AGWATER SOLUTIONS
Improved livelihoods for smallholder farmers

Irrigation Service Providers
A Business Plan

Increasing access to water for smallholders in sub-Saharan Africa

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Imagine this…

Mr. Desmond used to work in Dar es Salaam for a car rental company. Separated from his family, left behind in his village near Rutamba, Desmond was having a hard time. “We were struggling to get along. My wife and my children were trying to grow food on our small bit of land while I was stuck far away in the big city.”

The business incubator program made it possible for Desmond to return to his village and set up his own business. Now Desmond travels around the area with his two diesel pumps hiring out his services as an irrigation water supplier. During the dry season, he can earn US$10 - 12 a day. “Business is good and growing” Desmond says. “More farmers are trying their hand at vegetable growing and they all need irrigation in the dry season.” During the peak season, Desmond hires two part-time helpers to keep his three pumps working at maximum capacity. “Next year I plan to buy a second hand truck and a fourth pump” says Desmond. Desmond was fortunate enough to have the chance to be his own boss. He is back with his family and the future looks good.

Now imagine this…

If Desmond’s story were repeated hundreds of times in small farming communities across Burkina Faso, Ethiopia, Ghana, Tanzania and Zambia it would mean:

375 new irrigation service providers after 2 years irrigating an average of 7.5 hectares per dry season = 2,775 hectares of irrigated vegetable crops. After the first year, 225 self-employed irrigators using small pumps earning an average of US$1240 per dry season cropping cycle. Up to 7500 smallholder farmers earning at least US$760 in supplementary income.

Why this business plan?

- In many sub-Saharan African countries, millions of smallholder farmers derive much needed cash income from irrigated vegetable cultivation during the dry season.
- Most use simple hand-watering methods that are time consuming and limit the area they can cultivate.
- Some farmers use small motor pumps to expand their area and hence profit.
- However, only relatively better-off farmers can afford the initial investment costs and have the means to run and maintain a pump.
- Women farmers, in particular, face trouble accessing motorized pumps.

Domestic demand for fresh vegetables more than tripled in the past decades. With continued population growth, urbanization and improvement in living standards, demand is likely to rise throughout sub-Saharan Africa. Effectively, it could triple from 26 million tonnes in 2007 to 71 million tonnes in 2050.

Smallholder farmers therefore have good prospects for increasing household income and a strong incentive for increasing yields and the area of cultivation. Irrigating with small pumps will become a key factor in their ability to take advantage of this opportunity.

Proposed solution: Irrigation Service Provider

An irrigation service provider owns several portable motor pumps, with which she or he can irrigate farmers' fields. The irrigation service provider takes care of the running costs, operating and maintenance of the pump. Farmers pay a fixed rate per hour that covers all costs and a profit for the service provider.

Depending on the need of the farmers, the irrigation service provider can extend her or his services to providing loans for agricultural inputs, agronomic advice and credit.

Benefits

For local entrepreneurs:

- A profitable business opportunity.

For farmers:

- Affordable access to motorized pumping for those who do not have the means or skills to buy, operate and maintain a pump.
- Access to related services (agronomic/marketing advice and credit).
- The ability to cultivate larger areas and extend the growing seasons, both of which mean higher profits.
- Accessible to individual farmers; no need to organize in a group.

This business plan

- Shows that the irrigation service provider model is a profitable proposition for local entrepreneurs and their customers (farmers).
- Shows that an irrigation service business is profitable under a range of scenarios.
- Shows how the set-up of these businesses can be facilitated by Business Development Services.

CONTENT

Executive Summary

Millions of smallholder famers in sub-Saharan Africa are earning additional income by growing vegetable crops during the dry season. Over 80 percent of these farmers are watering crops using manual labor. There are regions where many of the farmers are already using small motorized pumps, and it is clear that these farmers have substantially higher incomes and better food security than those who depend solely on rainfed production. In other areas there is great potential, but there is a paucity of credit facilities for farmers, information about pumps is patchy and there is a huge discrepancy in prices. The purpose of this business case is to make it possible for more farmers to reap the benefits of pump-driven irrigation.

The case

This business case examines the economic feasibility of establishing irrigation provider businesses. It is based on research from the AgWater Solutions Project in Burkina Faso, Ethiopia, Ghana, Tanzania and Zambia.[1] The case shows how small entrepreneurs can earn a good income selling water pumping services during the dry season and how smallholder farmers can benefit by earning more money growing vegetables. We examine the case from two points of view: that of the smallholder farmer (the customer of the business) and that of the pump service provider (the business owner or entrepreneur).

The rise in demand for vegetable production in domestic and regional markets will mean that it is economically viable for smallholder farmers to increase production. The case further illustrates that poor access to water for dry season irrigation is one of the key factors limiting smallholder farmers and how that challenge can be overcome by establishing a pump rental market.

[1] The AgWater Solutions project aimed to identify investment options and opportunities in agricultural water management with the greatest potential to improve incomes and food security for poor farmers, and to develop tools and recommendations for stakeholders including policymakers, investors, NGOs and smallholder farmers. The lead implementing partners included International Water Management Institute, the Food and Agricultural Organization of the UN, the International Food Policy Research Institute, the Stockholm Environment Institute and iDE. The three-year project, which concluded in mid-2012, was funded by the Bill & Melinda Gates Foundation. The project was implemented in Tanzania, Ghana, Ethiopia, Zambia and Burkina Faso and two states in India (Madhya Pradesh and West Bengal).

The investment

Direct investments are required in three areas:

1. **Business Development Services** to help local entrepreneurs set up businesses providing irrigation services: 10 Business Development Services at an average cost of US$250,000 over 3 years = US$2.5 million.
2. A **loan guarantee fund** to encourage micro-lenders or Business Development Services to extend small loans to smallholder farmers who want to switch from hand watering to irrigating with motorized pumps: A fund of USS 560,000 for the first year of operation
3. A **loan guarantee fund** so that Business Development Services can offer loans to irrigation service providers to buy pump sets and start a business: A loan guarantee fund of USS 500,000.

Total investment for 3 years = US$3.8 million

These returns on investment compare favorably with investments in conventional irrigation development. Considering an average of US$10,000 to develop one hectare under a public irrigation scheme, 2775 hectares would cost US$27.7 million.

The returns

After the first year of operation:

375 new businesses a year earning total revenue of US$ 1.35 million annually.

Each year, 375 self-employed irrigation water suppliers using small pumps earning an average net income of US$1235 on revenue of US$3600 per dry season cropping cycle. Part-time employment for another 750 pump operators.

2,775 hectares of newly developed irrigated crop land per dry season after the second year.

10 business development services graduate 500 business operators in two years; assuming that 75% of these operations are in business after 2 years; assuming that each operator serves an average of 7.4 hectares per dry season.

7,500 smallholder farmers earning at least US$756 each in supplementary income per dry season for total net revenue of US$5.7 million.

375 irrigation service providers servicing 20 farmers per season.

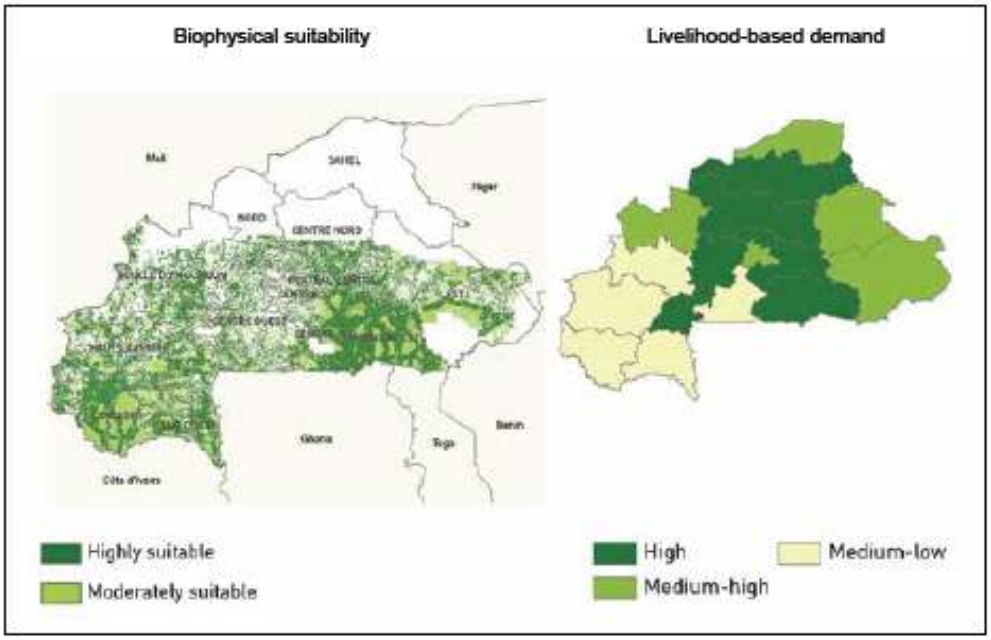
Note: Dry season vegetable cropping does not replace production of staple crops. Vegetable growing provides supplementary income in the dry season using small plots of land. The increased income is a significant contribution to household food security.

Vegetables include a variety of cash crops such as onions, tomatoes, leafy vegetables, carrots and peppers among others. While onions and tomatoes dominate, farmers change crops depending on price, marketing opportunities and storage options.

Geographic scope

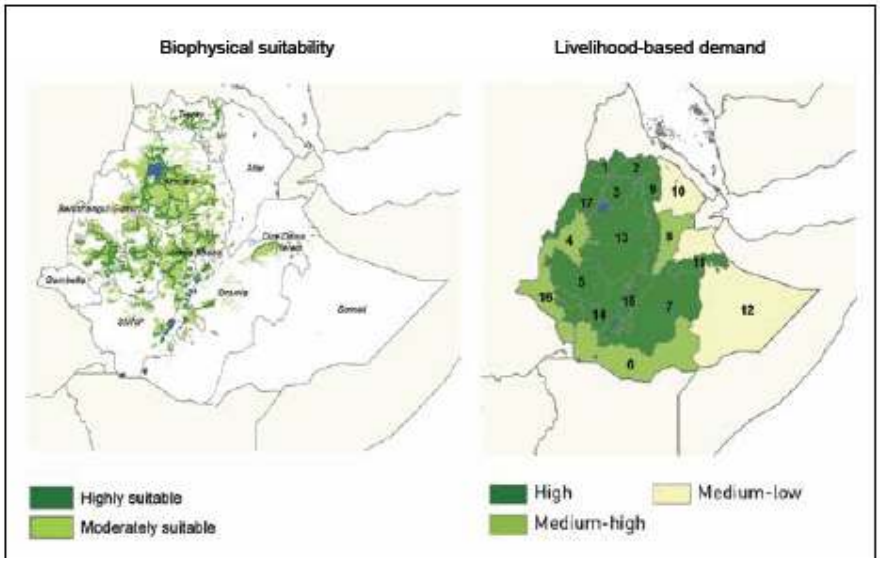
The geographic scope of the case includes Burkina Faso, Ethiopia, Ghana, Tanzania, and Zambia. The scope was determined by the availability of sufficient date of the required quality on which to build the business case. Within each of these countries, we have assessed the potential application of low-cost motorized pumps as an agricultural water management solution, taking into account the bio-physical suitability and potential impact on rural livelihoods. The following maps illustrate this potential, both high and low, for each of the five countries.

Burkina Faso: Locations suitable for small pump use based on biophysical factors and livelihood demand. At a 50% adoption rate we estimate the potential application area of 221,000-266,000 hectares, benefitting 276,000-332,000 households.



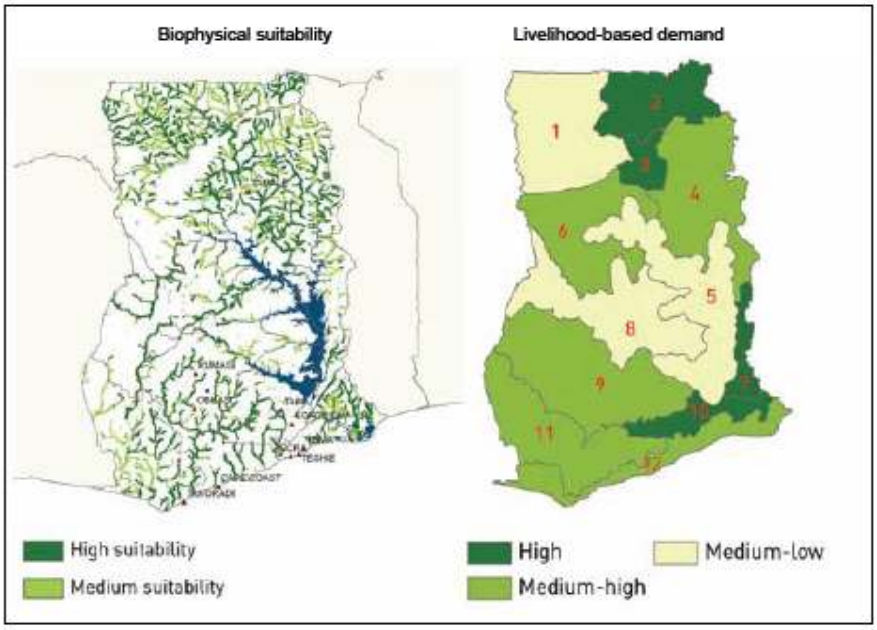
Source: FAO 2012a.

Ethiopia: Locations suitable for small pump use based on biophysical factors and livelihood demand. At a 50% adoption rate we estimate the potential application area of 0.9-1.8 million hectares, benefitting 1.1-2.2 million households.



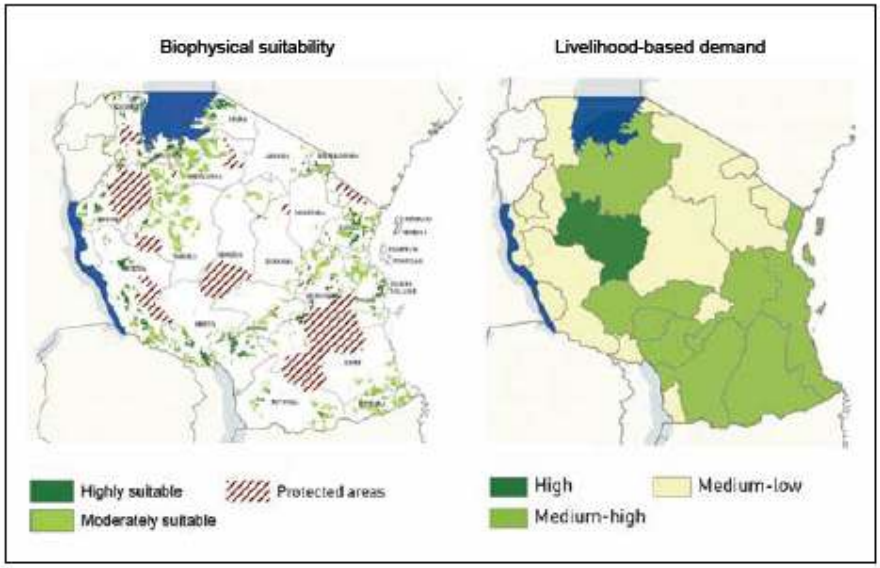
Source: FAO 2012b.

Ghana: Locations suitable for small pump use based on biophysical factors and livelihood demand. At a 50% adoption rate we estimate the potential application area of 451,000-584,000 hectares, benefitting 564,000-730,000 households.



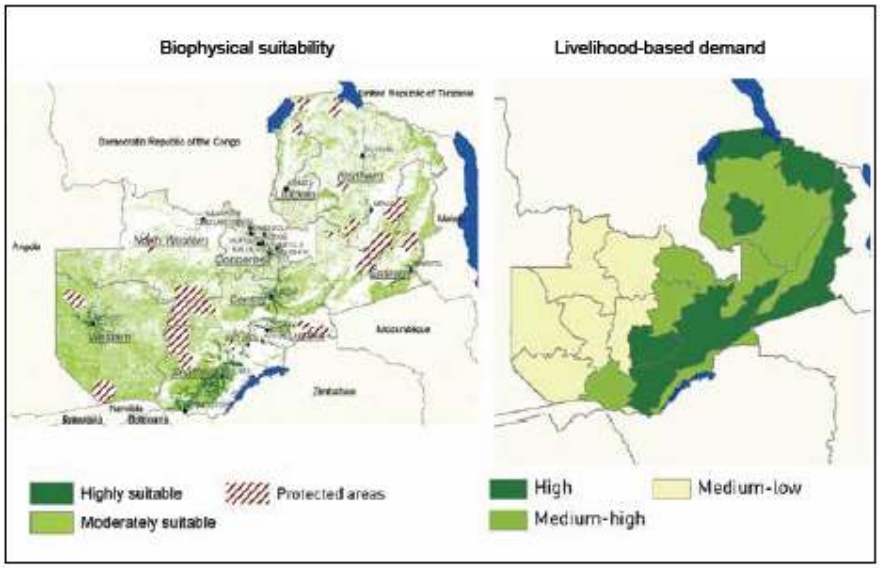
Source: FAO 2012c.

Tanzania: Locations suitable for small pump use based on biophysical factors and livelihood demand. At a 50% adoption rate we estimate the potential application area of 426,000-625,000 hectares, benefitting 532,000-781,000 households.



Source: FAO 2012d.

Zambia: Locations suitable for small pump use based on biophysical factors and livelihood demand. At a 50% adoption rate we estimate the potential application area of up to 214,000 hectares, benefitting 66,000-268,000 households.



Source: FAO 2012e.

For the whole of sub-Saharan Africa, we estimate motorized pumps having a potential application area of 29.6 million hectares, benefitting some 185 million rural people and generating net revenues of up to US$22 billion per year, once river basin hydrology, incremental yield improvements, investment costs, market access, and particularly potential impact of expanded crop production on local food price developments are taken into account.

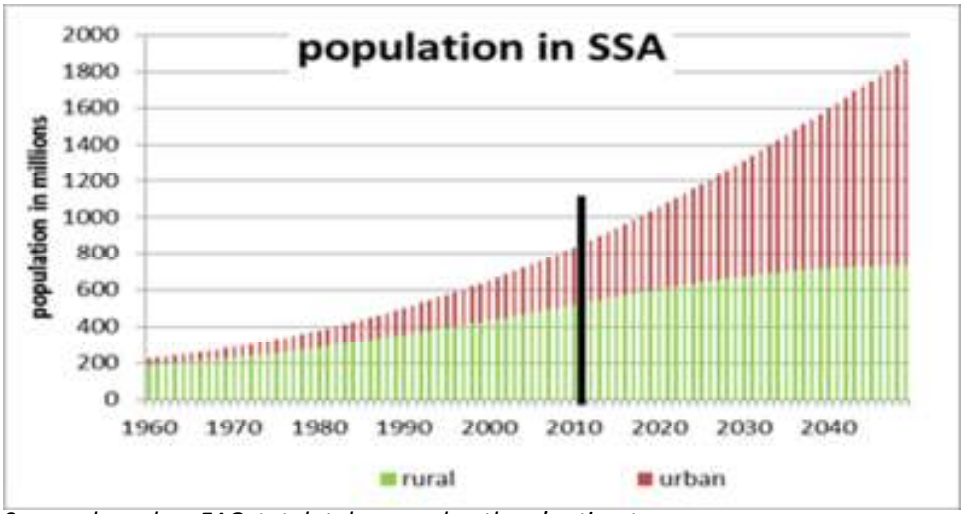
Case Studies

Case study 1: The smallholder farmer

In brief:

- Population growth and increased fresh vegetables consumption are driving demand for vegetable production.
- Smallholder farmers want to use pumps but cannot for several reasons, including the upfront investment cost.
- Farmers who use small pumps earn more money than those who do not, hence there is an economic incentive for farmers to make use of pumping services.
- Some farmers who do own pumps are renting their pumps to farmers who do not, hence there is an emerging rental market on which to build.
- For poor farmers, an irrigation delivery service offers more benefits than owning pumps.

Population and income growth are driving demand for increased vegetable production



Source: based on FAOstat database and authors' estimates

Per capita and total vegetable consumption in sub-Saharan Africa

	1961	2007	Change 1961-2007	Forecast 2050	Change 2007-2050
Consumption (kg/cap/yr)	33	35	8%	40	14%
Population (millions)	224	755	237%	1870	148%
Total consumption (million/ton)	7.3	26.4	263%	74.8	183%

Source: based on FAOstat database

Current production

In Burkina Faso, 94% of all vegetable production is sold at local markets, generating revenue of US$350 on an average land holding of 0.1 hectare. Peaks in vegetable production are observed in years when the cereal harvests during the wet season are lower than usual, pointing to the importance of off-season vegetable cultivation for additional income (DSA 2005).

In Ethiopia, 70% of the farmers in Oromia and SNNPR depend solely on rainfed staple crops, while 30% earn additional income from irrigated cultivation.
In Ghana, smallholder irrigation – primarily dry season vegetable cultivation – adds between US$175 to 840 to household income depending on the technology used.
In Tanzania, 50% of the cash income of smallholders involved in dry season private irrigation comes from dry season vegetable cultivation.
In Zambia, 20% of smallholders engaged in dry season vegetable cultivation earn an income 35% higher than the average.

Projected demand

Domestic demand for fresh vegetables has more than tripled in the last few decades. With continued population growth, urbanization and improvement in living standards demand is likely to rise throughout sub-Saharan Africa. If these trends continue, demand will effectively triple from 26 million tonnes in 2007 to 71 million tonnes in 2050. This means good prospects for smallholder farmers who can increase their household income by increasing yields and the area of cultivation. Irrigating with small pumps will become a key factor in their ability to take advantage of this opportunity.

Smallholder farmers want to use pumps but cannot

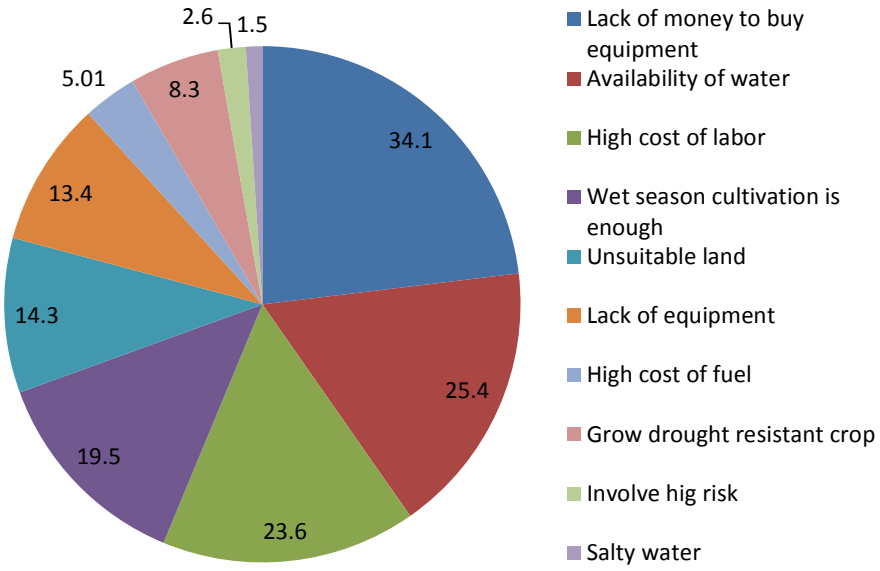
Farmers generally do know about motorized pumps. Surveys conducted for the AgWater Solutions project show a high level of awareness of both private irrigation in general and water lifting technologies in particular. However, most smallholder farmers (more than 80%), still use manual watering methods such as buckets and watering cans. Those who do own a pump typically paid for it themselves, and are among the top 20 percent in terms of income. The majority of farmers in Ghana, Tanzania and Zambia who rely on buckets or rainfed cultivation said they would prefer to use a motorized pump but lack the resources to do so.

Estimates of land area irrigation by small-scale private initiatives in selected countries of sub-Saharan Africa

	Area under small-scale private irrigation (ha)	Number of people involved	Water-lifting technology used			Number of motor pumps
			Buckets (%) users	Motor pumps (%) users	Treadle pumps (%) users	
Burkina Faso	10,000	170,000	85%	13%	2%	20,000
Ethiopia	350,000	n/a	84%	15%	1%	>400,000
Ghana	185,000	500,000	70%	30%	<1%	160,000
Tanzania	150,000	750,000	91%	8%	1%	70,000
Zambia	90,000	n/a	85%	13%	2%	15,000

Source: farmer surveys, AgWater Solutions project

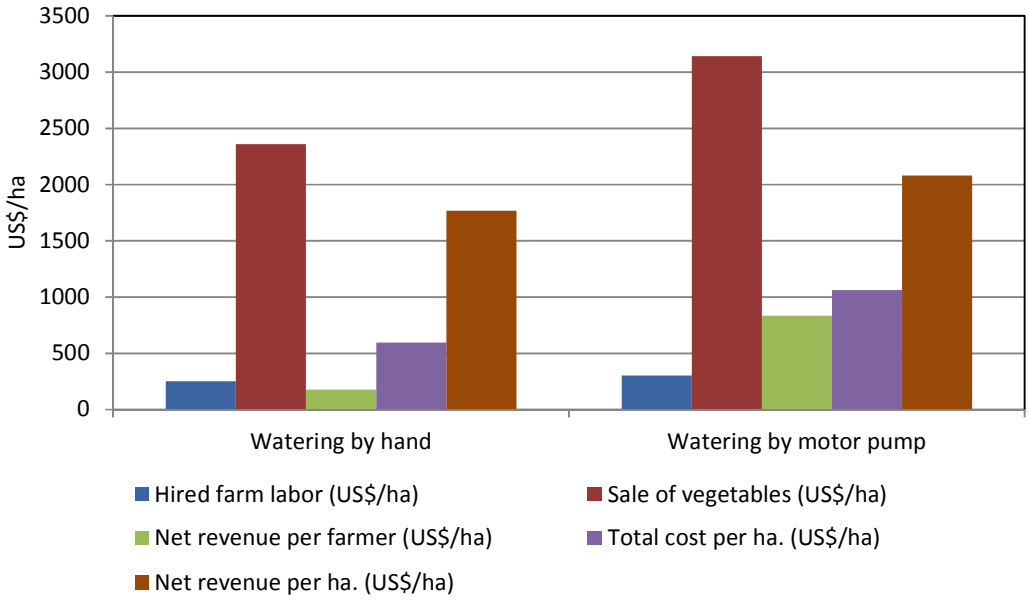
Reasons for not cultivating potential irrigable area



Source: Farmer surveys in Ghana, AgWater Solutions project

Farmers who use small pumps earn more money than those who do not

Farmers who own or use rented pumps cultivate more land, get higher yields and earn twice as much as farmers who water by hand. Farmers are generally aware of this.



Note: To calculate the net revenue per hectare for motorized pumps, the following irrigation costs/assumptions have been included: fuel costs of US$300/ha plus US$115/year amortization of the pump; the price of the pump is estimated at US$400 including accessories; interest rate is 15%/year; lifespan of the pump is assumed to be 5 years.

Source: Farmer surveys in Ghana, AgWater Solutions project

Some farmers who own pumps are renting them out

Some smallholders rent pumps from neighboring farmers who are better off.

Rentals play a significant role in the use of petrol and diesel pumps in selected areas in the Volta region in Ghana where pump ownership is atypically high. Farmers already renting out their pumps are potential candidates for expanding their informal rentals into an irrigation delivery business.

Mode of access	Bucket (%)	Treadle pump (%)	Petrol pump (%)	Diesel pump (%)
Privately owned	98.6	66.2	50.4	67.6
Communal	0.9	9.2	8.6	5.5
Company	0.3	1.5	1.7	2.7
Rental	0.0	9.2	36.8	10.8
Borrow from friends	0.0	7.7	2.6	8.1
Other	0.3	6.2	0.0	5.4
N	351	65	234	37

Source: Farmer surveys in the Volta region, Ghana, AgWater Solutions Project

Existing irrigation service providers in Gujarat and Burkina Faso

Sanjeev is a farmer. He lives in the village of Chhaapi in Gujarat where he cultivates maize and gram. He started renting out his services as an irrigation water supplier a few years ago. He charges US$1 an hour for 7 to 10 acres. Taking his pump on a donkey cart, he supplies water to a dozen neighboring farms. Demand is higher than he can supply. (Based on an interview by Tushaar Shah, 2010.)

Around the Korsimoro reservoir in Burkina Faso, groups of farmers started pumping water to irrigate vegetables. Typically, the relatively better-off pump owners rent out pieces of irrigated land to those without pumps. They buy the fuel, and maintain and operate the pump or hire an operator to do so. They charge US$120-150 per growing season for 0.1 hectare (Ndanga, 2011).

Another example comes from Bangladesh where a local NGO initiated irrigation delivery businesses for small farmers (Wood and Paler-Jones in their 1990 book: The Water Sellers).

This business model seeks to scale out these and other successful paid-for sharing arrangements.

Case study 2: The pump service provider

In brief

- There is a large potential market for irrigation services.
- Thousands of hectares of irrigable land could be cultivated if farmers had access to small pumps as pump owners cultivate more land.
- Farmers are already renting pumps from others.
- Large numbers of pumps are imported and sold, and there are existing networks of dealers.
- Pump rentals would be new niche in a well-established rental business sector.
- A financial analysis shows that a single entrepreneur operating an irrigation delivery service can earn an above average income.

There is a large potential market for pump rental

Thousands of hectares of irrigable land could be cultivated if farmers had access to small pumps.

Most farmers have access to an average of 1.4 hectares of additional land that could be cultivated. This land is idle because smallholder farmers cannot afford either to buy a pump or the time and labor it costs to water by hand.

	Own farm	Cultivated land (ha)	Additional irrigable area
Petrol pump	3.9	2.3	1.6
Rainfed land	2.2	1.5	1.3
Bucket (hand watering)	2.0	1.7	1.4
Treadle pump	2.4	4.0	2.1
Canal	1.7	1.7	1.5

Source: Data from farmer surveys in Ghana, AgWater Solutions project

Nearly 90% of the 1.8 million farm households in Ghana have an additional 1.4 hectares they could irrigate. That means 2.3 million hectares of extra land could be under cultivation.

In Burkina Faso, some 170,000 farmers, mostly smallholders, are involved in off-season irrigated vegetable cultivation, using buckets, watering cans and small motor pumps. Vegetable production nearly tripled from 60,000 tonnes in 1996 to 160,000 tonnes in 205 (DSA, 2005).

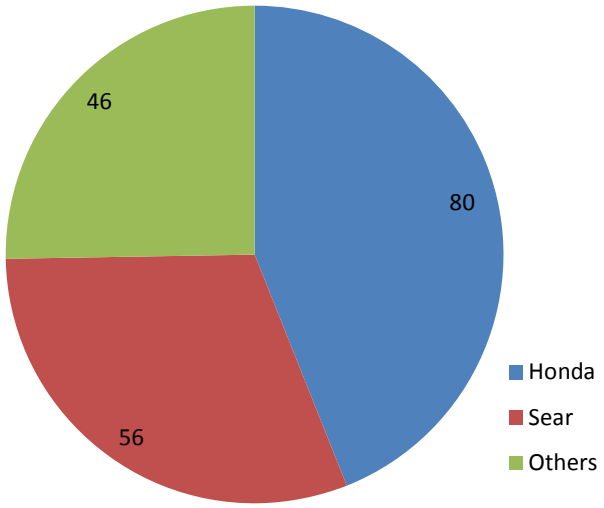
Large numbers of pumps are imported and sold….

There are currently an estimated 160,000 small motorized pumps in use in Ghana, 70,000 in Tanzania, more than 20,000 in Burkina Faso, and 60,000 in Oromia, Amhara and Tigray in Ethiopia. Research by the AgWater Solutions project shows that use of small motorized, mostly diesel pumps is on the rise in sub-Saharan Africa. This is driven, in part, by the potential amount of land available for irrigation and high demand for vegetables crops during the dry season.

In Tanzania, an estimated 750,000 farmers grow vegetables using buckets and watering cans to get water by hand with water from rivers and wells. Surveys indicate motorized pump sales are on the rise with estimated sales of over 7,000 pumps annually, and more than 70,000 pumps in use, which currently benefits over 150,000 farmers.

….. and there are existing networks of dealers

In Ghana, there are approximately 1500 agro dealers operating 3500 agro-input sales points (IFDC, 2010). One-third of the sales points responding to an AgWater Solutions survey indicated they do sell pumps.



Pump rentals are a new niche in a well-established rental business sector

Rental services are familiar in the target countries. In all five, there are companies renting out cars and mobile phones. In Ghana, there is a thriving rental sector offering office/conference equipment, cars, trucks, mobile phones, and equipment for construction, engineering, oil and gas, food and other services.

Rental services are more common and more sophisticated in large cities, but in most small towns you will find people renting chairs and tables and speaker systems for parties and events. Renting is a widespread business model. The irrigation provider service takes this one step further by including the pump operation into the model to avoid damage from mishandling the pump.

The implications for the business model are:

1. The rental model is widespread and therefore familiar to potential users;
2. There is a pool of people with knowledge and practical experience in the rental business; and
3. There will be legal instruments (contracts, laws, etc.) and accounting practices designed specifically for rental businesses that can be easily adapted to pump rentals.

The low use of pumps indicates considerable scope for pump rental

	Area under small-scale private irrigation (ha)	Number of people involved	Water-lifting technology used			Number of motor pumps
			Buckets (%) users	Motor pumps (%) users	Treadle pumps (%) users	
Burkina Faso	10,000	170,000	85%	13%	2%	20,000
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Zambia	90,000	n/a	85%	13%	2%	15,000

Source: farmer surveys, AgWater Solutions project

Farm equipment dealers in small towns in all study areas indicate and increased demand for small motorized pumps in recent years, which they attribute to the influx of cheap pumps from China. More than a million pumps are currently in use (compared to 20-25 million in India). The potential market for pumps in all of SSA could be in the range of 10 million.

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Financial Analysis: Irrigation Service Provider

In brief

- Business operators can earn a net income of over US$ 1235 per season on revenue of US$ 3600.
- Three pumps are the minimum number required per operator.
- The business is most sensitive to fuel prices and the distance between customer sites.

The Scenario

The size of the operation may vary depending on the market opportunities and skills of the entrepreneur. The numbers and prices are based on farmer surveys done in Ghana (details in annex) but general concepts are applicable to a wider geographic area.

Size of operation

The business is run by the entrepreneur and two assistants. The entrepreneur owns three 5HP motorized diesel pumps which were bought in the nearest town for around US$400 each, including accessories such as pipes. The average life span of the pump is 5 years.

Small repairs are done in-house; larger repairs are handled by mechanical workshops in the village. The three pumps consume 982 liters of diesel during one season (cropping intensity of 125%). Diesel can be bought locally.

We consider three pumps the minimum to run a viable business. If one pump breaks down and needs repair, the other pumps can be used more intensively to minimize loss of revenue. It is essential to provide uninterrupted irrigation services throughout the season otherwise the farmers' vegetables will suffer. Each additional pump adds proportionally to the business operator's profit.

The typical business serves 20 customers per day during the dry season and covers 7.4 hectares of irrigated vegetable crops. The entrepreneur and assistant each take a motor pump on a bike or cart to farmers in the neighborhood. A typical farm is 0.3 hectares and the distance between customers is no more than 3 km. The average traveling time between farms is 20 minutes and it takes about an hour to irrigate one farm. The irrigation service charge is equivalent to US$2.50 per hour which translates into an average of US$188 per season per farmer.

Revenue

The business sells irrigation services by the hour. The revenue is a function of the number of billed hours and the charge rate per hour. The number of hours that the entrepreneur can bill is limited by the number of working hours in a day, the time needed to travel between customers, downtime of the pump due to repairs, and administrative time. During one crop cycle of 75 days, the business can bill 843 hours to customers. To ensure a viable business the minimum charge is US$2.50 per hour resulting in gross annual revenue of **US$3600.** Depending on the climatic and geographic setting, there may be two crop cycles per dry season. In this example we conservatively assumed one cycle.

Rental price per hour	US$ per hour	2.50
Hours billed to customers	Hours	1472
Total revenue	US$	3682

Fixed costs

A motor pump plus accessories cost approximately US$400. The lifespan of a good quality pump is about five years. We assume that the pumps are bought locally and that the interest rate is 15%. The amortized capital cost is US$0.24 per hour for two pumps. To transport the pumps between customers, the entrepreneur uses a bike or cart he already owns, so there is no need to invest in a new one.

Pump purchase cost	US$	300
Pipes & accessories	US$/yr	100
Life-span per pump	years	5
Annual interest/discount rate	%	15%
Fixed cost per year/season*	US$	343
Amortized cost per billable hour	US$/hour	0.24

**Assumes 15% interest and 5 years payback period. Computed using web based amortization calculator:*
http://www.bankrate.com/calculators/mortgages/amortization-calculator.aspx

Variable costs

A major operational cost is the fuel to run the pumps. It takes about 2 liters of diesel to run one pump for 3 hours. Assuming a diesel price of US$1.20 per liter, this translates into US$0.80 per running hour per pump. Maintenance costs are estimated at US$40 per season or US$0.07 per running hour per pump. Other variable costs include repairs and maintenance, fees to the assistant (paid by hours worked) and costs incurred to transport the pump between customers.

Pump operation costs	US$	1281
Hired labor costs	US$	793
Transport related costs	US$	29
Total variable costs	US$	2104
Total variable costs	US$/hour	1.43

Total costs

Total costs amount to US$1.43 per hour billed to the customer, or US$2446 per crop cycle.

Variable costs	US$	2104
Amortization costs	US$	343
Total costs	US$	2446
Total cost per billed hour	US$/hour	1.66

Bottom line

The profit for the entrepreneur is US$816 per crop cycle. This translates into just under US$11 per day.

Total revenue	US$	3682
Total costs	US$	2446
Income	US$	1235
Income per day worked	US$ per day	16.47

Payback period and cash flow

The upfront investment of the service provider amounts to US$1200 for the three pumps and accessories. We assume that investments are financed from a loan facilitated by the business incubator. The business will break even in the first year and start making money thereafter.

Five year projections in US$

	Year One	Year Two	Year Three	Year Four	Year Five
Cost pump	1200	0	0	0	0
Adoption by customers	20%	40%	70%	90%	100%
Number of customers	4	8	14	18	20
Irrigated area	1.2	2.9	5.2	6.6	7.4
Fuel and maintenance costs	209	418	731	940	1044
Hired labor costs	158.6	317.3	555.2	713.8	793.1
Transport costs	5.89	11.78	20.62	26.51	29.45
Total variable costs	373	747	1307	1680	1867
Total capital costs	343	343	343	343	343
Total revenue	736	1473	2577	3314	3682
Net revenue	20	383	928	1291	1815

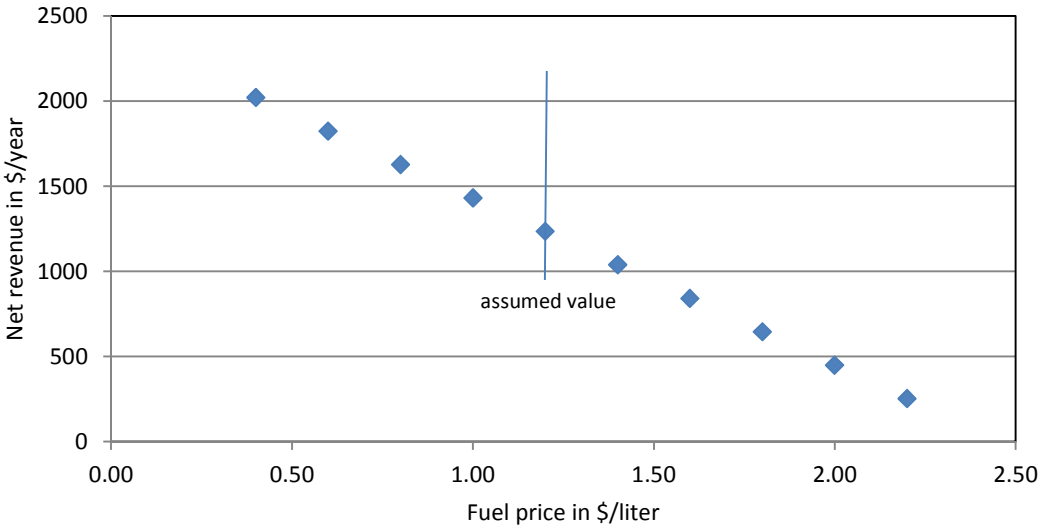
	Year One	Year Two	Year Three	Year Four	Year Five
Cost pump	800	0	0	0	0
Adoption by customers	25%	50%	75%	90%	100%
Number of customers	3	6	9	10	11
Irrigated area	1.2	2.1	3.2	3.8	4.2
Fuel and maintenance costs	145	290	434	483	531
Hired labor costs	77.6	155.3	232.29	279.5	310.5
Transport costs	3.95	7.90	11.85	14.22	15.80
Total variable costs	226	453	679	776	857
Total capital costs	204	204	204	204	204
Total revenue	464	927	1391	1669	1854
Net revenue	33	270	508	689	997

Sensitivity analysis

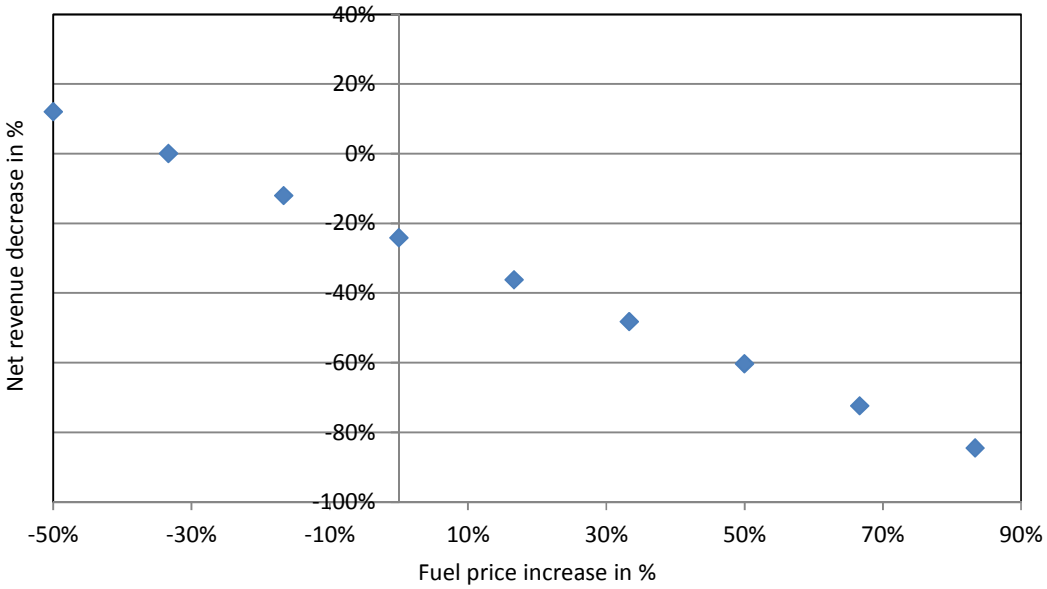
Fuel price

The biggest uncertainty for the entrepreneur is the fuel price. The graphs below show that a doubling in fuel price (to US$2.50 per liter) renders the business practically unviable, unless the entrepreneur drastically increases his charge to the customers.

Net revenue vs. fuel price (US$/liter)



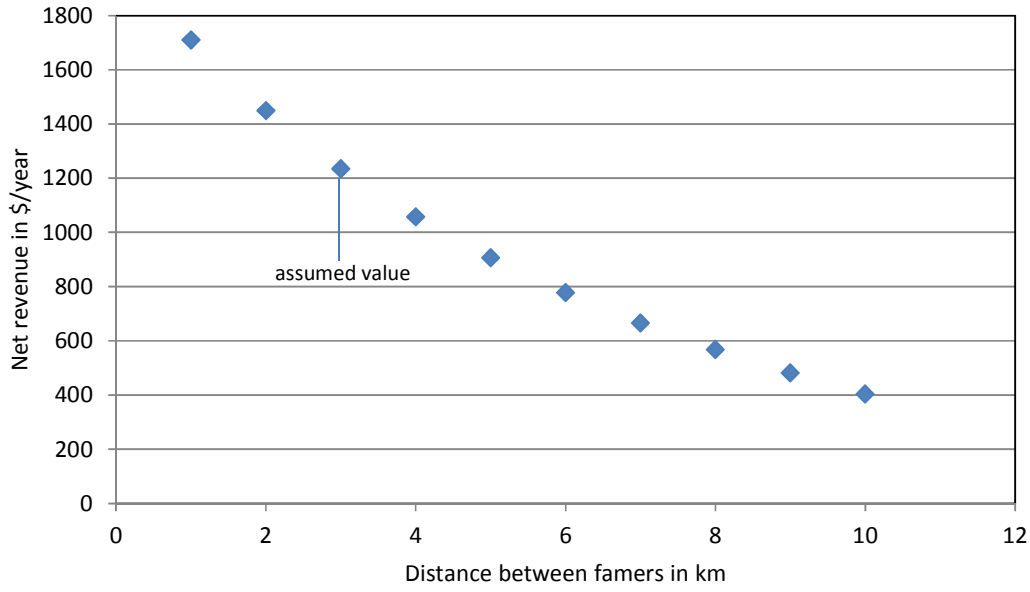
Net revenue vs. fuel price increase in %



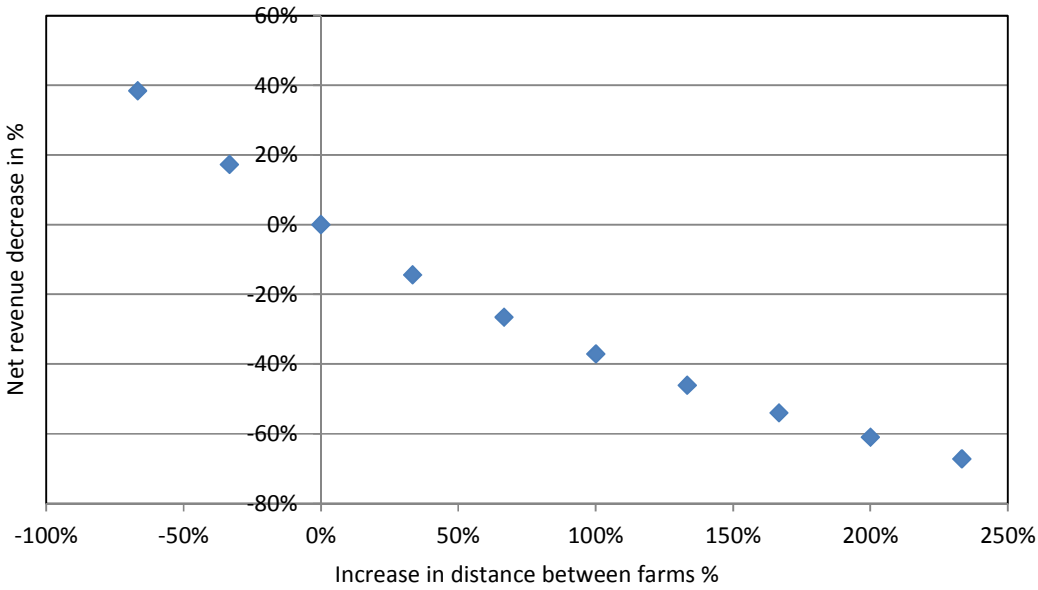
Travel time between customers

A major difference between sub-Saharan Africa and South Asia (where pump rental services for irrigation are common) is the population density. In sub-Saharan Africa, farms tend to be further apart, adding to travel time and costs for the pump rental business. The model assumes an average distance of 3 km between farms and transport by bike. The graphs below show that in areas with twice the distance between farms, the profit would be 37% less.

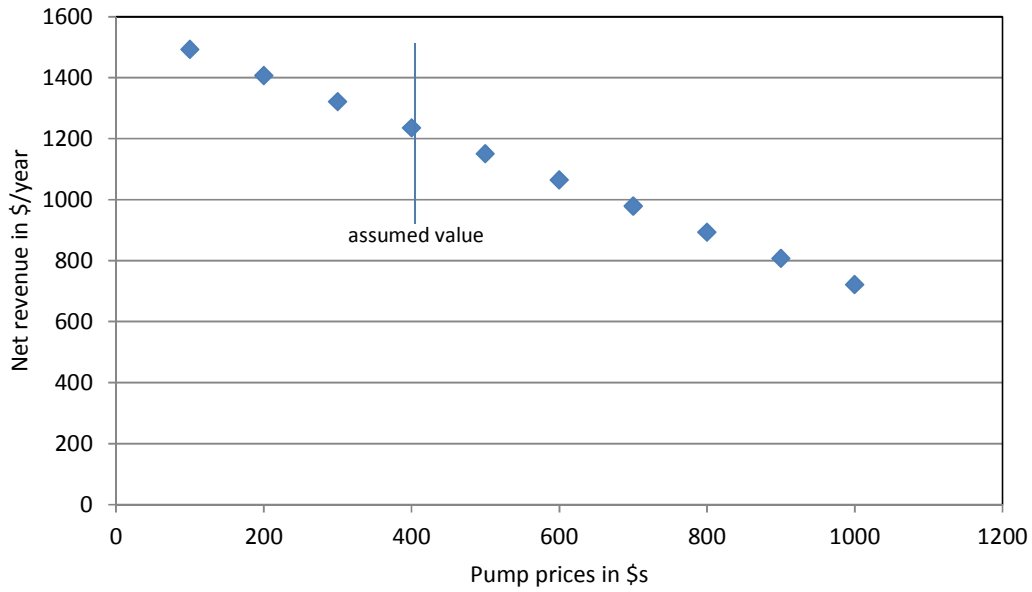
Net revenue vs. distance between farms in km



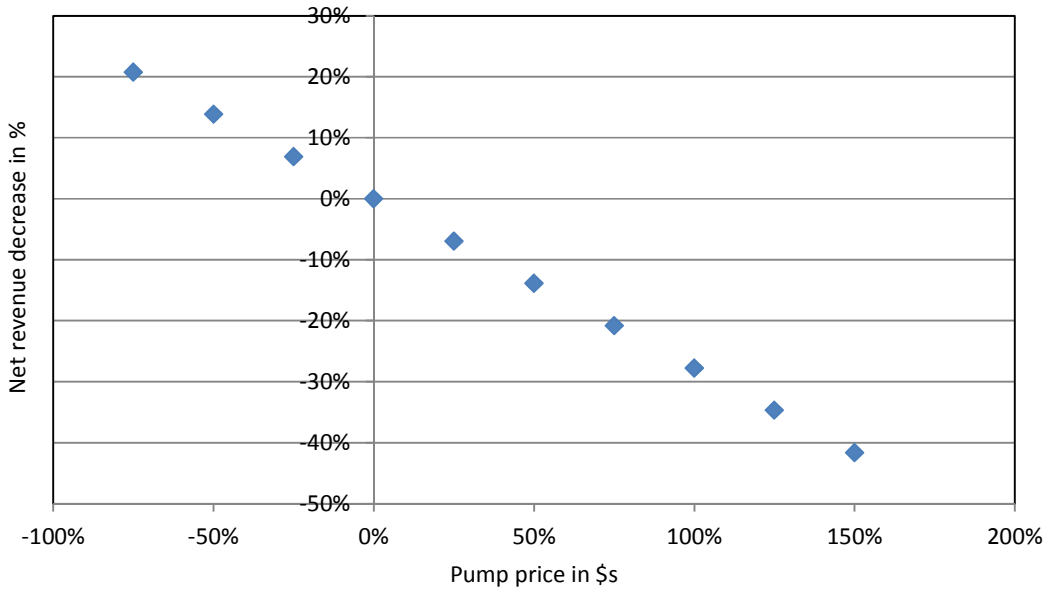
Net revenue vs. distance between farms in %



Net revenue vs. pump price increase in US$



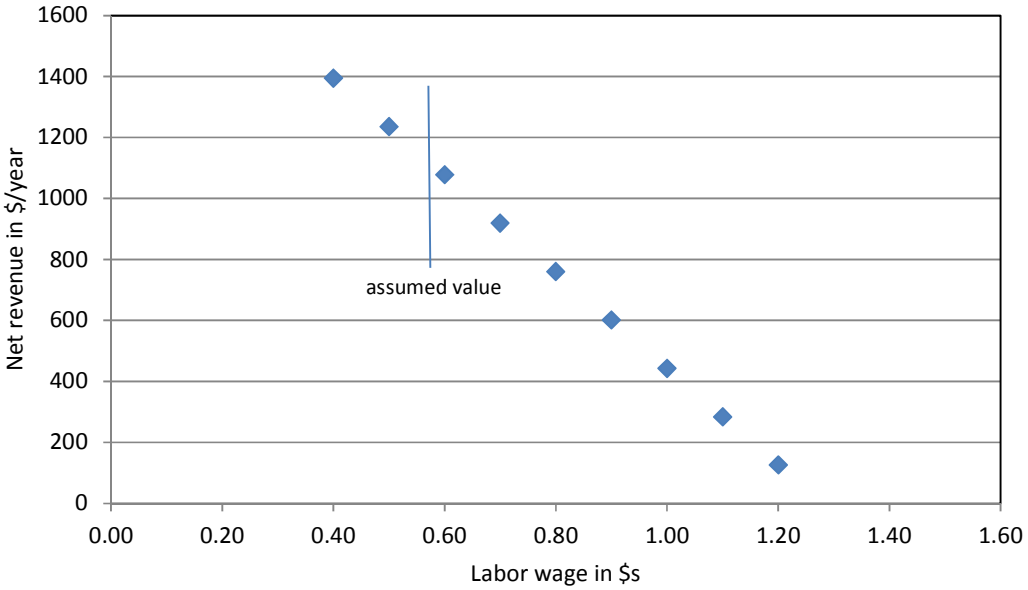
Net revenue vs. pump price increase in %



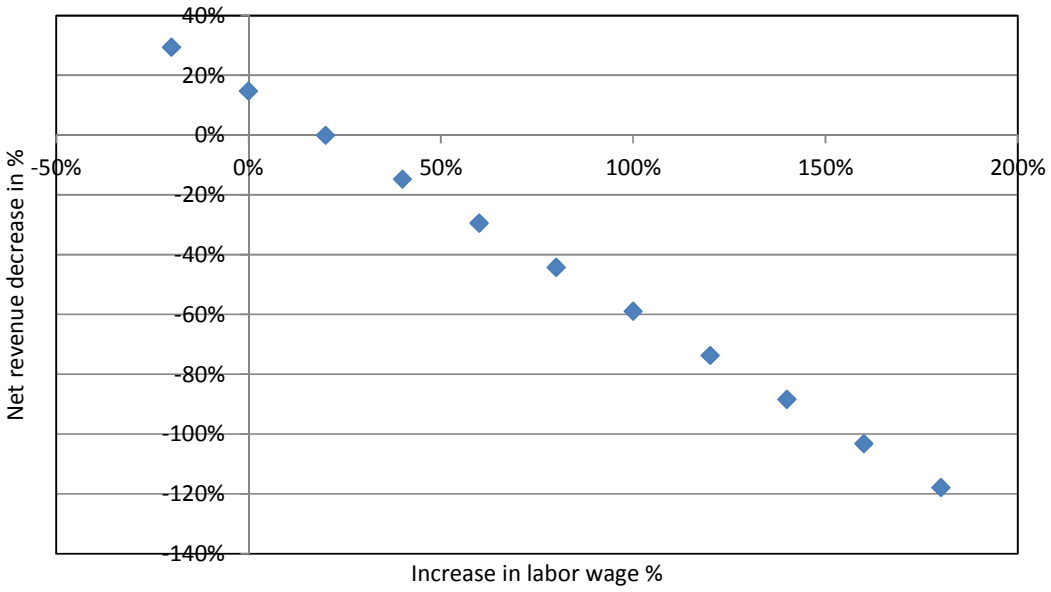
Labor wage

Labor costs are a relatively small part of the overall financial picture. Therefore, increases in wages have a relatively modest impact on the bottom line. A doubling of daily labor rate reduces the profit by only 9%.

Net revenue vs. labor wage in US$



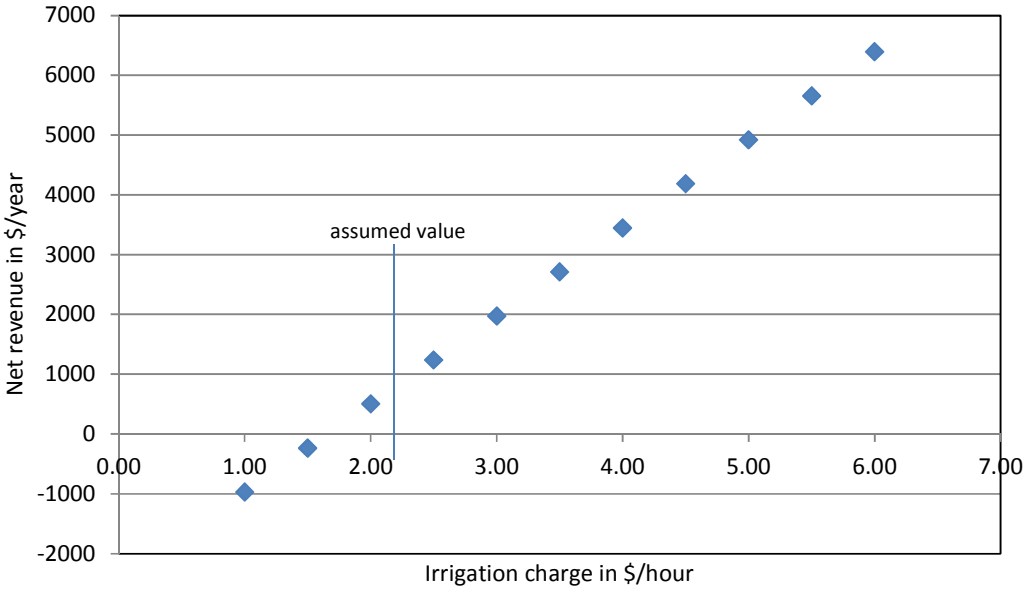
Net revenue vs. labor cost in %



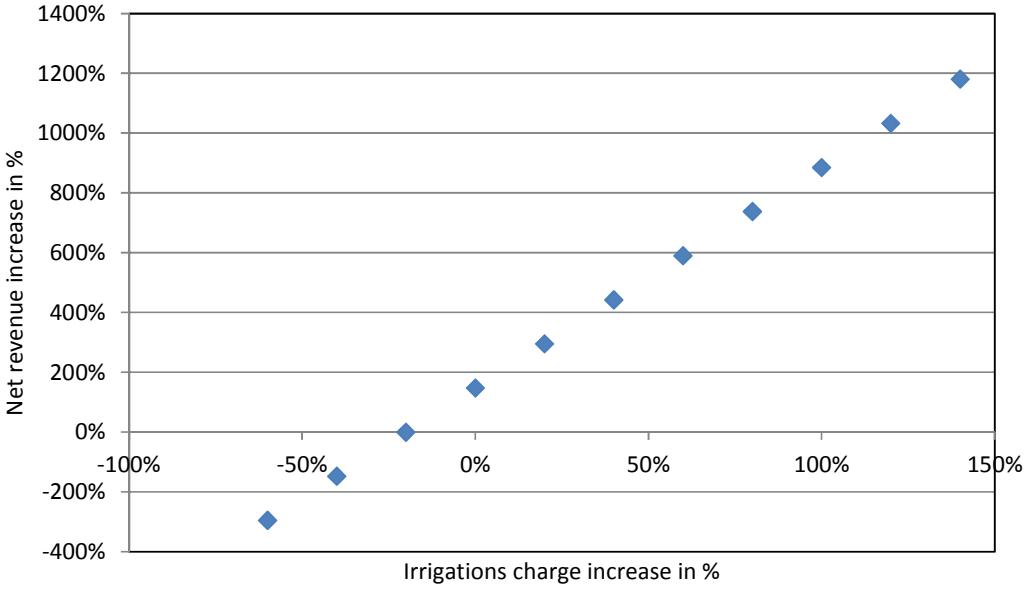
Irrigation service charge

To ensure a reasonable income to the entrepreneur, and to account somewhat for the inherent risks, the minimum charge is US$2.20 per hour. A charge of less than US$1 per hour generates a loss. If the charge is above US$5 per hour, farmers may not be interested (see next section).

Net revenue vs. irrigation charge (US$/hour)



Net revenue vs. irrigation charge increase in %



Financial Analysis: The Customer/Farmer

In brief

- Hiring a small pump cum operator for irrigation makes dry season vegetable cultivation more profitable than hand watering.
- The smallholder's operation is most sensitive to crop prices and yields.
- Irrigation charges are a relatively modest factor in the sensitivity analysis.

A typical customer of the irrigation service provider cultivates 0.375 hectares of vegetables in the dry season, generating revenue of US$ 1186 per crop cycle. On average input costs (excluding irrigation) amount to US$242. Irrigation service provision costs US$188 per crop cycle. The farmer makes a profit of US$756.

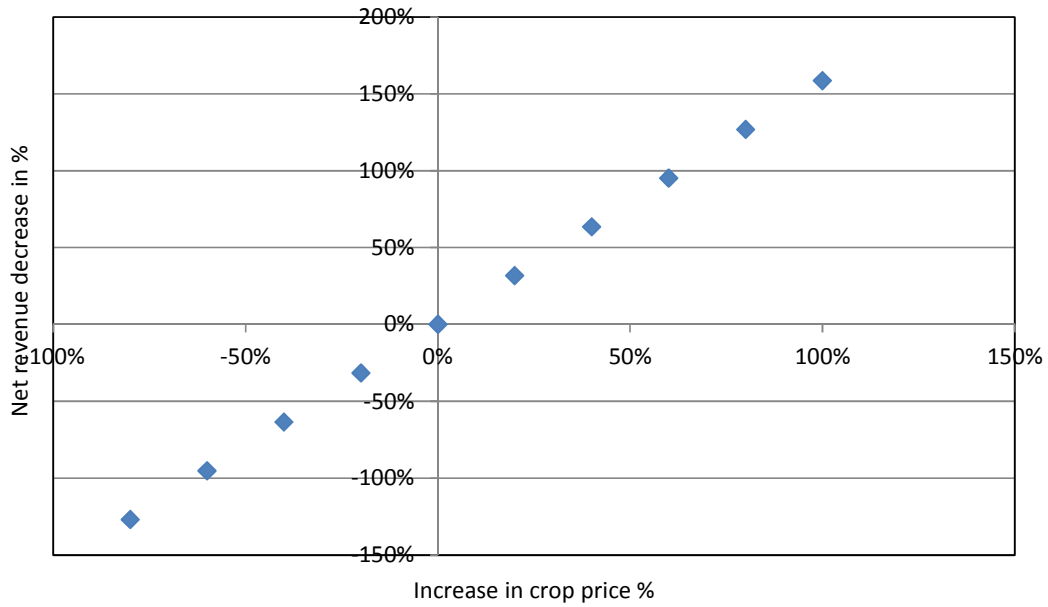
Labor	US$	112
Seeds	US$	38
Fertilizer	US$	57
Pesticides	US$	28
Misc equipment and fencing	US$	8
Irrigation @ 2.50 US$/hour	US$	188
Total costs	US$	429
Total revenue	US$	1186
Crop income	US$	756

Sensitivity analysis

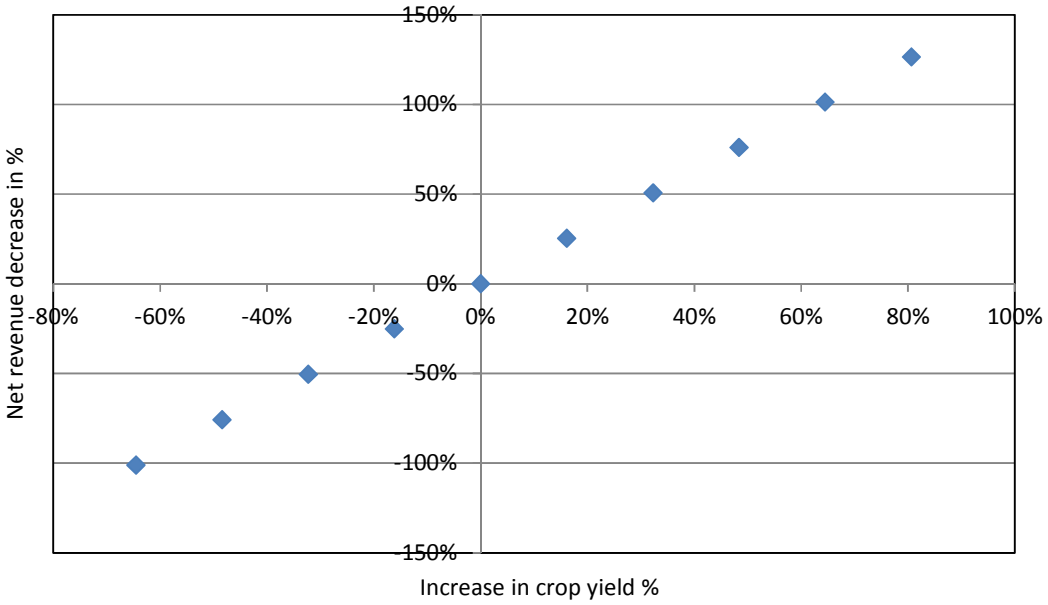
The irrigation service business depends on profitable irrigated vegetable farms as customers. Farm income is highly sensitive to reduction in yields (due to water shortage, pests and diseases) and crop prices. The graphs below indicate that if yields decrease by half, crop income reduces by 72%. If crop prices are half their current values, crop income drops by 90%. When crop prices decrease by 80%, irrigated vegetable farming is no longer profitable.

The impact of irrigation service charges and other input prices is relatively modest. A doubling of irrigation charges from US$2 to US$4 per hour reduces crop income by 19%. An increase of input costs by 50% decreases farm income by 10%.

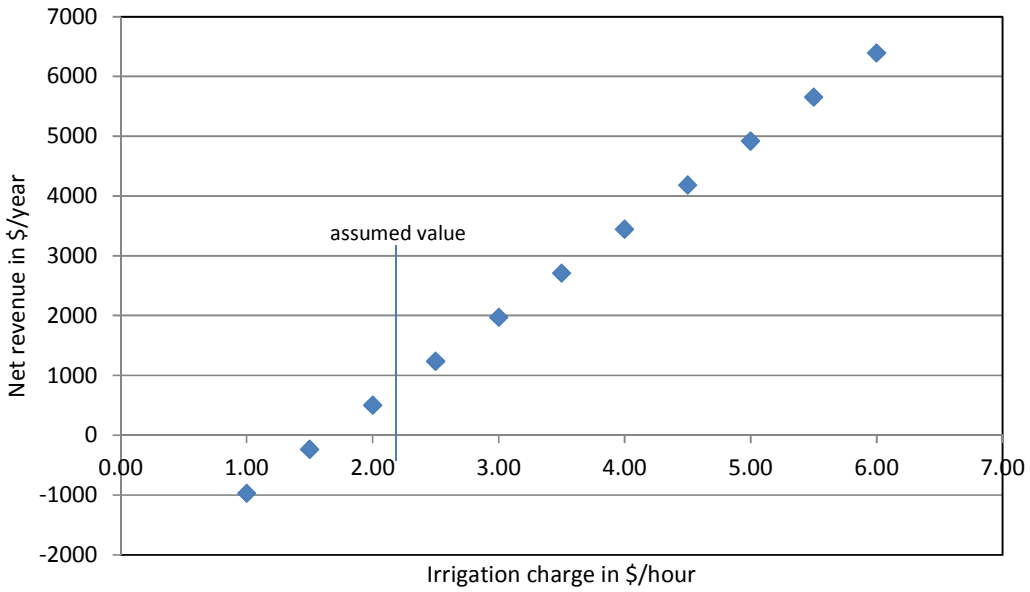
Crop income vs. selling price



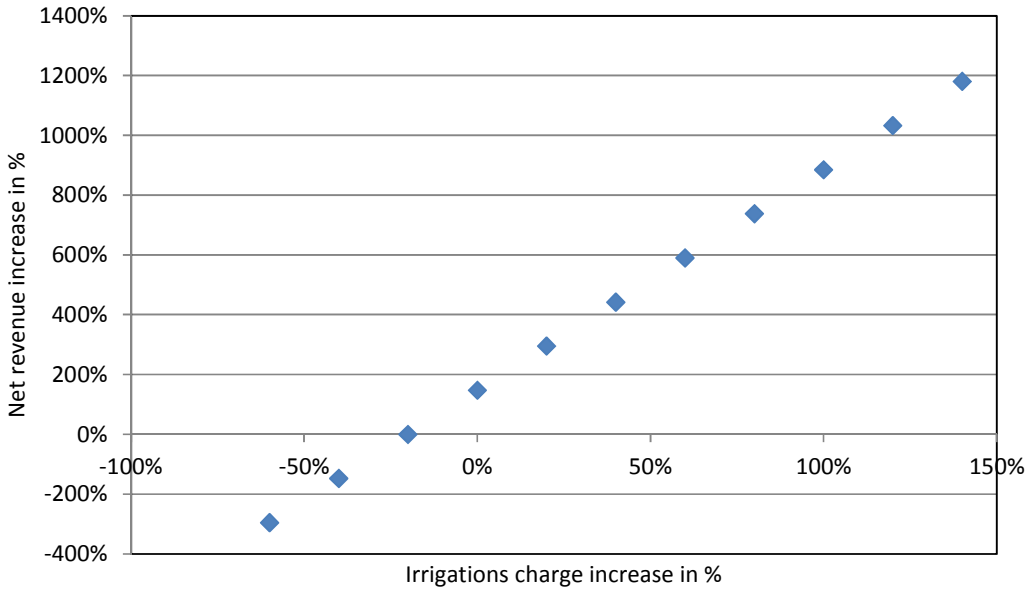
Crop income vs. yield



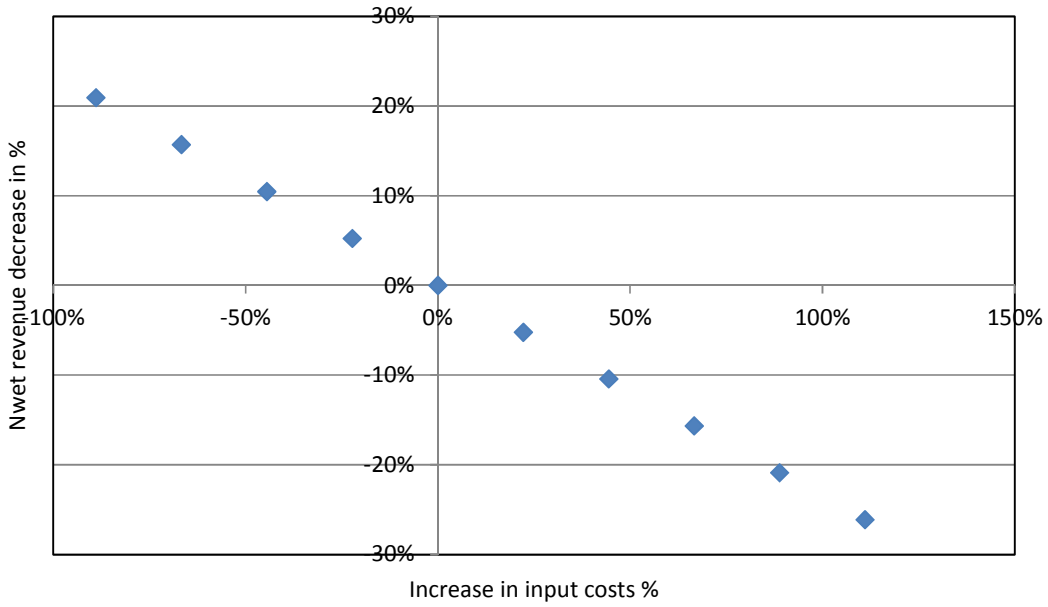
Crop income vs. irrigation charge in US$



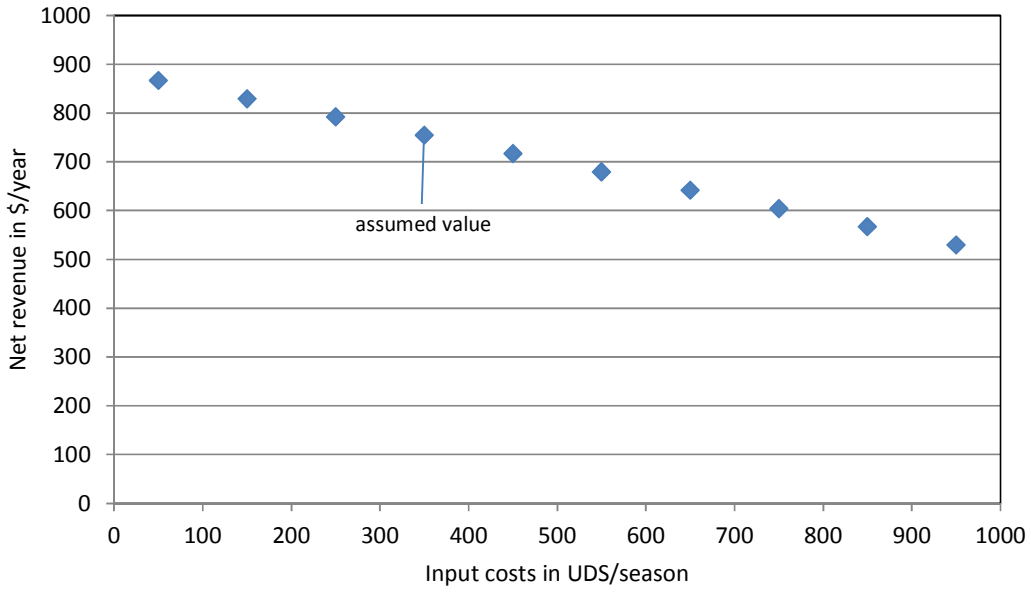
Crop income vs. irrigation charge increase in %



Crop income vs. input costs % increase



Crop income vs. input costs US$



Investments to kick off the pump rental sector

Three initiatives need funding to kick off the pump rental sector:

- Business Development Services to recruit, train and support pump service providers;
- Access to credit for starting entrepreneurs; and
- Access to credit for smallholder farmers.

Investment 1: Business Development Services maximize success rates

Successful completion of a business incubation program increases the likelihood that a start-up company will stay in business. Figures from the U.S. Small Business Administration show that after four years, only 44% of all firms remain in business, compared to 87% of companies who have been nurtured by a Business Development agency.

Business Development Services are not confined to developed countries like the USA. The growing **Incubator Network Africa** includes groups that have recently planned and opened agencies in Angola, Ghana, Kenya, Mauritius, Mozambique, Nigeria, Rwanda, Senegal, South Africa, and Uganda. In Ghana, BusyInternet Ghana promotes social and economic development through ICT applications. To date, BusyInternet has facilitated the set-up and growth of 11 ICT companies.

We propose establishing up to 10 Business Development units in small towns in areas of sub-Saharan Africa where there is potential for vegetable production. There are already a couple of facilities, such as the Tanzania Agribusiness Entrepreneurship Stakeholder Facilitator and the Artumas Foundation, which could be considered as potential partners.

The purpose of the Business Development Service is to recruit, train and support small pump service providers. The business case recommends supporting these units for a maximum of three years, after which they close or become self-financing. Support for Business Development Services will cost approximately US$1,060,000 per year per unit for a total of US$3,180,000 for three years.

		Unit rate	For 10 incubators
Salaries per Business Development unit	US$ / year	25,000	250,000
Office costs per office	US$ / year	15,000	150,000
Training costs per incubator	US$ / year	75,000	750,000
Operational cost per incubator	US$ / year	25,000	250,000
Total	US$ / year		1,400,000

The Business Development training program lasts four weeks. Successful candidates are paid a stipend to cover basic expenses for accommodation if needed, transportation and food. Books and materials will be provided free. The total charge per participant is US$2100.

Lodging	US$/training	1000
Meals	US$/training	560
Stipend	US$/training	500
Travel	US$/training	40
Total	US$/training	2100

One Business Development unit will train 30 irrigation service providers in the first year at a total cost of US$75,000 per year (participant costs 30*US$2100 + material and venue US$12,000). In the second year, the Business Development unit trains 20 participants at a total cost of US$50,000. The third year is dedicated to follow-up and support activities for the service providers and evaluation of the program to learn from this pilot.

The total cost for the 10 Business Development units is US$2.5 million.

	First year	Second year	Third year	Total
Training cost	750,000	500,000	0	1,250,000
Operational budget	250,000	250,000	500,000	1,000,000
Evaluation	50,000	100,000	100,000	250,000
Total	1,050,000	850,000	600,000	2,500,000

Business Development centers provide the following services:

Recruitment: Selection criteria cover the candidate's knowledge and experience of business agriculture.

Training: includes small pump repair and maintenance, basic agronomy (including topics such as Integrated Pest Management, soil improvement, safe use of agro-chemicals), and business management skills (bookkeeping, marketing, etc.). Ideally, Business Development centers would link with local agricultural extension offices, perhaps even be located in or near the same premises.

Support: 1) to help entrepreneurs secure loans, if required, by providing assistance with writing business plans, calculating the cost of the loan and contacts, and provide loan guarantees; and 2) to help small farmers secure a loan at the beginning of the growing season, to be paid back after harvest, to facilitate the switch from a small plot under hand watering to a larger area irrigated by the service provider.

Investment 2: Loan guarantees to irrigation service providers

We suggest that loan guarantees to irrigation service providers be provided for the first year only. We assume that once credit facilities gain confidence in the program they will assume the full risk of extending loans. Once the business is set up, the incubator will provide ongoing support in the form of a mentoring program.

Based on 300 candidates in the first and a success rate of 75% approximately 225 incubators may need a loan guarantee for US$2500 each, totaling US$562,500. Costs will vary by country.

Investment 3: Access to credit for smallholder farmers

One of the main constraints preventing smallholder farmers from cultivating more land is the cost of inputs. To cultivate 0.4 hectares of land, a famer needs approximately US$450 for seeds, labor, fertilizer, pesticide, equipment and irrigation.

Banks and micro-credit facilities have been reluctant to provide loans in the agriculture sector, but there are illustrative cases where they have with positive outcomes all around. The model that seems to work best is for an NGO or donor to provide loan guarantees up to a fixed amount (e.g. 50% of any individual loan up to a cumulative total of US$100,000).

The key element is to persuade lenders to structure loans around the growing season and the needs of farmers, not weekly or monthly repayments as they normally do for largely urban salaried clients.

The 225 irrigation service providers cater for 4500 farmers. Assuming that 50% apply for a loan with a guarantee up to US$225 per applicant, total amount needed is US$506,250.

Unused funds at the end of each year can be transferred to the Business Development Services operator to extend their programs. After three years, lenders should be sufficiently confident to assume the full risk of lending.

Total investments and benefits

		First year	Second year	Third year	Total
Investments	Business incubators	$1,050,000	$850,000	$600,000	$2,500,000
	Loan guarantees	$1,068,750			$1,068,750
	Evaluation	$50,000	$100,000	$100,000	$ 250,000
	Total	$2,168,750	$950,000	$700,000	$3,838,750
Benefits	Service providers trained	300	200		500
	New service providers operating	225	150		375
	New area irrigated	1665	1110		2775
	New farmers served (50% women)	4500 (2250)	3000 (1500)		7500
	Net revenue farmers	$3,403,688	$2,269,125		$5.672,813
	Net revenue providers	$227,957	$185,305		$463,262
	Total $$$ benefit	$3,681,645	$2,454,430		$6,136,675

Contingencies and dependencies

Reaching the business objectives outlined above will involve actors outside the immediate scope of this case. The case objectives can be achieved without their contributions, but their involvement would facilitate the process and enhance the outcomes.

If NGOs, extension workers and journalists can collaborate on producing and disseminating illustrated manuals on pump maintenance and repair in local languages, smallholder farmers will be better informed about the use and benefits of renting small pumps, which would help stimulate demand for pump rental services.

If extension workers would team up with existing initiatives such as AGRA and others and build on existing knowledge gained by NGOs (such as iDE), more and better agronomic information would reach smallholder farmers, which would help stimulate demand for pump rental services.

If mobile phone operators could provide daily prices via mobile phones, this would reduce the information asymmetries that currently prevent smallholder farmers from earning higher profits on their produce, which would motivate them to increase yields and/or bring more irrigable land under production, which would help reduce their risk and stimulate demand for pump rental services.

If duties and import taxes are lowered or eliminated and import procedures streamlined, dealers will import more pumps and a wider range of pumps, which will increase competition, improve after sales support, and stimulate demand.

If affordable micro-credit facilities are available, farmers will have access to credit to pay front-end costs for increased production. Crop insurance schemes and loan guarantees will enable farmers to take on the risk of loans.

Non-financial considerations

Positive impact

On-farm employment

The business model contributes to on-farm employment and reduces out-migration by making it possible to earn on the farm.

Multiplier effects

The town of Korsimoro some 80 km northeast of Ouagadougou, Burkina Faso has become an "onion hub" for the region. Traders come in trucks, some long distances, to buy in bulk. A wide range of service businesses have grown up around the central market, including food and beverage stalls, restaurants, garages and repair shops, hotels and retail shops.

Negative impacts

There are potential negative impacts to increasing the number of small diesel pumps in operation and increasing the area of land under intensive cultivation. It is beyond the scope of this case to determine the extent of these impacts or to recommend solutions. However, we propose that this initiative include a budget for communicating with local NGOs and research institutions who are interested in addressing these issues to encourage them to conduct ongoing research and experiment with solutions that will avoid or mitigate some of the potential negative impacts.

Environmental impact and resource management

The rapid adoption of small motorized pumps in India provides useful lessons. Where pumps have been widely adopted there has been over-exploitation. Where groundwater is the main source, there has been depletion of aquifers. IWMI researchers are demonstrating that well managed groundwater recharge schemes can overcome the problem, but these schemes are expensive and require considerable expertise and government support. Where rivers and lakes are the main source, there will be upstream-downstream and resource management issues to consider. Solutions here fall in the realm of the political. But there is also a hydrological component in regions where there is only so much water to share.

If a large number of individual farmers were to buy their own pump, water abstraction rates suggest that the limited water resources (using the renewable national water resources as an indicator) could become a problem. These estimates could be improved with better monitoring of farmer adoption rates and improving pump efficiency.

Pollution

Increased agricultural production usually leads to increased use of agro chemicals. Over and improper use are common and are reflected in human and animal health problems and declining water quality.

Greenhouse gas emissions

An AgWater Solutions study on the potential impacts of motor pump adoption in Ethiopia, Burkina Faso, Ghana, Tanzania and Zambia suggests that, in contrast to India, the emissions from water irrigation pumps are not likely to become a significant proportion of carbon dioxide emissions in each of the five countries. The emissions from pumps in 2010 were significantly less than 1% of each country's current agricultural sector emissions. Even with the development of a hypothetical scenario in which every smallholder uses a pump, the resulting carbon dioxide emissions are still less than 1% of the current agricultural sector emissions.

Annex: financial analysis for irrigation service providers

Pumping Costs	**Unit**	
Pump purchase cost	US$	300
Pipes and accessories	US$/yr	100
Life-span pump	Years	5
Fixed cost per hour-capital investment	US$/hr	0.23
Efficiency of pump	Liter diesel/hr	0.67
Fuel price	US$/liter	1.20
Maintenance costs	US$/hour	0.07
Operational pump cost per hour	US$/hour	0.87
Maximum capacity	**Unit**	
Average distance between plots	Km	3
Traveling speed between plots	Km/hr	10
Traveling costs	$/km	0.5
Traveling time between plots	Hours	0.3
Average plot size	Hectares	0.3
Down-time for repairs & maintenance	% of pumping hours	10%
Flow rate	m^3/hours	30
Water requirement in mm/day	mm/day	8
Max pumping hrs/day/pump	Hours	8
Max pumping days/week	Days	6
Administrative time	% of working hours	20%
Working hours per day	Hours	9
Working days per season	Days	75
Number of pumps		3
Labor price	US$/hours	0.50
Number of crop cycles/year-cropping intensity		125%
Time of irrigation per plot	Hours	0.80
Number of plots per day	-	19.6
Labor requirements	Hours/day	25.9
Total pump related costs	US$/year	1624
Total hired labor cost	US$/year	793
Total transport costs	US$/year	29
Billable hours per day	Hours	15.7
Billable hours per season	Hours	1473
Additional labor needed	Hours per day	16.9
Total cost per billable hour	US$/hours	1.66