

INCLUSIVE INNOVATIONS

Productivity Enhancements for Smallholder Farmers

Helping to raise farmers' incomes by providing them access and training to low-cost quality inputs and agricultural machinery

HIGHLIGHTS

- Agricultural equipment designed for use in small farm plots make it feasible for farmers to shift from labor intensive practices to higher-yielding mechanized practices.
- Inputs are made affordable by providing flexible payment options and savings based input packages.
- Farmer education services bundled with inputs help farmers understand accurate usage and application of inputs, thereby increasing their trust in improved inputs.



Dominic Chavez / World Bank

Summary

Agricultural productivity is severely hampered by lack of quality inputs and inefficient farming practices. Smallholder and marginal farmers are particularly prone to low yields and margins emanating from limited access to inputs, lack of knowledge about agricultural best practices, and restricted financial resources. In the absence of best practices, farmers use low-quality agricultural inputs, such as poor-quality seeds, fertilizers, agro-chemicals, veterinary medicines, and cattle feed. They resort to labor-intensive processes in lieu of agricultural equipment such as cultivators, tractors, and harvesters.

The productivity enhancement business model encompasses activities that provide farmers with access to low-cost quality inputs and agricultural machinery, and capacity building services to use these yield-enhancing solutions effectively. A number of enterprises have designed low-cost inputs that they make accessible and affordable to remotely located farmers. In addition, a large number of such enterprises provide capacity building services to enable farmers to make informed decisions on input usage. They often partner with agricultural experts and government programs to impart training in best practices.

Development Challenge

Approximately 80 percent of the field plots in Asia and Sub-Saharan Africa are managed by smallholder farmers¹. Despite being predominantly agrarian economies, farmers from these regions continue to face challenges in productivity and crop quality. Smallholder farming is characterized by heavy use of fertilizers to maximize yields from small plots and minimal use of mechanization. There are two key reasons for this poor productivity. First, smallholder farmers are unable to access quality inputs. Second, even when they can access superior inputs, they lack the know-how and expertise on how to use these inputs effectively. Further, these inputs are often unaffordable for smallholders, resulting in lower adoption rates. Use of inferior inputs or inefficiency in their use results in low yields and decreased bargaining power for farmers; poor financial returns; and consequently, lack of accumulated savings for purchase of improved inputs and farm machinery in the next crop cycle. This ultimately places these farmers in a vicious cycle of low productivity and subsistence farming.²

An estimated 500 million farmers³ constitute the world's smallholder population – they cultivate crops or produce livestock on farm lands that are lesser than two hectares in size⁴. Modern technologies are typically designed for use in larger farms, for instance irrigation equipment caters to field sizes over four hectares⁵ thereby forcing smallholder farmers to resort to flood irrigation. Research⁶ shows that using drip irrigation over the traditional flood irrigation method results in higher crop yields, increased fertilizer efficiency, reduced energy consumption, improved tolerance to salinity, and improved disease and pest control. In Sub-Saharan Africa, only 3 percent of the cultivated land is irrigated.⁷ Smallholder farming is also predominantly labor-intensive; farm workers provide 65 percent of the power required for land preparation in Sub-Saharan Africa, this figure stands at 40 percent in East Asia, 30 percent in South Asia and 25 percent in Latin America and the Caribbean.⁸

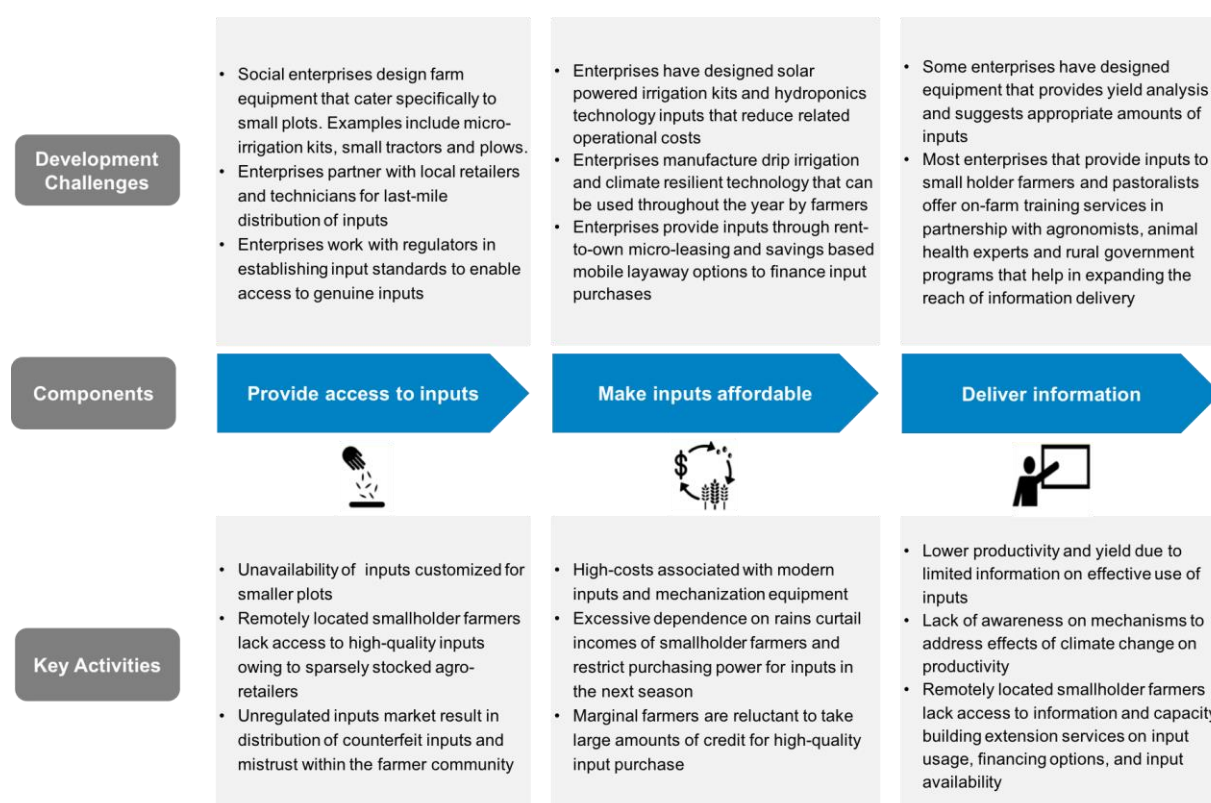
Smallholder farmers and pastoralists are often remotely located and underserved by input retailers. These farmers therefore lack access to crop productivity boosters such as climate-resistant seeds and organic fertilizers, and critical livestock inputs such as animal health services and nutritious feed. For example, limited availability of crop protection products leads to pest-related crop losses globally varying from approximately 50 percent for wheat to over 80 percent in cotton production, which with the use of pest management products could be reduced to 26 percent - 40 percent.⁹ Limited presence of agro-retailers coupled with lack of monitoring and law enforcement result in presence of counterfeit products in rural markets. Their poor performance reduces farmers' trust in input effectiveness. Smallholder farmers are also unable to access timely and sufficient information on effective usage of inputs, better farming practices and financial advice that ultimately result in untapped opportunities for these farmers to enhance productivity.

Business Model

Several enterprises address challenges faced by smallholder farmers in the pre-harvest stage. They provide access to inputs, make inputs affordable and disseminate information about solutions to enhance agricultural productivity.

Components of the model

Figure 1. Components of the model



Provide access to inputs

Most commercially available farm equipment is unsuitable for small plots. In order to address this challenge, a number of enterprises design inputs and machinery for use in small plots. For instance, Kamal Kisan's products, such as the *Vegetable Planter* and *Mulch Layer* are designed for use in farms that are smaller than two hectares, and enable farmers to substitute labor-intensive processes thereby decreasing dependence on labor and associated labor costs. Driptech manufactures and distributes micro-irrigation kits that are suitable for use in small fields. Some enterprises provide agricultural inputs to rural farmers through partnerships with local retailers and technicians. Sidai provides livestock and veterinary services to farmers through franchised *Livestock Service Centers* that are managed by local, trained technicians. The enterprise also works with regulators to advocate for improved law enforcement measures to monitor standards for veterinary services thereby increasing trust with smallholder farmers.

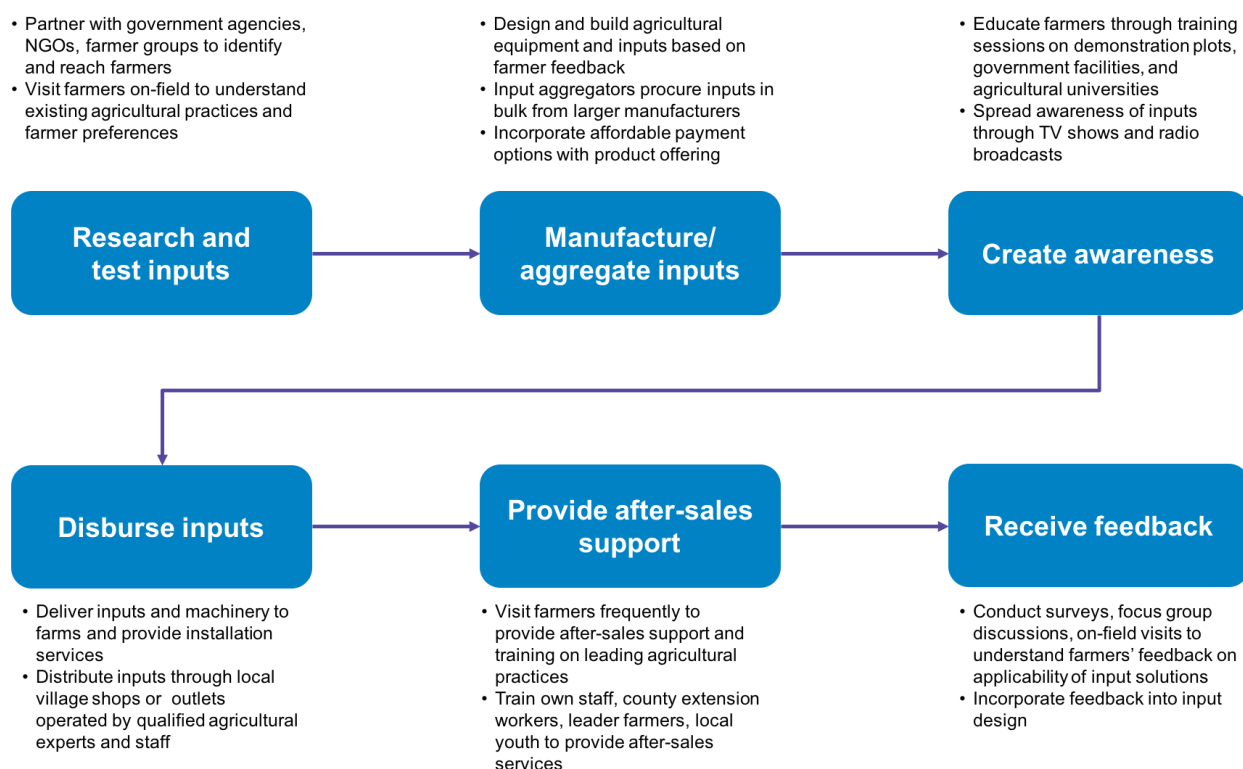
Make inputs affordable

Enterprises enable marginal farmers in reducing costs incurred on inputs and farming. They manufacture low-cost products that are sold in smaller affordable packages; provide installment financing to lower the burden of upfront costs, and sell inputs to a group of farmers who share the costs and further lease it to other farmers. myAgro, a company operating in Mali and Senegal provides a savings based mechanism for farmers to buy input packages of their choice – input packages could include different types of seeds, fertilizers, and training services. Farmers identify an input package that they would like to purchase, and set a savings target to match the cost of the inputs package. They then purchase myAgro 'planting cards' – scratch cards from local vendors at flexible amounts and frequencies and continue to add money to this card until the savings target is reached. Once the target is reached, the farmer can avail of the inputs package. myAgro's mechanism allows farmers to access quality inputs without availing credit financing. KickStart's rent-to-own model provides farmers a micro-leasing option to acquire inputs.

Deliver information

Enterprises such as Eruvaka Technologies, a company based in India offers data-analytics-supported aquaculture equipment that enables farmers to monitor their ponds through a smart-phone and adjust the amount of fish feed based on water quality and weather data. The real-time monitoring mechanism helps farmers increase yields and reduce unnecessary input costs. Micro Drip, a drip irrigation manufacturer and supplier trains farmers in using its irrigation solution effectively; the enterprise also partners with stakeholders such as Thardeep Rural Development Program and Universal Agro Chemicals to provide technical training on crop productivity.

Figure 2. Process of the model



Cost Factors

Solutions to improve agricultural productivity include providing access to quality inputs and suitable equipment, and improved knowledge to use inputs effectively. Many enterprises design and manufacture farm equipment and inputs by engaging with farmers and incorporating their suggestions. Costs incurred on research & development, product design and testing constitute a significant share of the overall costs for enterprises providing productivity enhancement solutions (Figure 3). The team interacts with smallholder farmers to understand the nature of labor intensive activities, prevalent cropping methods and the intended benefits of mechanizing an activity. For example, Kamal Kisan incurs over 30 percent of its total costs on pre-design research and 25 percent on product development.

Figure 3. Cost factors of the model



Input aggregators incur costs in procuring inputs from large manufacturers and repackaging inputs

Enterprises also require significant working capital to maintain inventory and ensure continuous supply of inputs to farmers in remote areas. Since enterprises need to educate smallholder

farmers about the benefits of quality inputs and equipment before they acquire them as customers, they also incur costs towards hiring field agents and agronomy experts, and establishing demonstration plots to conduct training sessions. Distribution costs comprise a significant share of total costs; enterprises either directly undertake last-mile delivery to farms or partner with farmer groups, farmer co-operatives and local village stores for distribution in remote areas. In addition to these costs, input aggregators incur costs in purchasing bulk quantities of seeds,

fertilizers, animal feed and other agricultural inputs from input manufacturers, repackaging them and selling these inputs to small-scale farmers.

Revenue Streams

Revenues are generated through sales of pre-harvest inputs such as seeds, feed, fertilizers, crop protection solutions, irrigation systems, farm machinery and equipment. Enterprises such as Proximity Design, Sun Culture, SAS Motors and Micro Drip manufacture and sell inputs to small-scale farmers while others like Sidai and myAgro aggregate inputs from large input manufacturers and sell these inputs to farmers. Enterprises also earn revenues by providing training and agronomy support to farmers; these services are provided either as part of the package with inputs or as a stand-alone service to farmers who may choose to purchase inputs after undergoing the training. For instance, Hydroponics Africa conducts training sessions on hydroponics farming in its demonstration plots and charges a fee of KSH 1000, which is waived from the total price of a hydroponics system if a farmer opts to procure a system after attending the training. Hydroponics Africa's hydroponics systems range from USD 50 for small farms to USD 29,000 for commercial size farms

myAgro customers are charged USD 20 – USD 30 for input packages that include seeds, fertilizers and training services

Financial Viability

The viability of the model hinges on the uptake of improved inputs by smallholder farmers, and for this, enterprises need to understand smallholder farmer needs, design inputs and machinery specific to those needs, and engage with farmers to educate them on the benefits of adopting improved inputs. Donor grants are important in supporting research, development and awareness creation activities prior to the actual sale of inputs and agricultural equipment to smallholder farmers. Enterprises providing yield-enhancing inputs and equipment have to engage extensively with farmers to understand their specific needs and preferences - this process often takes over a year.

In order to be cost efficient, enterprises aggregate farmers for research and testing of inputs, leveraging partners such as non-governmental organizations, government employed county extension workers and farmer co-operatives who engage directly with farmers, thereby decreasing costs incurred in reaching remotely located farmers. Enterprises such as Kamal Kisan ensure cost-effectiveness by designing and developing farm machinery based on farmer demand and competitor solutions. It develops machinery only if a majority of farmers perceive a cost benefit to substitute labor-intensive activities with mechanization and if the market is not already over-crowded.

Another effective mechanism is the integrated value chain model that companies like Siddhivinayak Agro employ. With the help of a bank loan, they provide 100 percent of the inputs and advice to farmers for potato cultivation—no cash goes to farmer only inputs and then they buy back all the harvest and give to the farmer net income after deducting all the input and other costs. This model reduces the risk for a bank and makes it easier to provide input finance.

Smallholder farmers' ability and desire to adopt yield-enhancing inputs is largely reliant on their understanding of the benefits, capacity to pay for these inputs and the ease or practicality of adopting these solutions. Farmers either have limited access to input financing or are reluctant to add to their debt burden to procure quality inputs in markets that are over-crowded with low-cost, sub-standard inputs. SunCulture's target farmers typically do not have the necessary capital to afford inputs; this is reflective in the fact that despite 65 percent of Africa's labor force employed in agriculture, less than 1 percent of outstanding loans are provided to the sector.¹⁰

Even when farmers have the capital, they would rather deploy it in competing uses as they are unaware of the benefits of these solutions and therefore, are reluctant to lock funds in for an entire growing season.¹¹ In response to this challenge, SunCulture is currently designing its own flexible payment asset-financing product. This will ensure customer stickiness and continuous sale of products. myAgro sells agricultural inputs using a savings based approach whereby farmers save ahead for fertilizers, seed packages,

agricultural machinery, and training services using a mobile layaway mechanism. They save towards a selected inputs package, can avail of it once they reach their savings goal; 35 percent of myAgro's operations are currently covered by farmer payments, and the remaining costs are covered by donor funding.

Enterprises that operate as input aggregators purchase inputs in bulk quantities from large input manufacturers allowing them to avail discounted prices. Their ability to maintain comfortable margins between their procurement prices and the prices they charge farmers determines their financial viability. This is further strengthened by ensuring low costs on maintaining inventory and repackaging inputs. Enterprises also require significant funding support during the initial years of operation to support their research and design activities. This is particularly so for enterprises that manufacture agricultural machinery as they spend considerable time conducting in-depth research on smallholder farmer practices and developing inputs and machinery that cater specifically to smaller plot sizes, and intensive farming practices. Typically, they ensure financial viability by leveraging grant funds for these activities.

Partnerships

Pre-harvest input enterprises partner with various ecosystem players in order to understand smallholder farmer needs, establish trust with the farmers and promote awareness to enable adoption of the productivity enhancement solutions. Enterprises partner with farmer co-operatives, farmer groups, agricultural research organizations and rural agriculture universities to conduct research and test prototypes of inputs and farm equipment. For instance, Sidai works with research organizations such as *Diagnostics For All* to conduct field testing and co-design pregnancy diagnostics for livestock, and *DSM* for feed quality testing. Some enterprises partner with research centres and universities to source data such as region-specific types of crops, total cultivated land use, land holding size, and agronomic conditions to inform new product development.

It is important for input enterprises to demonstrate the value of their solutions to smallholder farmers – enterprises use demonstration plots and training facilities of government research centres and agriculture incubators to showcase their products to farmers. They also provide training sessions to farmers on leading agricultural practices: for instance, Hydroponics Africa conducts training sessions on hydroponics farming in *Kenya Climate Innovation Centre's* demonstration plots and Kamal Kisan leverages *Krishi Vigyan Kendra's* facilities to train farmers on the benefits and appropriate usage of agricultural mechanization. Enterprises market and distribute their products to farmers through partnerships with farmer co-operatives, local government agencies, agriculture universities and media-based agricultural information service providers. Some enterprises partner with buyers of smallholder agricultural produce, such as sugarcane mills and greengrocers to reach potential farmer customers. Enterprises also find it beneficial to partner with non-governmental organizations (NGOs) to increase their market access to farmers located in remote areas. Multiple input enterprises partner with financial institutions to provide end-user financing to farmers for purchase of inputs and agricultural machinery.

Partnership models may also involve contractual agreements between the enterprise and the partner stakeholder; for instance Hydroponics Africa provides train-the-trainer sessions on hydroponics farming to staff of the *Uganda National Council of Science and Technology* under a Memorandum of Understanding (MoU) agreement, Sidai's partnership with *Global Good* for fertilizer quality testing involves a MoU.

Implementation: Delivering Value to the Poor

Awareness

Improved inputs and machinery can lead to increased productivity for smallholder farmers. However, limited access to pre-harvest credit, uncertainties in payback periods, existence of counterfeit products, and lack of knowledge on yield-enhancing products leads to resistance towards adopting improved inputs and agricultural equipment.

In order to address these challenges, enterprises interact with farmers to educate them on the benefits and value of using better quality inputs. Field agents conduct frequent meetings with farmer communities to disseminate information about the enterprises' products. They demonstrate the inputs and equipment in training sessions, and engage trained agro-experts to sell their inputs – these experts educate farmers on the advantages of using quality inputs vis-à-vis counterfeit inputs and help to build trust amongst farmers. Some enterprises partner with local and popular media to showcase their products and services on information platforms or leverage radio to broadcast information on the brand in vernacular languages. For instance, Sidai partners with Mediae's TV program *Shamba Shape Up* and call center service *I-Shamba* to educate farmers on its brand. The Real IPM Company, a pest management solution provider in Kenya has created an online library - *Real Insight Library* for farmers. The library provides farmers access information about the use of quality inputs and agricultural best practices.

Enterprises also rely on early adopters to spread awareness about their products within their local communities; they partner with farmer co-operatives and farmer groups to identify farmer champions who can validate the promise of productivity enhancement and spread the message among other smallholder farmers. Local government agencies, research organizations, universities and NGOs also play a pivotal role in aggregating farmers and educating them on the benefits of yield-enhancing inputs. Some enterprises partner with agro-dealers with complementary interests. For instance, myAgro partners with local village stores who have strong community networks to disseminate information on its input packages and its mobile layaway solution. Kamal Kisan partners with agro-dealers selling drip irrigation systems to increase awareness about its mulch layer.

Acceptance

Close interaction with smallholder farmers and customization of inputs and equipment to suit farmer preferences are key factors in winning acceptance amongst smallholder farmers. Even though mechanization might save labor and energy, crop production will not intensify if the equipment is not adapted to social, economic and environmental conditions.¹² SAS Motors develops machinery that is suitable for use in small-scale plots in India; the enterprise's *Angad Diesel Hal* is a low cost light-weight mechanized plough that is specifically designed for use by women working in small fields. Some enterprises, such as SunCulture and Kamal Kisan, co-create agricultural machinery with smallholder farmers, taking into consideration their views on plot sizes, design preferences, applicability to prevalent farming practices and trade-offs between mechanization and labor intensive processes. Constant engagement with farmers through SMS, surveys and on-field visits also enable enterprises to improve their products over time and gain customer acceptance.

Enterprises engage with local champions including village leaders, notable farmers, and Self-Help Group (SHG) leaders to educate farmers and receive feedback. Some enterprises customize their products based on the different regions that they serve; myAgro customizes its input packages which typically comprise seeds, fertilizers and training services, providing peanut packages for women in Mali, vegetable packages for women in Senegal, and maize and shorgum packages for men in Mali. In addition, an important factor determining smallholder acceptance is the time taken for inputs to reach farmers – easier access to inputs increases acceptance rates amongst farmers.

Accessibility

Enterprises need to establish effective last-mile delivery channels to reach smallholder farmers in remote rural areas. Some enterprises adopt a high-touch model wherein they deliver productivity enhancement solutions directly to farmers. For instance, in its initial stage of operations, farmers who purchased SunCulture's irrigation system had to collect the product from a central location and install it in their fields - this process could take up to 8 days. However, based on customer feedback, SunCulture amended the process by redesigning the product to fit into modular boxes that could be reassembled at site. It also transported the product directly to the farm where a SunCulture trained technician installed the product, reducing total delivery time to 1 day.¹³

Other enterprises build innovative partnerships for effective distribution. Hydroponics Africa partners with the Ministry of Agriculture in Kenya and trains its local county extension workers to deliver and install systems in farms. Sidai identifies and trains ‘Sidai Model Farmers’, who deliver the enterprise’s products to farms and provide training and after-sales support. Some enterprises partner with remotely located village shops or operate outlets on a franchisee basis to sell their products. For example, myAgro identifies local vendors who have strong community networks and also operates a network of Livestock Service Centres, fitted with small diagnostic laboratories to support farmers with product selection.

Affordability

High costs associated with modern inputs, compounded with limited availability of credit deter smallholder farmers from purchasing productivity enhancement inputs. Enterprises serving smallholder farmers address these barriers in innovative ways. A number of enterprises sell inputs in different package sizes at differentiated prices, thereby allowing farmers to purchase inputs in smaller increments at prices that they can afford. Enterprises such as Kick Start International and myAgro provide innovative financing options such as savings based payments, rent-to-own models and variable pay-as-you-go strategies, to make inputs affordable to farmers. Bundling value-added services such as delivery, installation, after-sales services and agronomy support makes it cost-effective and simpler for smallholder farmers to trust and adopt productivity enhancing inputs.¹⁴ SunCulture’s drip irrigation kit, which is priced at USD 900/acre and its solar water pump, which costs USD 1500 include delivery and installation costs along with additional agronomy support accessible via SMS and call centres. Its competitors provide similar products priced at USD 1300/acre and USD 2600 but only cover product costs, offering no value-added services.

Results and Cost Effectiveness

Access to affordable high-quality inputs coupled with supporting knowledge on sustainable agricultural practices results in increased yields, better incomes for farmers, increased bargaining power, and higher standards of living for farmer families.

Scale and Reach

Enterprises providing quality inputs and mechanized solutions to smallholder farmers scale through increasing uptake within their existing markets and widening their reach into new markets. Given the need for hi-touch engagement and farmer education, enterprises achieve scale through innovative solutions, easy to apply features and willingness to provide time and support to customers. Product demonstration allows farmers to understand the value of inputs offered by these enterprises thereby increasing the number of farmers subscribing to these solutions. Ease of product use also increases the number of buyers—SAS Motors designs its products for small farms and Kamal Kisan designs its farm equipment such that local blacksmiths can address minor repairs to the products, which has helped in building trust amongst farmers. Sidai has been able to rapidly scale its operations in Kenya through its direct delivery options and network of livestock service centres in remote areas; it is exploring opportunities to expand to Uganda and Tanzania.

Table 1. Reach of example companies

Company	Country of operation	Years of operation	Number of farmers reached
Kamal Kisan	India	1	Over 400 small-scale farmers in Karnataka, India
myAgro	Mali and Senegal	5	Over 25,000 farmers (of which 18,000 farmers have completed paying for their packages)
Sidai	Kenya	5	100,000 farmers

Improving Outcomes

Productivity enhancement input enterprises not only tailor agro-inputs and machinery for use on smallholder farms. They also make these inputs cost-effective for farmers to use and invest time in

imparting the requisite knowledge on the benefits of using these inputs. Farmers in turn are able to access low-cost quality inputs, make their pre-harvest processes more energy and water efficient, increase their families' food security, health and nutrition. Apart from cost saving for farmers, SunCulture's irrigation kits enabled saving of 171 million litres of water and 360000 litres of diesel fuel in a year; using its systems as an alternative to traditional irrigation kits also helped in reducing 397,440 kilograms of carbon dioxide emissions.¹⁵ Similarly, Hydroponics Africa enabled urban slum households to install its systems on rooftops and vertical walls thereby increasing food security for low-income urban farmers. The enterprise's systems also helped farmers conserve water in their cultivation processes – they utilized 220 litres of water through hydroponics systems in comparison to 500 litres by using traditional irrigation kits.¹⁶

By adopting efficient irrigation systems, smallholder farmers in Andhra Pradesh decreased energy use by 350-450 KWh/hectare, increased water efficiency by 30 percent-60 percent, increased yields by 40 percent-110 percent and increased

Cost Effectiveness

According to a 2015 study, smallholder farmers can increase net annual incomes by 80 percent to 140 percent with access to productivity-enhancing technologies such as improved seeds, micro-irrigation systems or improved cow breeds.¹⁷ Enterprises providing drip irrigation, solar-based pumps and hydroponic technology enable farmers to substitute energy and water intensive farming techniques. For instance, a research study¹⁸ measuring the impact of efficient irrigation technology on smallholder farmers highlights cases of farmers in Andhra Pradesh, India who adopted efficient irrigation technologies to decrease costs of labor, fertilizer and pesticides by 25 percent. Farmers in Burkina Faso who adopted drip kits and motor pumps witnessed an increase of 395 percent in gross margins with a payback period of 1 year; and farmers in Zambia increased their gross margins by 68 percent using drip kits and treadle pumps.¹⁹

SunCulture's impact measurement shows that its AgroSolar irrigation kit saved farmers USD 10,416 per acre per year as compared to the costs incurred in using a traditional petrol pump and furrow irrigation. Maize farmers who used the enterprise's equipment earned an annual revenue of USD 14,000 as compared to USD 600 using traditional irrigation methods.²⁰ Improved irrigation methods also allow farmers to grow water-intensive crops such as watermelons and cotton, in addition to the regular crops that they grow, resulting in additional sources of income. A number of farm input enterprises focus on organic agriculture, using non genetically-modified seeds, organic fertilizers and agro-inputs which leads to an increase in potency of crops, restoration of soil fertility, health advantages and preservation of biodiversity.²¹ Farm mechanization enables farmers to decrease their dependence on labor and its associated costs; for example, farmers in India spend over 40 percent of their cultivation costs on labor.²² In addition, agricultural mechanization helps in increasing the area under cultivation, improving quality of cultivation increasing yields, reducing excessive workload and in some cases, providing an additional source of income for farmers who rent their equipment to other farmers in their communities.²³

Taking it to Scale

Challenges

Large input providers have typically been reluctant to address the needs of smallholder farmers due to challenges in their ability and willingness to pay. Additionally, the lack of awareness about agricultural best practices and the remoteness of these markets also add to the cost of servicing this customer group. Against this background, enterprises that have structured their businesses to serve smallholder farmers need to overcome multiple barriers in attaining financial viability and scaling their operations.

Difficulty in regulating remote markets and the low margins on inputs allow inferior quality and counterfeit products to thrive and be accepted by farmers. For instance, a number of input suppliers in Cambodia sold inferior inputs to farmers by visiting them at their homes.²⁴ Such information asymmetries create lack of trust in farmers and resistance towards buying reasonably priced and good quality productivity

enhancement inputs, Enterprises therefore work closely with input manufacturers to ensure consistency in quality and works with trained personnel to serve smallholder farmers.

Enterprises typically need to adopt a high-touch engagement model, involving frequent after-sales support in order to maintain farmers as repeat buyers; however, lack of sufficient qualified staff and personnel becomes a challenge for these enterprises. Reaching remotely located farmers increases transaction costs for enterprises serving smallholder farmers – a number of enterprises partner with local community organizations such as county workers, farmer co-operatives and non-governmental organizations to undertake awareness creation, farmer education, marketing, distribution and after-sales activities to keep costs minimal. In addition, weak infrastructural facilities increases logistics costs, a challenge that is particularly applicable for bulky products.²⁵ Lack of accurate data on smallholder farmer practices and preferences makes it difficult for enterprises to design productivity enhancement solutions, estimate demand and gauge optimal levels of inventory.

Farmers often require financing support to fund upfront costs associated with inputs, even in cases that involve shorter pay-back periods. However, due to the limited understanding of smallholder farming practices and the perceived risks in lending to these farmers, most financial institutions fail to provide end-user financing to farmers making it difficult for enterprises to sell inputs to such farmers. In addition, many enterprises lack access to capital which restricts them from providing leasing or variable payment strategies to farmers in order to afford upfront costs of inputs. Limited finance support also prevents enterprises from stocking sufficient inventory, conducting awareness activities, hiring qualified staff and expanding to other markets.

Role of Government and Policy

Given the lack of access to quality inputs, low availability of financing and limited awareness among smallholder farmers, governments have the potential to play a major role in supporting enterprises that cater to smallholder's pre-harvest requirements.

A number of governments provide exemptions on sales and value added taxes (VAT) enabling enterprises to offer high-quality inputs to smallholder farmers at lower costs. However, frequent changes in policies related to VAT might cause input price instability, ultimately leading to a loss in smallholder farmer customer base. For instance, the Government of Kenya revised its position on VAT on agricultural inputs making it challenging for input manufacturers to retain affordable prices; in 2012, it introduced a bill that proposed a tax on agricultural inputs, which resulted in a significant rise in input prices. Tegemao Institute of Agricultural Policy and Development's research²⁶ on the impact of imposing the 16 percent Value Added Tax (VAT) on animal feed found that manufacturers were forced to raise their feed prices, which they passed on to consumers, resulting in a 70 percent -100 percent decline in profits for producers. The Government reversed the VAT rule in May 2014. Similarly, the Government of Honduras is in the process of proposing a bill that will exempt payment of 15 percent sales tax on import of agricultural machinery and agricultural implements.²⁷

Bureaucracy, lack of guidelines and restrictive regulatory policies are amongst the top factors that hamper growth and scale of private enterprises in the productivity enhancing input space. For instance, a number of enterprises spend considerable time in interacting with government officials to receive subsidies and exemptions; agricultural producers in Nicaragua have cited that excessive paperwork and lack of agility delays the process in receiving tax exemptions for purchase of farm machinery and equipment.²⁸ The Government of El Salvador excluded high quality seeds from its agricultural package. According to the Agricultural Suppliers Association, this move will prevent higher yields since seed varieties distributed by the Ministry of Agriculture and Livestock typically produce 20 percent less production per acre than the seeds available in international markets.²⁹

Several governments across developing countries offer subsidies in the form of targeted vouchers to enable farmers to adopt high-quality inputs and agricultural machinery. Ten African governments spend roughly US\$1 billion annually on input subsidy programs, amounting to almost 30 percent of their public

expenditures on agriculture.³⁰ However, it is important for governments to use input subsidies judiciously, focused on increasing trials and adoption of high-quality inputs, boosting private player participation³¹. They should also adopt a strategy to gradually enable farmers to move away from relying on subsidies to eventually procure yield-enhancing inputs at market prices. In addition, enabling initiatives such as the MoU between the National Seed Association of India and the Bangladesh Seeds Association help increase availability and accessibility to quality seeds.³² Regulatory initiatives in Philippines have enabled mechanization levels to increase from 1 hp/ha to 2 hp/ha.³³

Enterprises that serve smallholder farmers also benefit from partnerships³⁴ with governments that involve their participation in various capacities: aggregation of farmers, awareness generation on high-quality inputs, provision of facilities that can be used by enterprises to test inputs and demonstrate product usage to farmers, marketing and distribution of inputs to remotely located farmers, installation and after-sales support to farmers. For instance, Hydroponics Africa trains government employed county extension workers in hydroponics farming and further leverages these workers in sales and marketing activities. County workers install hydroponics systems, conduct frequent consultation visits to farms and undertake after-sales services. The enterprise partners with the Ministry of Agriculture in Kenya on a non-contractual basis and provides train-the-trainer based training to staff of the Uganda National Council of Science and Technology under a MoU agreement.

Conclusion

Enterprises that manufacture and distribute yield-enhancing inputs open up the market for quality inputs to small-scale farmers. Farmers benefit in terms of reduced costs and increased productivities. However, uptake of such inputs is closely related to the cost of these solutions and the availability of end-user financing. In order to keep costs low and ensure high quality, input manufacturers may use locally sourced materials, partner with financial institutions to provide end-user financing to farmers, and cross-subsidize their product offerings to smallholder farmers as well as commercial farmers at differential prices. Input aggregators may purchase inputs in bulk from larger input manufacturers in order to avail lower prices that can then be passed onto smallholder farmers.

With low-quality alternatives available in the market and farmers resistant to changing traditional cultivation practices, it is imperative for enterprises to educate and persuade farmers on the benefits of their products in order to increase uptake and enable scale. Partnering with NGOs, government agencies, farmer co-operatives, research organizations and agricultural universities helps enterprises in reducing farmer training, marketing, distribution, and after-sales costs and reaching a larger farmer audience.

Table 2. SEs: Productivity enhancement

Company	Country	Solution Description
Driptech	India, China, Multiple African countries	Driptech produces affordable, high-quality irrigation systems designed for subsistence and small-plot farmers. The company's system can be scaled up or down depending on the size of the field, thus giving it a technological advantage over both capital intensive commercial drip irrigation and water intensive flood irrigation.
Eruvaka Technologies	India	Eruvaka Technologies develops on-farm diagnostic equipment for aquaculture farmers. The enterprise integrates sensors, mobile connectivity and decision tools for affordable aquaculture monitoring and automation.
Hydroponics Africa	Kenya, Uganda, Tanzania	Hydroponics Africa specializes in manufacturing, installation and marketing of hydroponic systems. It trains farmers in hydroponic farming technology, which is not only resilient to climate change but also provides superior nutritional value and growth at cheaper input costs.
Kamal Kisan - Simple Farm Solutions Private Limited	India	Kamal Kisan develops cost-effective mechanization solutions for India's small and marginal farmers, to reduce labor dependence and increase profitability.
KickStart International	Kenya, Zambia, Ghana, Democratic Republic of Congo, Burkina Faso, Ethiopia, Malawi, Mali, Mozambique, Nigeria, Rwanda, Senegal, South Sudan, Tanzania, Uganda, Zimbabwe	KickStart develops and mass produces high quality irrigation tools that meet the needs of the poorest farmers in Africa. KickStart offers mobile layaway and rent-to-own models as financing options to farmers.
LishaBora Hydroponics Ltd.	Kenya	LishaBora manufactures hydroponically-grown dairy feed that is nutritious and affordable in order to raise the amount of milk produced by smallholder dairy farmers.
Mekelle Farms PLC	Ethiopia	Mekelle Farms PLC is a poultry company that operates a breeding farm and hatchery in Ethiopia. It distributes live chickens to a network of rural farmers. The Company produces highly fertile, disease-resistant chickens and sells them to smallholder farmers in Ethiopia.
Micro Drip (Pvt) Ltd.	Pakistan	Micro Drip develops and manufactures drip irrigation systems along with agricultural training and after-sales support to small-holder farmers in Pakistan.
myAgro	Mali, Senegal	myAgro uses a mobile technology platform to provide access to fertilizer and seed packages on layaway. In addition, the enterprise also provides technical training, market access to premium buyers and access to asset loans for appropriate small-scale farm equipment.
Proximity Design	Myanmar	Proximity Design designs and manufactures affordable and energy-efficient irrigation products for farmers.
SAS Motors	India	SAS Motors develops low cost agricultural machinery such as the Angad Diesel Hal and power tiller for use in small farm plots.
Sidai Kenya Ltd.	Kenya	Sidai provides livestock and veterinary services to pastoralists and farmers in Kenya through franchised and branded Livestock Service Centres that are equipped to provide quality animal health products and professional technical advice.
SunCulture	Kenya	SunCulture designs and sells low-cost solar powered water pumps and drip irrigation kits to smallholder farmers in Kenya. The company delivers the products to the farmers and provides installation and after-sales support.

<u>The Real IPM Company Ltd.</u>	Kenya, Zambia, Zimbabwe, Ethiopia, Tanzania, South Africa	The Real IPM Company Ltd. designs integrated pest management programs for farmers in Kenya. It also conducts training sessions on agricultural practices in demonstration plots.
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Additional Reading

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CASE STUDY: KAMAL KISAN



KAMAL KISAN

Founding year: 2013

HQ: Bangalore, India

Countries of operation : India

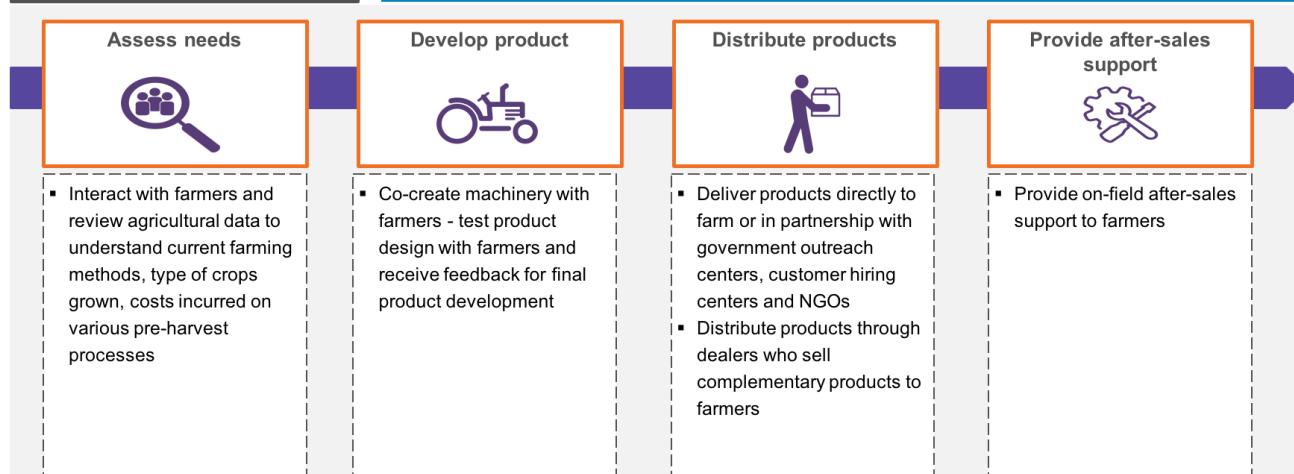
Orientation: For-profit

Employees: 10

Turnover: INR 10 Lakhs

Farmers in developing countries predominantly practice smallholder farming, cultivating crops in plots smaller than two hectares in size. Modern machinery is typically built for use in large farms and don't match traditional farming processes followed by farmers in these countries. In India, the lack of access to suitable mechanization equipment, coupled with high levels of migration of labor force from rural areas results in farmers spending up to 40% of total cultivation costs on labor.

Kamal Kisan is a social enterprise that designs and builds agricultural machinery for India's small and marginal farmers. The enterprise's approach includes understanding relevant needs and preferences of smallholder farmers and co-creating cost-effective and energy efficient machinery. The products offered by the enterprise include a vegetable planter, mulch layer and sugarcane planter. It has sold its products to 385 farmers in Karnataka. Kamal Kisan's solutions have helped farmers decrease labor costs by 50% and saved over INR 14 Lakhs for its customer farmers.



Operating Model

Kamal Kisan designs and manufactures cost-effective and energy-efficient farm mechanization solutions for small and marginal farmers in India, with the aim to decrease labor costs by 50 percent and increase productivity by 50 percent. The enterprise identifies the products for development based on factors including crop land under cultivation, crops and agricultural processes that are heavily labor dependent, processes that contribute significantly to the total cost of cultivation, and existing availability of solutions in the market.

Kamal Kisan's target customer base includes horticultural farmers and sugarcane growers who earn USD 10000-12000 per year per acre.

The enterprise co-creates agricultural machinery with farmers by incorporating their views on the applicability of the farm equipment to their current farming processes and small plot sizes. By incorporating customer feedback on product design, the enterprise makes it easier for farmers to adopt its products. It identifies farmers who are willing to participate in the research and testing phase by leveraging on the farmer network of Krishi Vigyan Kendra - a government based agricultural extension center, agricultural universities, and agricultural businesses such as sugarcane mills. In addition, it partners with Krishi Vigyan Kendra for state and district level data related to current agricultural practices adopted by smallholder farmers, and potential areas of intervention to improve agricultural technology and productivity of smallholders.

Kamal Kisan adopts various strategies to create awareness, generate demand and sell its products. It conducts on-field visits to rural farms, interacts with farmers and farmer co-operatives on the issues that they face due to labor-intensive cultivation processes and provides knowledge on the benefits of adopting



WORLD BANK GROUP

This series on Inclusive Innovations explores business models that improve the lives of those living in extreme poverty. Editors are Elaine Tinsley and Natalia Agapitova. Researched and developed by Intellectap.

the enterprise's simple technology as a substitute to human labor. The enterprise works with local community leader farmers to further engage in farmer-to-farmer demonstrations of its products. It partners with agro-equipment dealers, who sell complementary products to farmers, to expand its marketing reach. In addition, Kamal Kisan partners with agricultural universities and local government organizations to reach remotely located farmers. The enterprise either delivers its products directly to farmers or sells its products via partner agro-dealers.

The *Vegetable Planter (USD30)* allows 1 laborer to plant 1 acre of vegetables within 4 hours as compared to 4 laborers using a conventional planter. The *Mulch Layer (USD525)* can lay 1 acre of mulch film in 3 hours using 2 laborers instead of 6 laborers. The *Sugarcane Planter (USD 1425)* combines the processes of creating ridges, dropping cane material and covering with soil into a single pass within 4 hours per acre.

Kamal Kisan provides on-farm after-sales services. The uncomplicated design of its farm equipment allows farmers to seek maintenance and repair support from local blacksmiths. This is a key factor in building farmer confidence.

Financial Sustainability

Farmers are able to relate to the value of substituting expensive labor-intensive processes with Kamal Kisan's affordable mechanized solutions since the enterprise involves farmers in the product design and development stage. As a result, smallholder farmers are more open to purchasing the enterprise's products. However, this interactive process requires significant upfront research and testing costs to be incurred by the enterprise prior to the sale of solutions.

Kamal Kisan receives financial support (debt) from IIT Madras' Rural Technology Business Incubator. The enterprise has also received funding and is incubated by the Villgro Innovation Foundation. In addition, it has received grant funding by the Ministry of MSME for research and development activities.

Impact

Kamal Kisan's affordable and sustainable mechanized solutions have enabled 50 percent reduction in labor costs which results in 10-50 percent reduction in total cultivation costs. The use of machinery has also led to a significant reduction in the time spent on farming operations. The energy-efficient mulch layer, in combination with drip irrigation, has helped farmers reduce water usage by 50 percent to 80 percent allowing farmers to grow additional water-intensive crops such as watermelon and cotton. Kamal Kisan also engages village level entrepreneurs to lease its equipment on a rental basis to farmers to generate additional income.

Challenges and Lessons

Owing to its high-touch operating model, Kamal Kisan faces challenges in providing personalized post-sales support to farmers. Reaching remotely located farmers has also proven to be time-consuming and resource-intensive for the enterprise. Currently, it deploys its own team to provide after-sales services. However, going forward, the enterprise plans to partner with dealers who could provide last-mile support services.

In addition to farmer feedback on product design, the enterprise also heavily relies on data to support the initial assessment of product development. However, a severe lack of reliable data on agriculture in India makes it difficult for Kamal Kisan to efficiently conduct its preliminary gap assessment and product research.

CASE STUDY: SIDAI

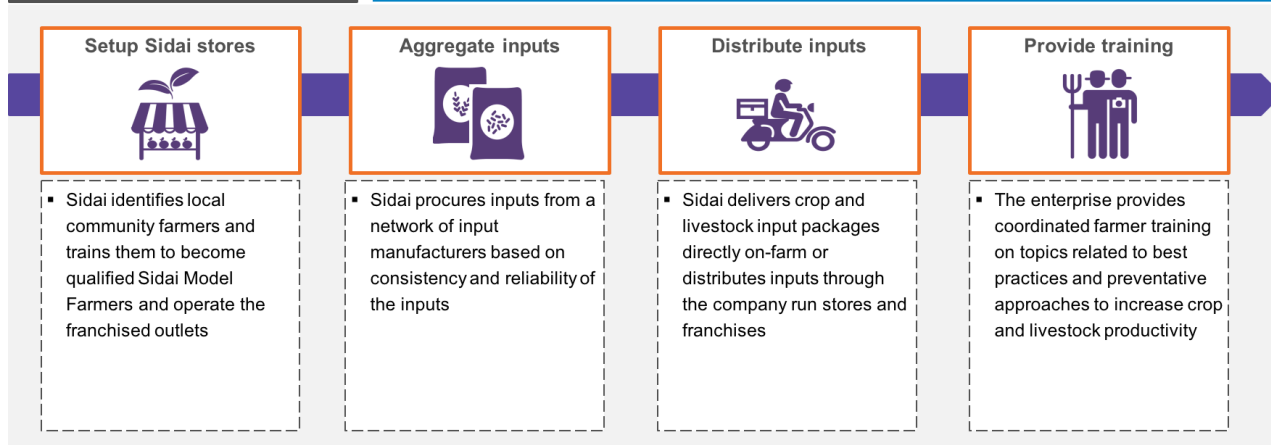


Founding year: 2011
HQ: Nairobi, Kenya
Countries of operation : Kenya
Orientation: For-profit
Employees: 58
Turnover: USD 5.84 Million

Remotely located farmers in Kenya lack access to high-quality crop inputs, veterinary and on-farm services at fair prices. Lack of regulations related to input standards further accentuates the problem of unqualified sellers hawking counterfeit goods and low-quality products to ill-informed smallholder farmers and pastoralists. In addition, the nature of the inputs market is largely government-driven or donor-aided resulting in distorted markets.

Sidai is a social enterprise that aggregates inputs from its network of input manufacturers and distributes inputs to small-scale farmers through its franchisee outlets or through on-farm delivery. In addition, the enterprise also provides on-farm training services to farmers on crop and livestock practices.

The enterprise serves as a one-stop-shop for farmers, stocking over 400 products including crop inputs, animal feed and veterinary medicines. Sidai has sold inputs to over 100,000 farmers and has trained 39,738 farmers on improved practices to increase crop and livestock yield.



Operating Model

Sidai provides quality tested inputs to smallholder farmers and pastoralists in Kenya. The enterprise purchases inputs from local suppliers as well as some of international manufacturers that are interested in entering the Kenyan market. Sidai aggregates and sells these inputs in small pack sizes. It distributes products to farmers either directly to their farms or through its outlets and Livestock Service Centres located in remote areas. Sidai has 12 company run stores, 117 franchises, and 350 stockists.

Sidai's model focuses on driving uptake of yield-enhancing inputs by building trust among farmers and creating awareness on the benefits of using improved crop and livestock inputs. The enterprise adopts various strategies to educate farmers.

- It includes supporting description and guidance on proper use of inputs on the product packaging.
- Sidai outlets and stores are run by trained personnel who provide information on product selection to farmers. Most outlets are fitted with small diagnostic laboratories to ensure that diseases are diagnosed correctly and the right product is used.
- It trains field staff that educates farmers through workshops and demonstration sessions on field.
- It broadcasts training information on the radio in vernacular languages.
- Sidai advertises its brand and products on television programs such as *Shamba Shape Up*, and provides information updates to farmers through *iShamba* – an SMS and call centre service.
- It coordinates group activities and leverages on local brand ambassadors to generate awareness in their communities.

It has reached over 8 million farmers through features in television programs, over 2 million farmers through radio programs and 400,000 farmers through phone & SMS.

The enterprise is a Kenya Veterinary Board accredited CPD training provider and trains all its franchisees on customer service standards and standard operating procedures in order to enable quality and reliable service to customers. Given the inability of the government to provide veterinary services to remotely-located pastoralists in Kenya, Sidai has partnered with the Director of Veterinary Services and GALVmed to distribute East Coast Fever (ECF) vaccines to livestock farmers. The benefit of Sidai's de-centralized model is that it allows smallholder farmers to organize themselves in groups that procure inputs in a cost-effective manner. For instance, each ECF vaccine can treat 40 cattle, making it economical for a larger group of farmers to purchase.

Financial Sustainability

Currently operating at a 14 percent margin, the company expects to grow at a CAGR of 76 percent and profit margins of 25 percent in the next 4 years. The enterprise incurs significant personnel costs towards employing technically-qualified professionals such as qualified veterinarians, and animal health technicians who operate Sidai shops, and provide on-farm extension services and farmer training services. The business model also requires sufficient working capital to stock inventory in the Sidai shops in order to cater to remotely-located farmers. In addition to revenues generated through sale of crop and livestock inputs, Sidai receives some funds from donors to support farmer training and public information campaigns. The growth of the company is financed by debt and equity investments.

Impact

Sidai has provided access to high-quality animal health products to remote parts of Kenya, including northern Kenya that were previously un-served by input dealers with the market dominated by unsustainable donor-funded handouts of free products. Through its network of franchised and company-managed branded stores, Sidai has served over 100,000 farmers with genuine inputs and farmer training sessions. It has created 343 jobs, with women constituting 30 percent of its workforce. The vaccine distributed by the enterprise has protected 7,000,000 animals; farmers who have used Sidai's vaccines have seen livestock losses reducing from 30 percent to 5 percent. Sidai has also provided training related to technical and business skills to veterinarians and animal health professionals. Through its partnerships with other stakeholders, Sidai has provided market linkages and capacity building on specialist areas to farmers.

Sidai has initiated pilot projects with milk processors linking dairy farmers with quality inputs and services. The model is based on a check-off system leading to improved milk yields and milk quality

Challenges and Lessons

Sidai's primary challenge relates to pricing its products competitively, in comparison to prevailing prices of inferior inputs available to farmers. In response to this low-price environment, the enterprise focuses on delivering genuine products to farmers, complemented by supporting information and guidance by trained experts—an approach that will drive farmers to understand the added-value and long-term benefit of purchasing Sidai inputs.

Last-mile distribution and on-farm training services to the enterprise's target customer base of remotely-located smallholder farmers in Kenya result in higher operational costs. The founding team would like to reinvest profits in their long-term social benefit initiatives.