International Water Management Institute

TECHNICAL BRIEF

Business models for solar-powered irrigation in Ethiopia

Background


Photo: Petra Schmitter/IWMI

This brief describes three business models for smallholder solar pump irrigation in Ethiopia, each with the potential to improve agricultural production, productivity and income. The purpose of the brief is to provide prospective investors with evidence that solar pump irrigation can be both suitable and sustainable.

Policymakers throughout sub-Saharan Africa, including those in Ethiopia, agree that increasing small-scale irrigation can reduce poverty and support economic growth. Limited access to the energy needed to pump water is a major constraint in most countries. Electricity is an inexpensive and efficient form of energy, but it is rarely available: only 14% of Ethiopia's population has continuous access to electricity due to poor grid coverage and the wide dispersal of farms (World Bank 2012). The use of fossil fuel motor pumps is constrained by several factors, e.g., high operation and maintenance costs, and also results in negative environmental impacts.

Solar-powered pumps offer a low-cost and environmentally-friendly alternative to electric irrigation technologies and motor pumps. Research suggests that investing in solar irrigation can profit smallholders, although the level of profit depends on the type of crops under cultivation, water delivery and application systems, and the size of the cultivated area. Other factors influencing profits include access to markets, and labor and input costs, although these are not unique to solar pump irrigation. Given the number of existing and potential motor pump users in Ethiopia – between 210,000 and 400,000 – the scope for expanding the solar pump market for irrigation appears to be significant.

The Ethiopian government is committed to developing solar and other renewable energy resources, as enshrined in a range of policies, laws and regulations. The national government recently offered incentives for engaging in the solar pump sector, including access to finance, and duty and tax exemptions. Yet, there are challenges. The regional states are responsible for covering the full cost of small-scale irrigation projects, but most lack the resources and capacity to respond to farmer demand. In addition, the number of ministries, departments and agencies involved in coordinating solar energy can make it difficult for investors, importers, manufacturers and service providers to understand or respond to opportunities. While some development donors, nongovernmental organizations (NGOs) and private sector actors have already piloted solar pump projects in Ethiopia, these have not been adequate to estimate the potential market. There is a need for smart business models that present attractive opportunities for private sector investment in solar pump irrigation.

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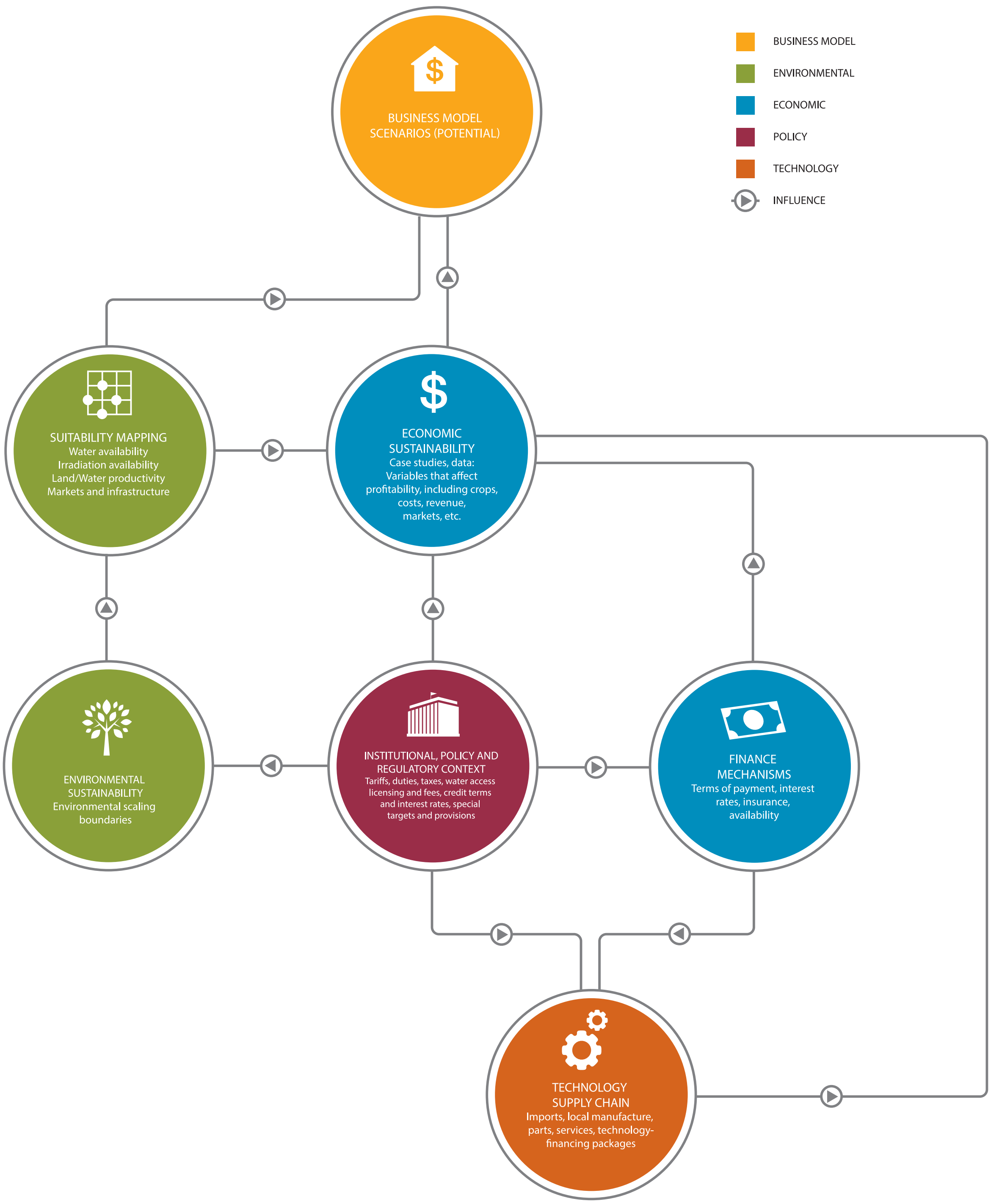
Methodology

A business model describes how an organization creates, delivers and captures value. A typical business model includes a number of elements: products and services, clients, activities, partnerships, costs, revenues and markets. In the context of the development sector, a business plan will have ambitions beyond profits, including the achievement of social, economic and environmental goals. The elaboration of business models for solar-powered pump irrigation should take contextual factors into account, including biophysical suitability, the institutional, policy and regulatory environments, related input and output markets, and economic and environmental sustainability (Figure 1). It should also consider measures to enhance equity, as gender and social equity can affect the sustainability of development investments.

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



Business models for solar-powered irrigation

The three business models presented in this brief were informed by a range of sources, including published and grey literature, maps, key informant interviews, focus group discussions, secondary quantitative data, and information from the public and private sectors, farmers, research institutions and civil society organizations. Each business model takes a different approach to promoting investment in solar irrigation.

Assuming a 50% adoption rate, Ethiopia hosts between 105,000 and 200,000 potential solar irrigation pump customers. Costing between USD 450 and 850, the pumps can significantly reduce the consumption of fossil fuels on farms. Ensuring access to water during dry seasons can lead to higher incomes for farmers due to greater agricultural production (assuming stable market prices for produce). Higher incomes can, in turn, lead to improvements in nutrition and health.

At the same time, agricultural intensification can eventually contribute to water quantity and quality deterioration, and can reduce the availability of water for everyone over time. These risks potentially apply to the scaling up of irrigation in general and can be exacerbated by such factors as climate change and weather variability. A watershed approach to planning and regulating water resource use is important to balance the trade-offs and support sustainability (Giordano et al. 2012). On-farm management practices exist to mitigate some negative externalities, while incentive mechanisms may also diminish the risk of inefficient water abstraction (WLE 2017).

There is as yet no concrete evidence that women or men farmers benefit more or less from the use of solar pumps for irrigation. However, as noted in Box 1, women may lack the rights to access land, water and information, which would support the adoption and use of, and benefits from, solar irrigation.

Box 1. Gender and solar irrigation.

Any effort to enhance irrigation in Ethiopia requires taking a gender perspective. A study conducted by the International Water Management Institute (IWMI) found that women preferred solar pumps to other irrigation technologies when the pumps are located nearby and can be used for multiple purposes, such as irrigating household gardens and providing water for the home (Nigussie et al. 2017). Women and girls often spend hours each day hauling water from the closest water source. A water supply near the home would save them significant time and effort, as well as providing an opportunity to earn extra income by supplying water to neighbors. In addition, using solar pumps increases yields and diversifies the family diet. However, women face barriers to adopting solar pump irrigation. They traditionally control water use for domestic activities, rather than for productive purposes such as irrigation. Women farmers also have significantly less access to agricultural information than men, which limits their capacity to obtain credit, make decisions about technology adoption and strengthen irrigation practices. This could limit their ability to benefit equally from the use of solar pump technologies.

Since irrigation water is only needed for a certain number of hours and most existing farms in Ethiopia are well under 1 hectare, the pumps could be used to extract additional water and the excess sold to neighboring farmers. According to one estimate, solar pumps serve only 15% of their potential use. However, the business models presented here did not assess these additional costs or revenue options.

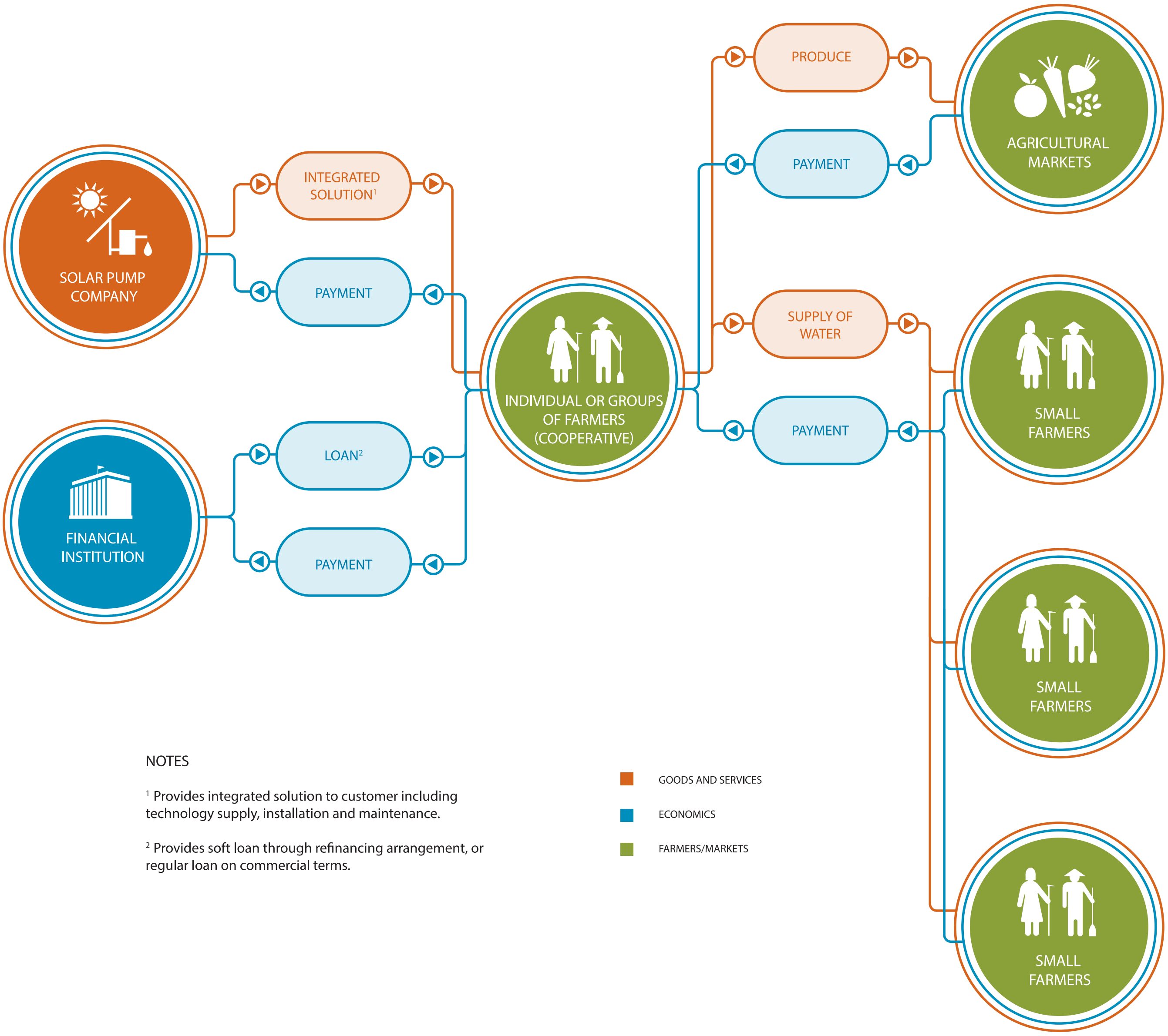
Business model 1: Individual purchase

The first business model is based on the purchase of solar pumps by individual farmers to increase their access to irrigation water throughout the cropping season (Figure 2).

Rural microfinance institutions (MFIs) are a potential source of credit for farmers that wish to invest in solar pumps, although interest rates are high. Policies to set lower interest rate ceilings, combined with financing mechanisms, such as matching revolving funds, credit guarantees from development entities or government funding, could help speed up the adoption of solar-powered irrigation as could alternative financing options by pump suppliers (e.g., lease-to-own, pay-as-you-go or buy-as-you-use; these are described below). Public sector intervention may be needed to ensure a stable and competitive solar pump supply chain under this scenario.

Another option is a cost-sharing model where a group of farmers pool their funds to invest in a solar irrigation pump. Pooling investments would reduce individual risk and could allow farmers to negotiate lower interest rate loans from MFIs or banks. However, other factors might limit the success of the scheme, such as the location of the pump, which could restrict the number of farmers willing to join the pool, or cost implications, if water needs to be transported to non-contiguous farms.

Figure 2. Business model 1: Value chain schematic.



Business model 2: Out-grower or insurer scheme

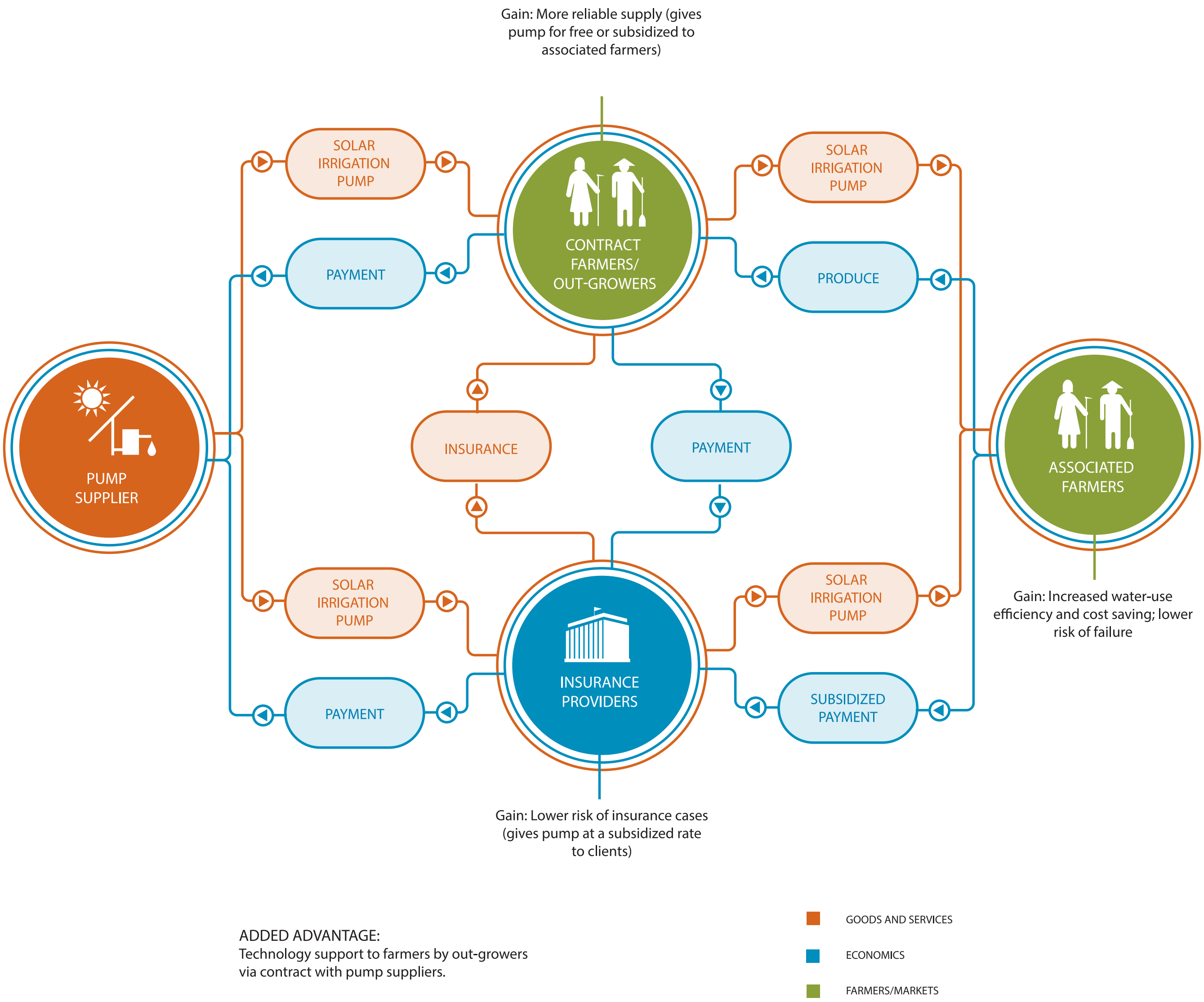
The second business model assumes that agro-companies that conduct out-grower schemes will be interested in investing in solar irrigation pumps (Figure 3). Such schemes involve a contractual partnership between farmers and companies for the production of commercial crops. By providing their contracted farmers with solar pumps, companies can reduce the risk of crop failure, receive a steadier stream and higher quality of agricultural products, and increase their income. This would outweigh their upfront investment in the pumps.

According to this model, the companies deliver the solar pumps to farmers – much as they do with other agricultural inputs – and provide technical support for the operation and maintenance of the pumps. The companies can either purchase the pumps with the idea that farmers would buy them over time, or give farmers the solar pumps for ‘free’, assuming that the investment and any transaction costs do not outweigh expected profits.

This business model favors farmer cooperatives, which typically have a stronger bargaining power and can thus guarantee greater benefits for farmers. Companies engaged in contract farming are in fact known to prefer farmer cooperatives, since they help achieve production scale and mitigate the failure of individual farmers to meet their contractual obligations.

Alternatively, crop insurers may also wish to invest in solar irrigation pumps for smallholder farmers, because they can reduce the risk and size of damage claims, and realize a higher profit margin. Crop insurers can offer solar pumps for free, at a subsidized rate, or at full cost in combination with flexible financing to farmers. An option for full cost recovery of the solar pump could be part of the insurance premium paid by the farmers. Increasingly, Ethiopian farmers are purchasing small-scale crop insurance (e.g., weather index-based crop insurance) to mitigate the impact of climate change. Further research is needed to evaluate the economic feasibility of this model, in particular, to estimate the net benefits to the insurers from subsidized or full cost recovery financing.

Figure 3. Business model 2: Value chain schematic.



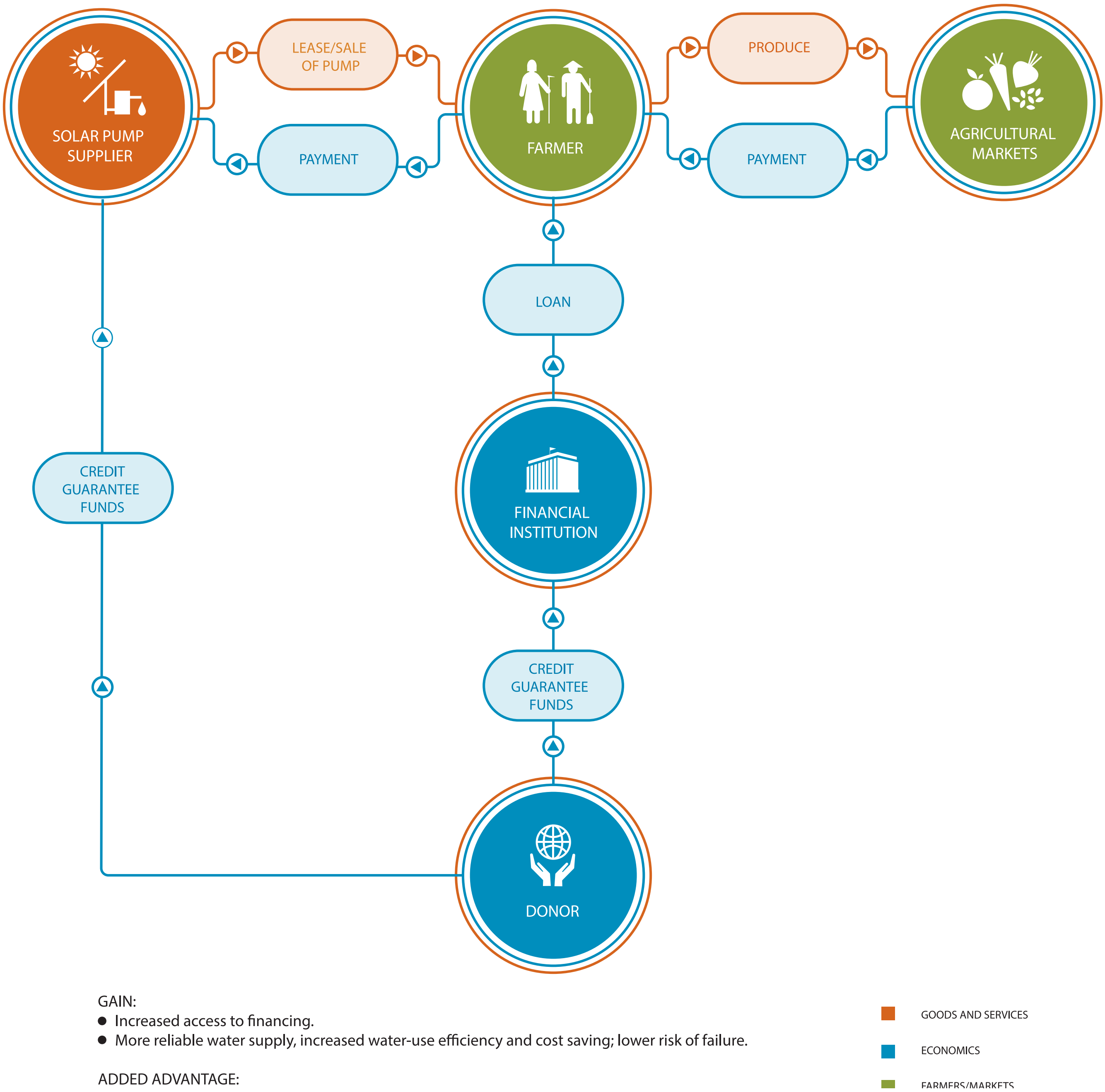
Business model 3: Supplier model with bundled financing

The third business model facilitates access by farmers to financing from solar irrigation pump suppliers, manufacturers or importers (Figure 4). A number of approaches can be envisaged under this model.

- The suppliers (and service providers) work with local financial institutions (MFIs, cooperatives, banks) to offer **direct financing** to smallholder farmers. The farmer makes a down payment and periodic repayments. Using bundled financing mechanisms can increase farmers' incentive for technology use. However, this often comes at a higher risk to the technology supplier when farmers are unable to pay back the loans. An alternative avenue to mitigate this risk and still increase access to credit for farmers is for the government and/or donors to establish credit guarantee fund mechanisms to encourage MFIs and even commercial banks to lend money to smallholder farmers.

- For the above, the government (possibly through donors or international funding mechanisms) provides guarantees on loans granted by banks for the purpose of purchasing solar irrigation pumps, essentially acting as a partial substitute for conventional collateral. This offers third-party credit risk mitigation to lenders, since the government absorbs part of the losses in case of default. A sustainable **credit guarantee scheme** requires that risk is distributed among the scheme (government or independent entity), the lender and the borrower, so that default and claim rates are kept to a minimum.

Figure 4. Business model 3: Value chain schematic.



- The **lease-to-own** approach helps to address the prohibitive upfront costs involved in purchasing a solar pump. The approach allows farmers to repay both the asset and financing according to payment schedules that are tailored to their income streams. Once all the payments have been made, the farmer owns the equipment. This model mitigates the capital investment risk (loss of collateral due to delayed payment) that farmers face and minimizes upfront payments. Moreover, the provision of additional services by the supplier, such as installation, assembly and repair, when factored into a higher assessed value and corresponding price charged, could make a lease-to-own model comparatively more affordable for farmers than traditional financing options. Variations on this approach include **pay-as-you-go** (farmers pay for use, and the supplier retains ownership and responsibility for maintenance); and **buy-as-you-use** (farmers pay for use and maintenance service, and obtain ownership of the asset after the payment of a set amount). Any of these approaches would be facilitated through information and communications technologies (ICT), e.g., the use of mobile phone-based payments; although access to the internet and other infrastructure could be limiting factors. This system is commonly used in a number of countries and could become available in Ethiopia before long.


Photo: Apollo Habtamu/ILRI

Conclusions and further research

Our research suggests that at least three promising business model scenarios can be used to support solar pump-irrigated agricultural production by smallholder farmers. All three scenarios offer benefits, but the out-grower schemes and pump supplier options with bundled financing are particularly attractive. Nevertheless, scaling up the scenarios will require further analysis of the institutional, regulatory and financial contexts in which they might be deployed, and this will in turn necessitate further data and feasibility testing. In particular, further information is needed on the suitability of different zones for solar pump implementation, the viability of solar pumps in communal irrigation schemes, and the use of the solar pump for both water supply and as an off-grid source of household energy.

The analysis provided in this brief assumes a rural context without an electricity infrastructure, and a policy context that limits sales to the grid. It does not consider the use of larger pumps and high-powered, solar-based pumps for communal irrigation schemes. It also does not investigate the potential for mini-grid solar systems to provide electricity for both local irrigation, and domestic and commercial needs. There is potential for these and other scenarios, but they require more research and exploration to ensure that they are coherent with the regulatory environment.

As solar pump irrigation becomes more accessible and affordable, and attracts greater investor interest, it will be important to incorporate environmental implications (e.g., climate variability, groundwater recharge rates and impact at the landscape scale) into suitability mapping and monitoring. The expansion of solar pumps will more than likely require new approaches to water resource governance. Finally, further research is needed on mechanisms to ensure that women as well as men are able to enjoy the benefits of solar pump irrigation.

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The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. IWMI works in partnership with governments, civil society and the private sector to develop scalable agricultural water management solutions that have a real impact on poverty reduction, food security and ecosystem health. Headquartered in Colombo, Sri Lanka, with regional offices across Asia and Africa, IWMI is a CGIAR Research Center and leads the CGIAR Research Program on Water, Land and Ecosystems (WLE).

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