

briefing paper

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Chiansi irrigation

Patient capital in action



InfraCo

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Executive summary

InfraCo's Chiansi irrigation project adopts a fundamentally new approach to boost food production and incomes of smallholder farmers. It involves the creation of a shared, commercially managed water infrastructure system for all landowners. The cost of the irrigation project is paid back from the value uplift generated by the separately managed commercial farm operation, taking place on land of which half is unused land contributed by smallholder farmers. Free irrigation is provided over the smallholder market garden plots.

The starting presumption is that privately owned agricultural ventures should be funded in the private sector from commercial sources of debt and equity. However, it will not be possible to fund the Chiansi investment on this basis. This is because there are high front-end fixed costs that act as a barrier to entry by commercial investors. Expected returns prior to start up are insufficient to attract debt and equity from commercial sources, but once the start-up costs and the investment in very long-life assets have been made, incremental average costs fall sharply and returns on new investment become fully commercial.

The financial returns on capital invested in Chiansi tell only part of the story. There are major additional benefits that accrue to smallholders, of which account is not taken in the conventional financial calculus. Smallholder household incomes are expected to more than triple as soon as the investment is made. A conservative estimate of the economic real internal rate of return (IRR) of the investment is 17 per cent.

The key question is how to overcome the barriers to entry and kick-start sustainable commercial agriculture in a way that ensures the principal beneficiaries are the smallholder farmers and their families living in the area. The answer is patient capital. The effect of the injection of patient capital into Chiansi is to overcome the barriers to entry created by the need to fund one-off start-up costs and very long-life assets, and therefore to realise the large smallholder and wider economic benefits referred to above. Patient capital levers-in debt and equity from commercial sources: the resulting enterprise is sustainable. Patient capital is only a one-off requirement and once repaid it can be reinvested elsewhere. However, without patient capital, the investment cannot get started and none of the benefits will be realised.

InfraCo invested US\$3 million of Private Infrastructure Development Group (PIDG) 'social venture capital' pre-financial close to turn the Chiansi idea into an opportunity. What is needed to turn it from an opportunity into a reality is patient capital.

The importance of the Chiansi model is that it illustrates an approach that can be widely replicated in Africa. The circumstances that make Chiansi work – available underused land, good soils and access to water supply – are widespread in many countries. All that is needed to achieve similar benefits elsewhere is limited amounts of social venture capital to get projects to financial close and sufficient patient capital at financial close.

Introduction

The Chiansi irrigation project is located in the Kafue district of Zambia, adjacent to the Kafue River. The smallholder farmers living in the region are some of the poorest people on the planet, yet there are abundant land, good soils and plenty of water in the Kafue River. There is huge potential for a major increase in agricultural productivity and much higher incomes for farmers, but this potential has not been realised.

The Chiansi irrigation project is an InfraCo-led development.¹ The project aims to realise the agricultural potential of the area by stimulating sustainable commercial agriculture in ways that ensure that the smallholder farmers in the area are the principal beneficiaries.

This paper covers three areas:

- It describes an innovative solution to the commercialisation of smallholder land, which generates major improvements in incomes and welfare for the rural community.
- It explains why the solution cannot be financed and implemented if 'left to the market' because there are barriers to entry that deter investment. It then explains what these barriers are.
- It shows how patient capital can overcome the barriers to entry, kick-start sustainable commercial agriculture and ensure that the smallholder farmers and their families are the principal beneficiaries.

The current situation

The current situation is that there is very little commercial agriculture in the area. Smallholder farmers engage in subsistence agriculture using traditional methods. Smallholders own their own land. Although they own, on average, five hectares of productive land, only 20 per cent of that land is cultivated because they are not able to manage more than one-hectare plots using traditional methods. The remaining 80 per cent of the land is unused.

Smallholders principally grow maize. Yields are very low – typically one tonne per hectare – on the one hectare of land that is cultivated. By comparison, commercial farmers in Zambia typically produce maize yields of eight tonnes per hectare. So the potential output of the smallholders' land, if all five hectares were farmed, is 40 times current output. Low yields are the result of a lack of knowledge of modern farming methods, a lack of access to finance to purchase agricultural inputs, and a lack of access to irrigation to enable crops to be

grown all year round. Smallholders produce very little, if any, marketable surplus and annual household incomes are very low, estimated at less than US\$250.

Food security is poor because of droughts and floods that have occurred repeatedly in recent years. Crops regularly fail with the result that there has been reliance on food aid by the majority of smallholders in five of the last seven years. Unsurprisingly, health outcomes are poor.

The Chiansi irrigation project

Project objectives

The project has three key objectives. First, it aims to realise a very large increase in agricultural productivity by utilising efficiently the unused land and introducing irrigation and modern farming practices. Second, it aims to ensure that the principal beneficiaries of the project are the smallholder farmers and their families living in the area. Third, it aims to establish arrangements that empower local communities to build on the success of the project and continue sustainable, self-reliant social and economic development in the future.

Project concepts

The concepts that informed the project design were as follows:

- Irrigation is critically important. It will enable large improvements in productivity and incomes and major improvements in food security. Rain-fed agriculture cannot deliver good outcomes in areas like Chiansi where there is a long dry season followed by an unpredictable rainy season.
- Aggregating and bringing into productive use smallholders' unused land, thereby achieving economies of scale, is the key to unlocking the productive potential of the land.
- Creation of a commercial farm hub growing crops under irrigation using modern farming practices on unused land generates incremental value sufficient to pay all the costs of irrigated farming and generate a significant surplus that will benefit the smallholders/landowners.
- Creation of a shared bulk water supply system where the costs of providing irrigation infrastructure for the commercial farm hub can be paid for out of the value uplift on the commercial farmland. As a result, irrigation can be provided to the smallholder plots at very little extra cost.

Project design

The project adopts a new approach to boost food production and incomes of smallholder farmers. It involves the creation of a shared, commercially managed water infrastructure system for all landowners. The cost of the irrigation project is paid back from the value uplift generated by the separately managed commercial farm operation, taking place on land of which half is contributed by the smallholder farmers.

New bulk water assets and infield irrigation systems will be constructed to serve up to 2,500 hectares of undeveloped land (Figure 1). The main physical components of the project are the pump stations, canals, pipes and storage facilities that will provide irrigation water to the infield irrigation pivots. There will be a number of commercial farm hubs, which will grow under irrigation wheat, soya, and potentially, upland, rice and sugar. Farming equipment and irrigation pivots will also be provided to the smallholder farmers for use on their market garden plots.

Commercial arrangements

The smallholder farmers have agreed to combine 80 per cent of their land (the unused

portion) into landholder co-operatives which will enter into 20-year leases with independent commercial farm-operating companies (FarmCo(s)), owned initially by InfraCo (Figure 2). In return for contributing their land, smallholders will receive an equity interest in the FarmCo that will entitle them to a portion of the distributable cash flow. In addition, they will have the option to increase their ownership in the FarmCo after the initial investment has been repaid. The remaining 20 per cent of the land will continue to be farmed directly by the smallholder farmers, but now with the benefit of free irrigation of that land.

A special purpose Infrastructure Services Company (ISC) will be established to finance, build and operate the irrigation assets (Figure 3). Ownership of the ISC will be shared between the Zambian Government and a Trust established to provide transparent governance. The board of the Trust will include representatives of the local farmers and providers of the investment capital. After 25 years, full control of the Trust will revert to the local farmers who will assume full co-ownership of the ISC alongside the Government.

The ISC will provide the following services: supply of bulk water; long-term lease of infield irrigation equipment and farm equipment to

Figure 1: Chiansi project design

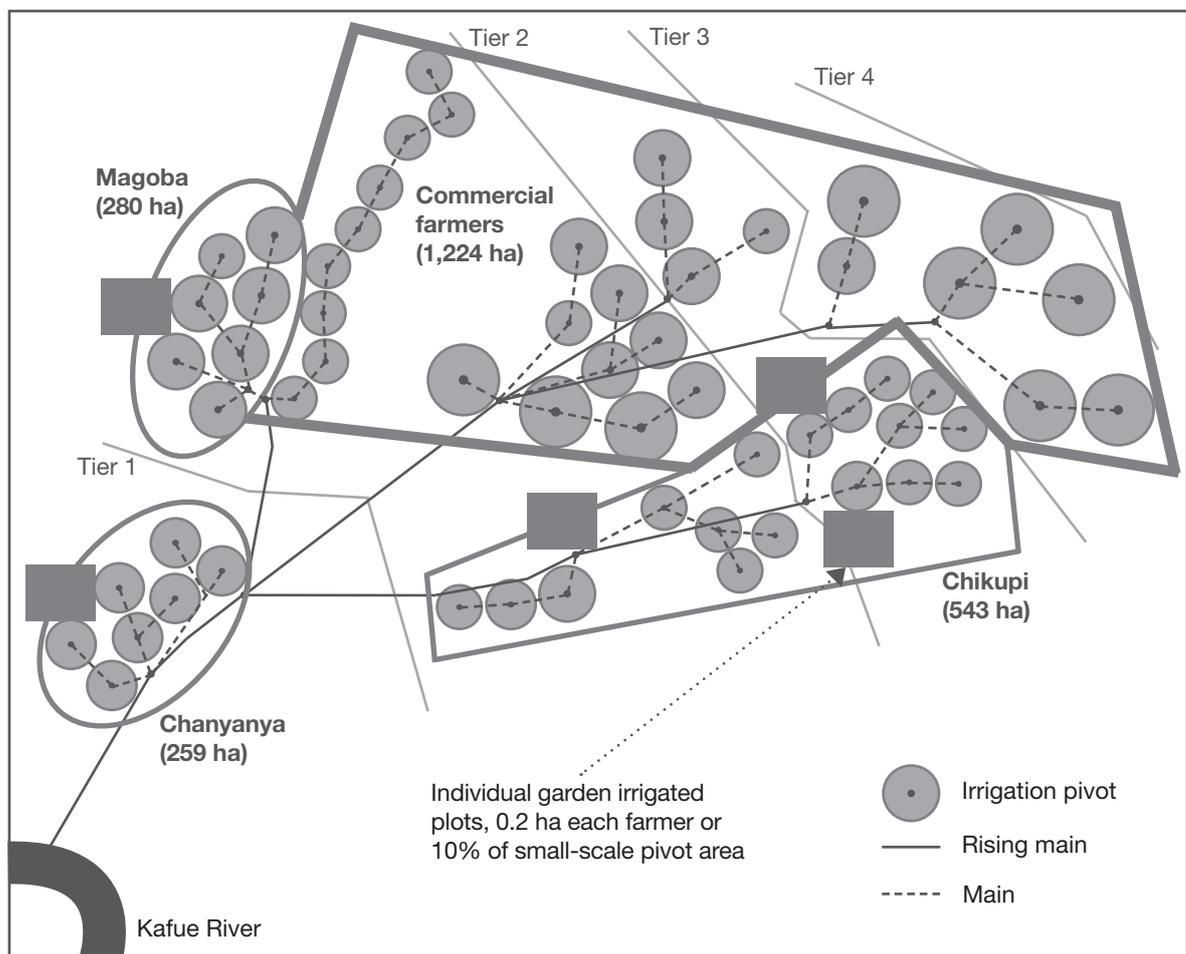


Figure 2: Chiansi commercial arrangements

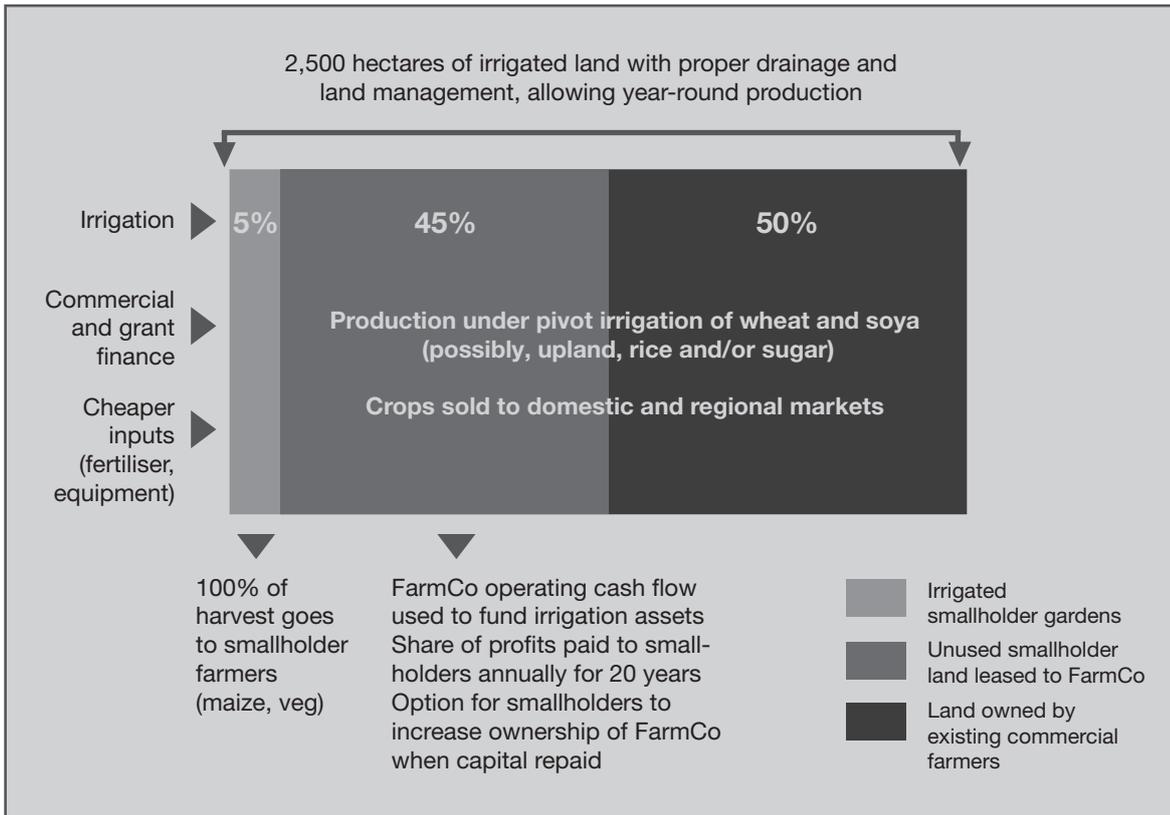
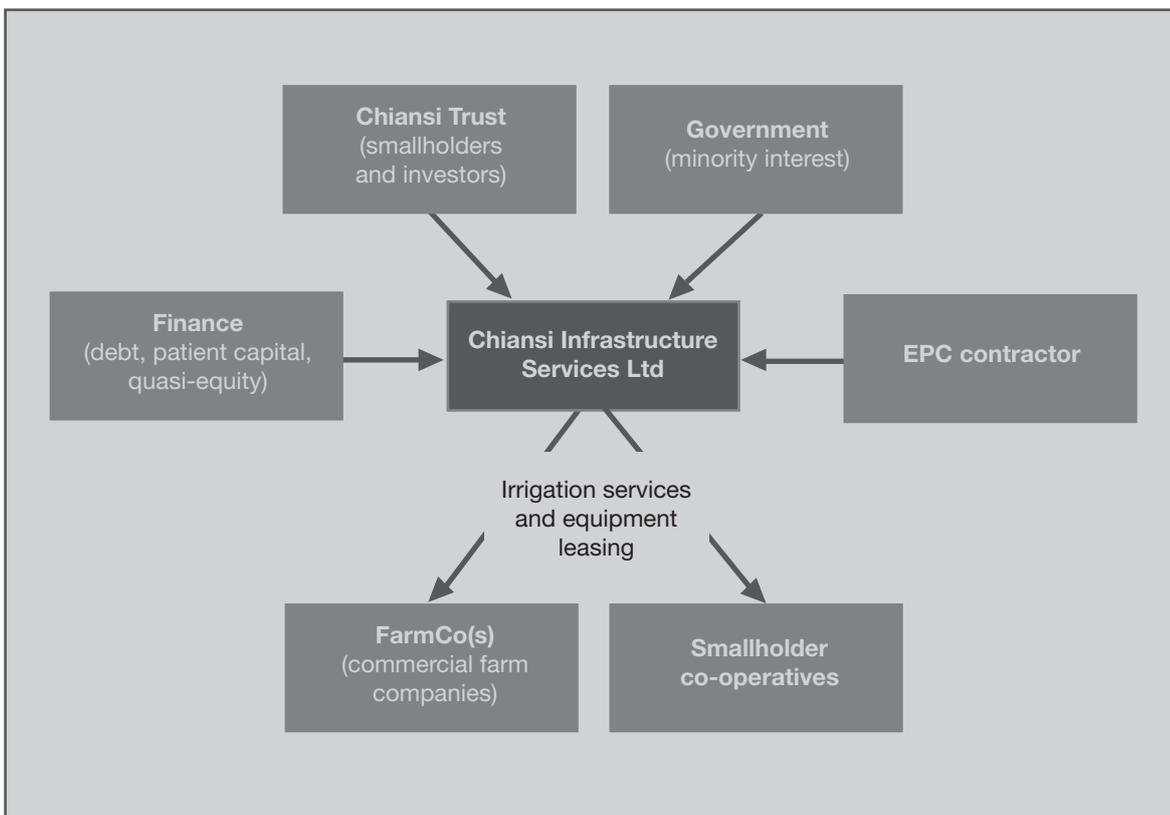


Figure 3: Chiansi project structure



the FarmCo(s); irrigation to market garden plots for use by members of the smallholder co-operatives; potable water through the provision of new boreholes and renovation of existing boreholes in the area; and electricity supply to key public buildings such as schools, clinics and community centres. In exchange for providing these services, the farmers will grant the ISC permission to operate their rights to extract water for irrigation from the Kafue River for the duration of the project.

One or more FarmCo(s) will be established in the area to act as customers of the ISC. The FarmCo(s) will be wholly owned by commercial farmers and the smallholder co-operatives. The FarmCo(s) will be commercial enterprises providing a dividend income to their owners, including the smallholder farmers, out of distributable surplus. A management contract with a competent commercial farm organisation will be put in place to ensure appropriate oversight of the operations of each FarmCo.

Co-operative societies to represent the interests of the smallholder farmers have been, and are being, established. Support and guidance in establishing the co-operative societies are being provided by USAID, and Engineers without Borders will provide technical support to the co-operatives post-financial close.

Pilot phase

The model has been successfully tested in Chanyanya, a community in the Chiansi area. The pilot involved the development of 208 hectares of contiguous farmland currently

owned by smallholder farmers in Chanyanya Village at a cost of around US\$2.5 million. One hundred and forty-eight hectares are being farmed under commercial management and the remaining 60 hectares continue to be farmed by the smallholder farmers. Irrigation pivots have been successfully installed on both the commercial farm and the smallholder plots. Wheat and soya yields in the first season on the commercial farm were up to expectations. Smallholder farmers have begun to diversify their crop mix to include vegetables, as well as maize. The pilot has demonstrated that the model works and generates the expected amount of value uplift. It has also demonstrated to other smallholders in the area the large benefits of the scheme and consequently has generated widespread enthusiasm to be included in subsequent phases of the development.

Project economics

This section describes the financial costs and benefits of the project.

Capital costs

The total cost of the fixed assets is a little under US\$25 million (Figure 4). About 60 per cent of the total capital costs are either one-off costs (land clearing, resettlement, development costs²) or relate to assets with very long lives (canals, water mains)³. The incremental cost of providing irrigation for the market garden plots is less than US\$1 million. The working capital requirement for the commercial farm is about US\$5.6 million.⁴

Figure 4: Chiansi capital costs, by major category

Category	Cost (US\$1,000s)
One-off start-up costs and long-life assets	
Canals	399
Water mains	4,720
Pump stations	2,161
Electrics	643
Land clearing	2,350
Resettlement	570
Development	2,000
Buildings	800
<i>Sub-total</i>	<i>13,600</i>
Other capital costs	
Infield irrigation pivots (FarmCo)	7,158
Irrigation pivots (smallholder plots)	360
Farming equipment	2,928
Contingency	863
<i>Sub-total</i>	<i>–</i>
Total capital costs	24,952
Working capital	5,575
Total finance requirement	30,527

Yields and output

Projected yields from year three are seven tonnes per hectare for wheat and 2.8 tonnes per hectare for soya (Figure 5). The assumed yields are prudent and below those achieved by other commercial farm operations in Zambia. Production at Chanyanya has confirmed that these yields are comfortably achievable. The commercial farm will produce annually 17,500 tonnes of wheat (winter) and 7,000 tonnes of soya (summer), representing an eight to nine per cent increase in total Zambian output.

In Zambia, wheat and soya prices are at a premium to South African prices reflecting import parity, plus transport costs. Based on an average price slightly lower than the five-year historic average in Zambia, production from year three will have an average value of about US\$12 million per annum. There is significant potential upside that has been excluded from the base case analysis.

Project financial rate of return

The project generates an 11.5 per cent pre-tax project real financial IRR over 50 years (corresponding to the duration of the long-life assets). The net cash flow generated by the commercial farm over this period is sufficient to repay, in full, the cost of installing the irrigation assets and generate substantial benefits for the local economy in the form of payments to smallholders/landowners, employees and in taxes.

Financing the investment

The starting presumption is that private sector agricultural ventures should be funded in the private sector from commercial sources of debt and equity. However, on this basis, it will not be possible to fund the Chiansi investment: therefore it will not proceed. Figure 6 shows why.

Figure 5: Chiansi operating margins

	Wheat					Soya				
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 1	Year 2	Year 3	Year 4	Year 5
Price (US\$/tonne)	380	388	395	403	411	375	383	390	398	406
Yield (tonnes/hectare)	6.0	6.5	7.0	7.0	7.0	2.0	2.5	2.8	2.8	2.8
Variable costs (US\$/hectare)	1,440	1,484	1,529	1,559	1,590	780	807	833	849	866
Gross margin (US\$/hectare)	840	1,036	1,239	1,264	1,289	8	149	260	265	270

Figure 6: Financing plan and equity returns (with and without patient capital)

Category	Without patient capital	With patient capital
Financing requirement, US\$ million	30	30
Debt, US\$ million (%)	12 (40%)	12 (40%)
Patient capital, US\$million (%)	–	15 (50%)
Equity/quasi-equity, US\$ million (%)	18 (60%)	3 (10%)
Equity IRR (%)	9	17

The debt capacity of the project has been calculated assuming a loan life of 11 years and a nominal dollar interest rate of nine per cent per annum. Because this is a greenfield project, a relatively high life of loan debt service cover ratio (DSCR) is likely to be required by senior lenders. Assuming that lenders require a life of loan DSCR of x1.7, the project cash flows will support about US\$12 million of debt (40 per cent of the total funding requirement). The balance of the funding will have to come from equity.

Assuming that US\$12 million of senior debt can be raised on the terms set out above, the equity IRR (after allowing for annual payments to landowners for use of their land) over 25 years is about 10 per cent nominal (7.5 per cent real). This is clearly insufficient to attract commercial sources of equity to invest in Chiansi at this early stage. Therefore, funding from fully commercial sources will not be available and the project will not proceed on this basis.

The case for patient capital

It would be wrong, however, to conclude that the Chiansi project should not proceed.

Barriers to entry

There are several reasons why the expected equity return prior to start-up is below the threshold return set by commercial investors. First, because Chiansi is a greenfield venture, it has to incur about US\$5 million of capital costs that are one-off start-up costs. These costs, once incurred, will not recur, but they have to be funded and there is no margin in the selling price of the outputs to recover these costs. So they depress the pre-start-up equity return. Second, about US\$9.5 million of the capital costs relate to assets that create value over 50 years or more. But, because commercial investors' time horizons are much shorter than the total useful life of these assets, and prior to start-up they discount future value at a high rate, this longer-term value addition is not adequately recognised. Third, because Chiansi is a greenfield venture, important segments of the private equity market will not invest on any terms. Those that will set very high hurdle rates for taking on this type of risk exposure.

Declining average costs, arising from the need to finance high front-end fixed costs, constitute a classic barrier to entry by commercial investors. Expected returns prior to start-up are insufficient to warrant investment. However, once start-up costs have been sunk and the investment in the long-life assets has been made, incremental average costs fall sharply and returns on new investment become fully commercial. The incremental return on new investment at Chiansi following start-up is in excess of 17 per cent in real terms.

Economic benefits of Chiansi

The financial returns on capital invested in Chiansi tell only part of the story about the economic costs and benefits of the project. There are four categories of additional benefits that accrue to smallholders, of which account is not taken in the financial calculus set out above.

Benefits to smallholders

- The financial analysis of Chiansi treats payments by the FarmCo(s) to the smallholder farmers as a cost to the project. Of course, these payments are important benefits for the smallholders. No account is taken in the financial calculus of the value of these payments to smallholders. Over the life of the 20-year lease they have an estimated value of around US\$450 per annum for each smallholder household. From an economic perspective, these payments are not properly treated as costs. They are distributions of value added created by the FarmCo/ISC.
- The project will provide about 6,500 people living in the area with year-round irrigation for at least 25 years. The financial analysis includes the cost of providing irrigation at no charge to the smallholders' market garden plots, but it does not include the valuation of the resulting benefits. The most obvious benefits are the improved maize yields and the ability to grow vegetables, both of which are made possible by irrigation. The annual benefit from irrigating these plots is estimated to be no less than US\$150 per smallholder household. The combined value of these two payments is estimated to be no less than US\$600 per

annum per smallholder household – a more than 300 per cent increase in household income for every benefiting household, as soon as the investment is made.

- Another important benefit for smallholders is the major improvement in food security. The risk of the rains being too early or too late disappears; the need for food aid disappears with it. Health outcomes will improve. These are important additional benefits that have not been valued in the financial analysis.
- There are also value-chain benefits. Currently, smallholders use very few agricultural inputs – one of the reasons that yields are so low. The FarmCo hub will provide easier access for smallholders to agricultural inputs such as fertiliser, improved seeds, farm equipment etc. Because the FarmCo will purchase in bulk for its own needs, the cost of these inputs for smallholders will fall considerably. Moreover, the FarmCo will provide credit for smallholders, drawing on the revolving credit facility arranged for its own use. So, in addition to improvements in smallholder output resulting from irrigation, there will be further gains arising from easier and cheaper access to agricultural inputs.

Community benefits

- The project will construct new boreholes and improve existing ones to serve the local community with potable water. It will also extend electricity supply to a number of public buildings such as schools, clinics and community centres. The cost of this is included in the financial calculus, but the associated benefits have not been included.
- The smallholders have agreed to set aside 20 per cent of the payments made by the FarmCo and dedicate these funds to developing community projects. The financial benefit is included in the analysis set out above. What is not included, however, is significant intangible benefit in the form of strengthened community organisation and governance (through the co-operative societies) to direct the future social and economic development of the area.

Wider economic benefits

- The start-up stage will generate about 1,000 new jobs and there will be more than 250 permanent jobs working for the ISC and FarmCo(s) throughout the life of the FarmCo.
- The financial analysis treats the cost of employment and taxes as costs to the project; however, from an economic perspective, these are largely a distribution of incremental gross value added. Since the opportunity cost of unskilled labour in the area is very low, the bulk of the payments for wages and salaries can be considered to be a net economic benefit. Likewise tax payments are an economic benefit for the economy, not a cost.
- The economic IRR of the project has been estimated over 25 years. No value has been attributed to the indirect benefits such as improved food security/health benefits/value-chain benefits/community benefits. The economic real IRR of Chiansi on this conservative basis is approximately 17 per cent.

So, the story so far is that the investment at Chiansi will not attract commercial capital because it offers investors sub-commercial expected returns prior to start-up. The high front-end fixed costs constitute a barrier to entry. However, if the barriers to entry can be overcome, incremental returns on new investment generate fully commercial returns. The enterprise would be sustainable. Moreover, the economic benefits are very significant and the project is strongly pro-poor. Therefore, the question is how can the barriers to entry be overcome – how can we get the investment started? The answer is patient capital.

Patient capital in action

Patient capital is long-term, subordinated capital invested at a sub-commercial cost, which is used to fund the one-off start-up costs and part of the cost of the very long-life assets. Here, patient capital is modelled as redeemable preference shares with a six per cent coupon, a five-year grace period, and redemption over years 12 to 20 (ie commencing after senior debt has been fully repaid).

A revised financing plan including a tranche of patient capital has been modelled (Figure 6 on page 8). It assumes, as before, that 40 per cent of the funding is provided by senior lenders for 11 years at nine per cent.⁵ In this case US\$15 million of patient capital is made available on the terms set out in the previous paragraph and the balance of the funding (10 per cent) comes from commercial equity providers. The subordination of the patient capital facilitates the raising of the senior debt (by providing a risk cushion). The low coupon on patient capital gears the IRR on commercial equity to about 16 to 18 per cent, which should be just about high enough to attract equity investors seeking commercial returns.⁶ So, the availability of patient capital levers-in an equal amount of commercial capital and, by overcoming the barriers to entry, kick-starts the growth of sustainable commercial agriculture.

If patient equity were made available on these terms then the grant-equivalent cost of the concessional capital would be about US\$8 million. This is the NPV cost of the sub-market coupon on patient capital. It is also the amount of grant funding that is implicitly being committed to bring about the financial and economic benefits set out above.

The effect of the injection of patient capital is to overcome the barriers to entry created by the need to fund one-off start-up costs and very long-life assets, and therefore to realise the smallholder and wider economic benefits referred to above, which otherwise would not have been realised. The resulting enterprise is sustainable. Patient capital is needed only once.

Cash-flow projections over 25 years are inherently uncertain. The analysis has considered the consequences for patient capital providers of the enterprise doing either better or worse than in the base case.

It is assumed that patient capital providers would benefit from upside-sharing provisions and acceleration rights in the event that the FarmCo's actual revenues turned out to be higher than originally anticipated.⁷

In the event that the business performed less well than expected, there may not be sufficient cash flow to redeem the patient capital on the due dates. Redemption may be delayed, but

since the life of the assets is much longer than the redemption period, there will be continuing annual net cash flow increments for many more years. The risk that patient capital would never be redeemed is extremely low.

Sustainability

After 25 years, the land lease terminates and ownership of the land reverts to the smallholder landowners, unless they agree at that time to extend the lease arrangements. One-time costs will not recur and long-life assets will not need replacing for many more years. Therefore finance will only be needed to replace the infield infrastructure and farm equipment. Senior debt and patient capital would have been redeemed at that point in time. So there is very little risk of the FarmCo not being able to generate sufficient cash flow at that time to sustain and grow the business into the future.

Conclusions

InfraCo's Chiansi irrigation project adopts a fundamentally new approach to boost food production and incomes of smallholder farmers. It involves the creation of a shared, commercially managed water infrastructure system for all landowners. The cost of the irrigation project is paid back from the value uplift generated by the separately managed commercial farm operation, taking place on land of which half is unused land contributed by smallholder farmers. Free irrigation is provided over the smallholder market garden plots.

The starting presumption is that privately-owned agricultural ventures should be funded in the private sector from commercial sources of debt and equity; however, it will not be possible to fund the Chiansi investment on this basis. This is because there are high front-end fixed costs that act as a barrier to entry for commercial investors. Expected returns prior to start-up are insufficient to attract debt and equity from commercial sources. But once the start-up costs and the investment in very long-life assets have been made, incremental average costs fall sharply and returns on new investment become fully commercial.

The financial returns on capital invested in Chiansi tell only part of the story. There are major additional benefits that accrue to smallholders, of which account is not taken in the conventional financial calculus. Smallholder household incomes are expected to more than triple as soon as the investment is made. A conservative estimate of the economic real IRR of the investment is 17 per cent.

The key question is how to overcome the barriers to entry and kick-start sustainable commercial agriculture in a way that ensures the principal beneficiaries are the smallholders and their families in the area. The answer is patient capital. The effect of the injection of patient capital into Chiansi is to overcome the barriers to entry created by the need to fund one-off start-up costs and very long-life assets, and therefore to realise the large smallholder and wider economic benefits referred to above. Patient capital levers-in debt and equity from commercial sources. The resulting enterprise is sustainable. Patient capital is needed only once and once repaid it can be reinvested elsewhere. But without patient capital the investment cannot get started and none of the benefits will be realised.

InfraCo will have invested about US\$3 million of PIDG 'social venture capital' to get Chiansi to financial close.⁸ To realise the Chiansi potential – an investment with a 17 per cent real economic return that is sustainable and generates major benefits for smallholders – will require an investment of patient capital amounting to US\$15 million with a grant equivalent cost of about US\$8 million. This patient capital will lever-in US\$15 million of commercial debt and equity at financial close. It will be replaced with 100 per cent commercial capital over time.

The importance of the Chiansi model is that it illustrates an approach that can be widely replicated in Africa. The circumstances that make Chiansi work – available under-used land, good soils and access to water supply – are widespread in many countries. All that is needed to achieve similar benefits elsewhere is limited amounts of social venture capital to get projects to financial close and sufficient patient capital at financial close.

Notes

- 1 InfraCo (www.infraco.com) is a public-private partnership infrastructure development company. It undertakes early-stage development of infrastructure opportunities acting as principal and seeks to attract private-sector debt and equity to invest in them at financial close. InfraCo is the developer of Chiansi and has completed the Chanyanya pilot stage of the development.
- 2 Development costs are costs incurred prior to start up and include finalising the commercial arrangements, completing a bankable feasibility study, arranging the finance, and supervising implementation in the early years.
- 3 Canals and water mains have asset lives of no less than 50 years.
- 4 The financing is assumed to include a committed revolving working capital facility.
- 5 Senior debt will be sourced from commercial lenders with the benefit of partial credit enhancement from, for example, GuarantCo and/or from infrastructure debt providers such as Emerging Africa Infrastructure Fund.
- 6 For Chiansi the balance of the funding will be quasi-equity, ie secured high-yield income notes with equity characteristics but not conveying an ownership interest in the assets or the land.
- 7 In practice, target returns on equity and upside-sharing arrangements would be negotiated on a case-by-case basis depending upon the risks of each particular case. For further details about patient capital see: Palmer (2010), *Agricultural growth and poverty reduction: the case for patient capital*, AgDevCo.
- 8 PIDG (www.pidg.org) is a group of European government donors who subscribed to the share capital of InfraCo. InfraCo uses the social venture capital provided by PIDG to bring infrastructure projects to financial close and seeks to recover its investment with a premium from incoming investors at financial close.



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