

Financial analysis for the irrigation service provider

In brief:

- Business operators can earn a net income of over US\$ 800 per season on revenue of US\$ 1800.
- Two 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 3 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 **two** 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 2.50 US\$ 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\$s	3682

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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 he doesn't need to invest in a new one.

pump purchase cost	US\$s	300
pipes & accessories	US\$s/yr	100
life-span per pump	years	5
Annual interest/discount rate	%	15%
fixed cost per year/season*	US\$s	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\$s	1281
hired labor costs	US\$s	793
transport related costs	US\$s	29
total variable costs	US\$s	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\$s	2104
amortization costs	US\$s	343
total costs	US\$s	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 a little under US\$ 11 per day.

total revenue	US\$s	3682
total costs	US\$s	2446
income	US\$s	1235
income per day worked	US\$s per day	16.47

Payback period and cash flow

The upfront investment of the service provider amounts to 1200 US\$ 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 & 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 & maintenance costs	145	290	434	483	531
hired labor costs	77.6	155.3	232.9	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



Crops grown in the dry season can be taken to market for sale.

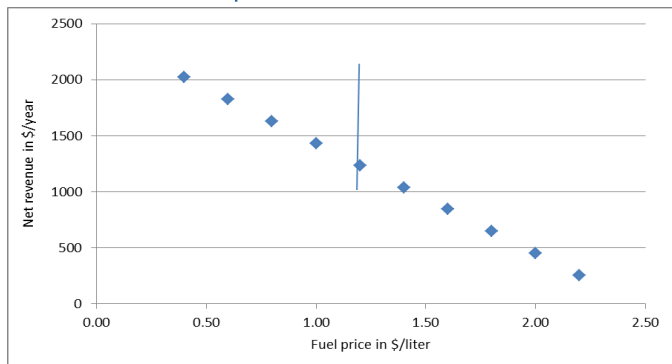
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Sensitivity analysis

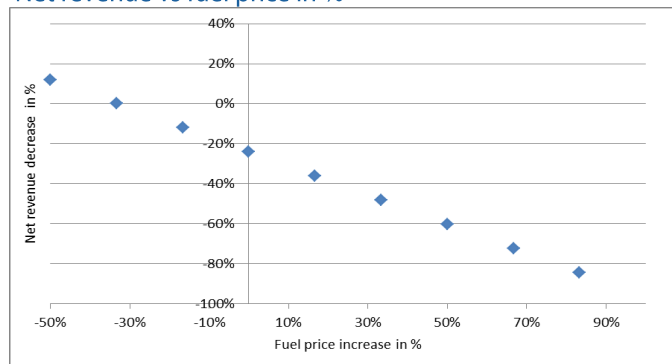
Fuel price

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

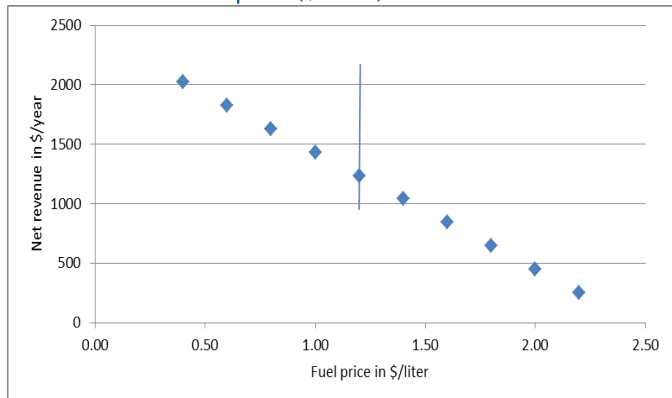
Net revenue vs fuel price (\$/Liter)



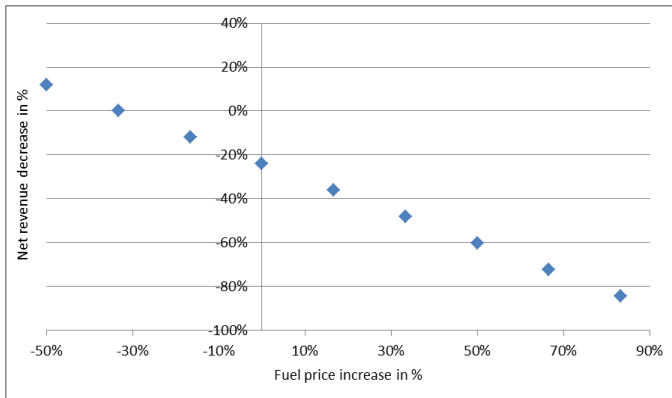
Net revenue vs fuel price in %



Net revenue vs fuel price (\$/Liter)



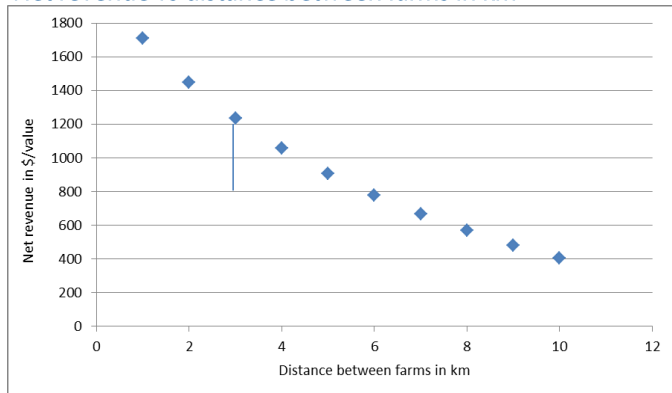
Net revenue vs fuel price in %



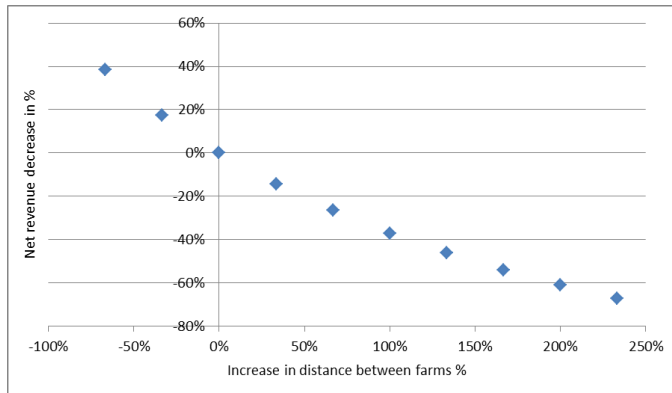
Travel time between customers

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

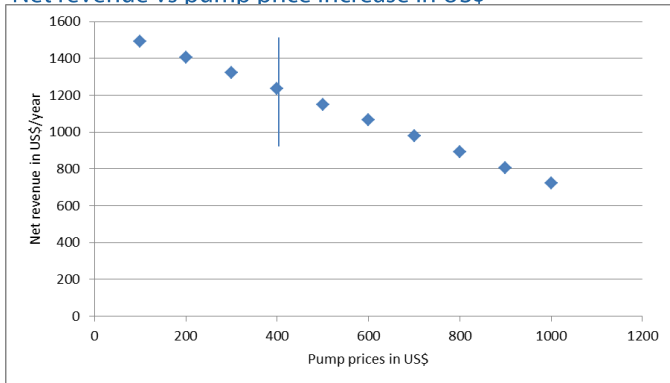


Net revenue vs distance between farms in %

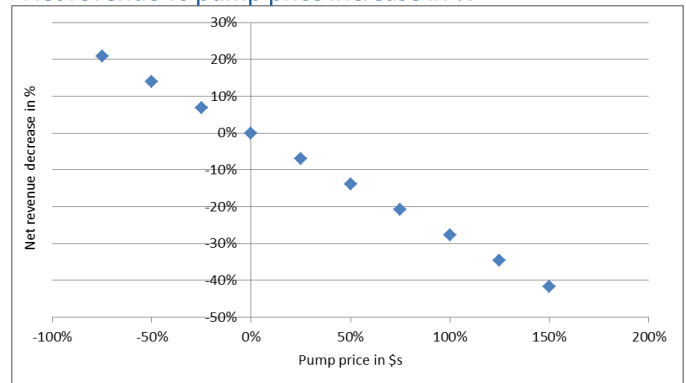


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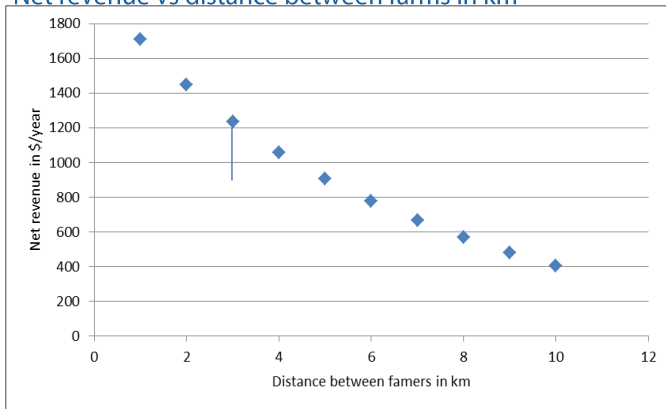
Net revenue vs pump price increase in US\$



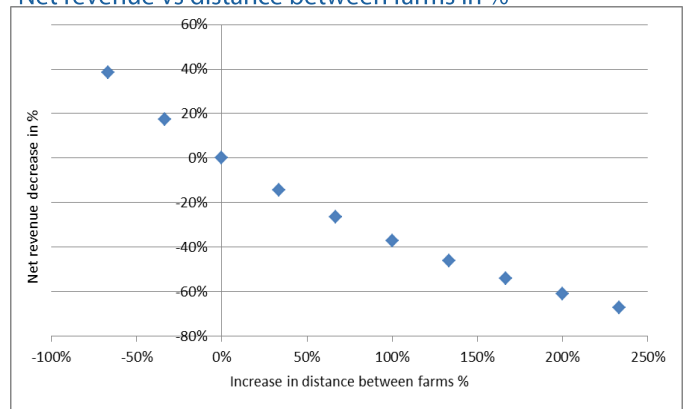
Net revenue vs pump price increase in %



Net revenue vs distance between farms in km



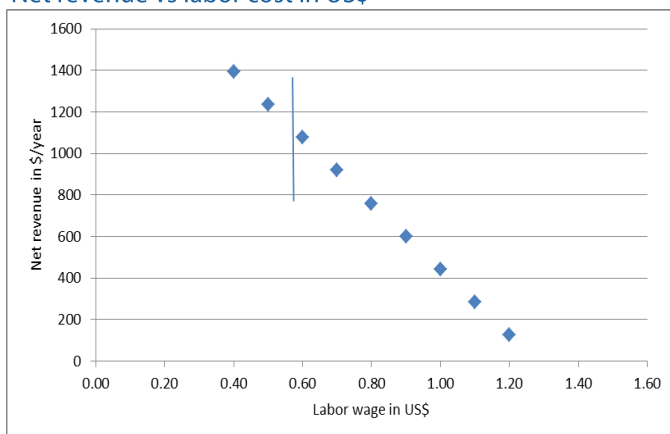
Net revenue vs distance between farms in %



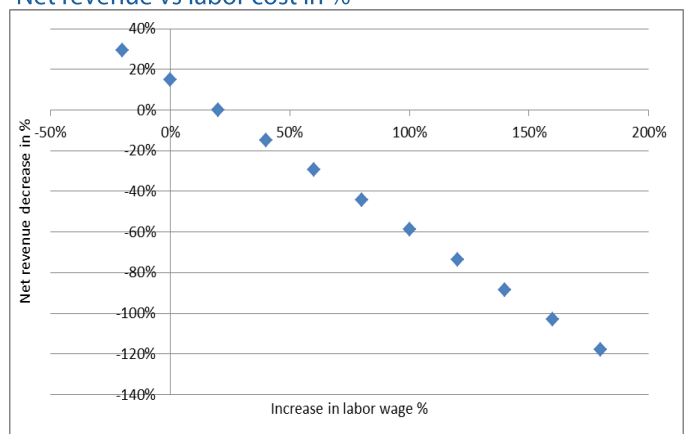
Labor wage

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

Net revenue vs labor cost in US\$



Net revenue vs labor cost in %

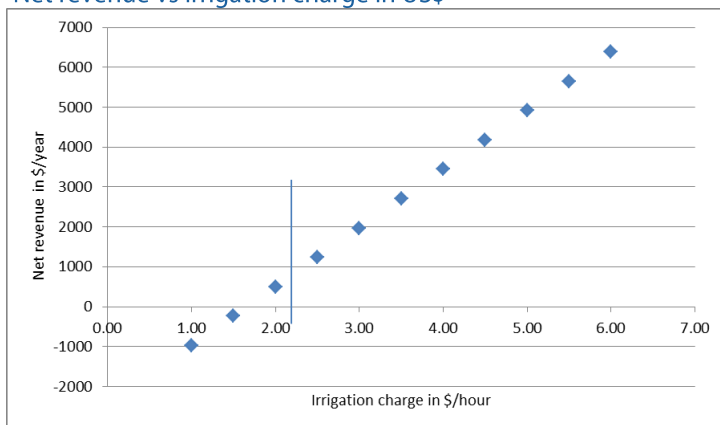


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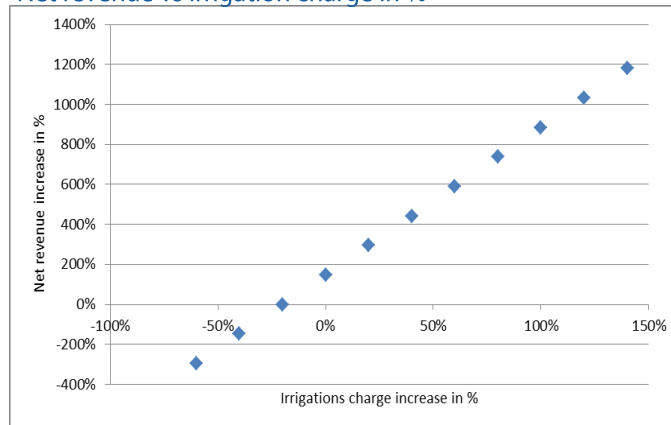
Irrigation service charge

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

Net revenue vs irrigation charge in US\$



Net revenue vs irrigation charge in %



With plenty of local farmers in need of a pump, this man's rental business is healthy and growing.

Financial analysis for 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 1265 US\$ per crop cycle. On average input costs (excluding irrigation) amount to 242 US\$. Irrigation service provision costs her 188 US\$ per crop cycle. She makes a profit of 756 US\$.

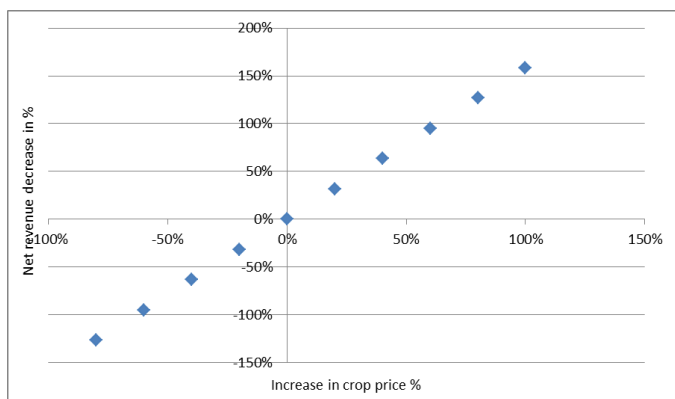
Labor	US\$	112
Seeds	US\$	38
Fertilizer	US\$	57
Pesticides	US\$	28
Misc equipment & fencing	US\$	8
Irrigation @ 2.50 US\$/hour	US\$	176
total costs	US\$	429
total revenue	US\$	1186
crop income	US\$	756

Sensitivity analysis

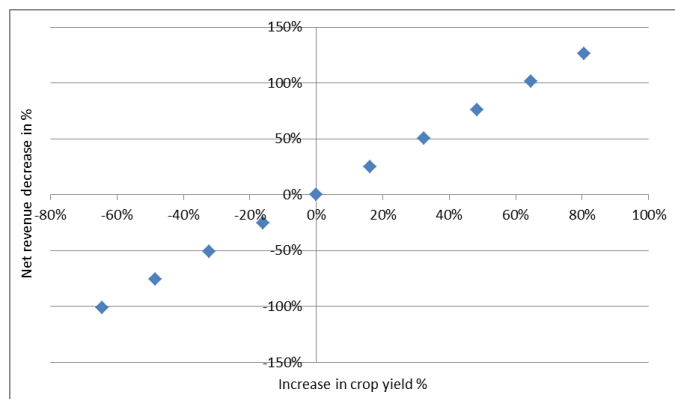
The irrigation service business depends on profitable irrigated vegetable farms as customers. Farm income is highly sensitive to reduction in yields (due to water shortage, pests and diseases) and crop prices. The graphs below indicate that if yields decrease by half crop income reduces by 72%. If crop 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 2 US\$ to 4 US\$ per hour reduces crop income by 19%. An increase of input costs by 50% decreases farm income by 10%.

Crop income vs selling price

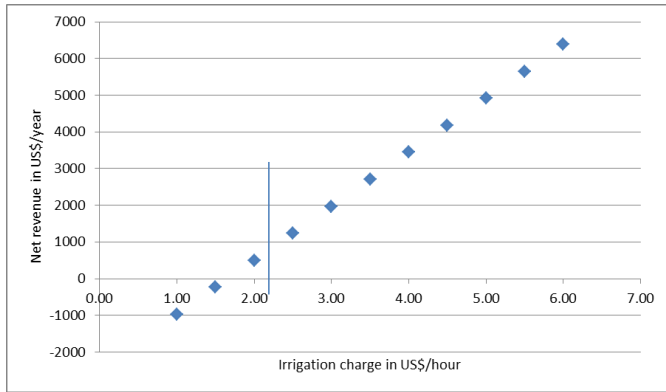


Crop income vs yield

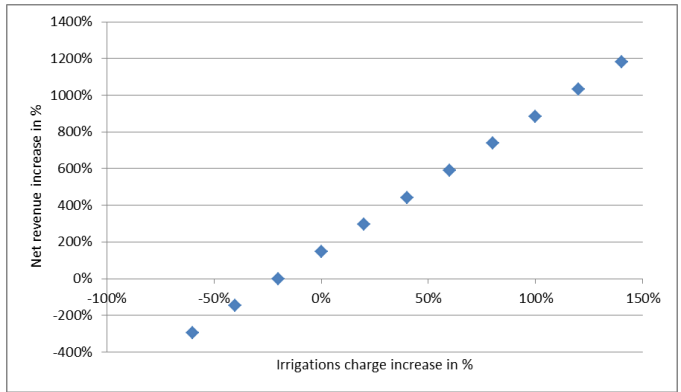


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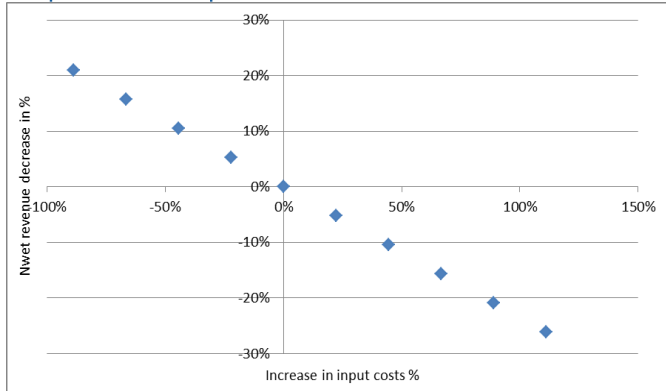
Crop income vs irrigation charge in US\$



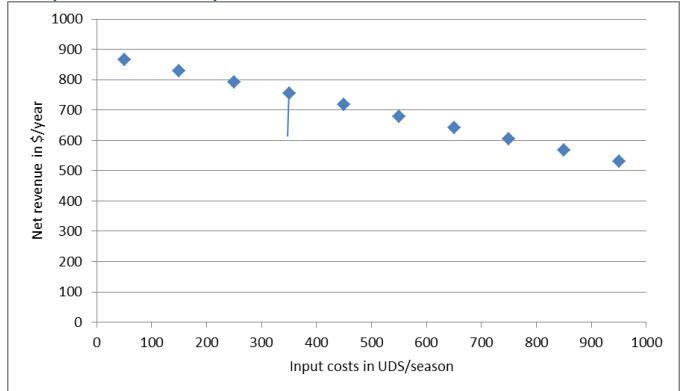
Crop income vs irrigation charge increase in %



Crop income vs input costs % increase



Crop income vs input costs US\$



With populations growing there will always be a need for produce in the market. Farmers who can grow vegetables in the dry season are guaranteed an income.

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;
- 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 percent 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 million 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			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 (participants costs 30*2100 + material & venue 12,000). In the second year, the Business Development unit trains 20 participants at a total cost of 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.

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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 covers 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.
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 farmer 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 oper-	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 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 suggests 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 AWS 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 provider

Pumping costs	unit	
pump purchase cost	dollars	300
pipes & accessoires	dollars/yr	100
life-span pump	years	5
fixed cost per hour -capital investment	dollar/hour	0.23
efficiency of pump	ltr diesel/hr	0.67
fuel price	US\$/liter	1.20
maintenance costs	US\$/hour	0.07
operational pump cost per hour	dollar/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	dollar/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	dollars/year	1624
total hired labor cost	dollars/year	793
total transport costs	dollars/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	dollar/hours	1.66
Revenue	unit	
Rental price per hour	hrs	2.50
Total revenue	dollars	3682
Bottom line		
Total costs	dollars/year	2446
Total revenue	dollars/year	3682
Net income	dollars/year	1235
Net income per day	dollars/day	16.47
Irrigated area per service provider	hectares	7.36
Number of customers	-	20.0

Data based on farmer survey in Ghana, AWM Solutions project

References