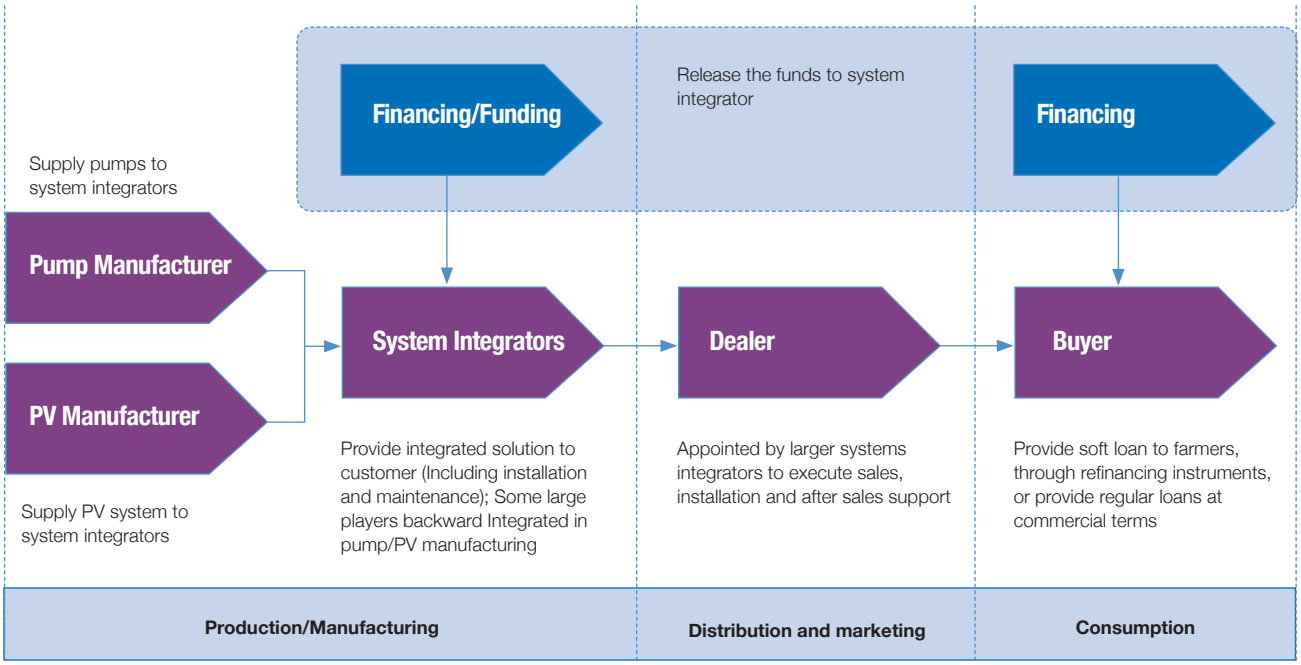
Figure 2. Overview of a supply chain framework of the solar irrigation pump market



(SOURCE: SHAKTHI FOUNDATION AND KPMG, 2014)

CGIAR Research Program on Water, Land and Ecosystems

The CGIAR Research Program on Water, Land and Ecosystems (WLE) combines the resources of 11 CGIAR centers, the Food and Agriculture Organization of the United Nations (FAO) and numerous national, regional and international partners to provide an integrated approach to natural resource management research. WLE promotes a new approach to sustainable intensification in which a healthy functioning ecosystem is seen as a prerequisite to agricultural development, resilience of food systems and human well-being. This program is led by the International Water Management Institute (IWMI) and is supported by the CGIAR System Organization, a global research partnership for a food-secure future.

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