Can smallholder farmers meet the financial costs of irrigation services? A case study on economic efficiency and social equity in South Africa.

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1. Introduction: why an interest on irrigation services costs

Until recently, surface irrigation in developing countries has been a classic donor- or government-driven public works and rent-seeking operation (Briscoe, 1999: 461) that systematically implied central public or parastatal management of operations. In subsistence irrigation agriculture, subsidization by Government is usually justified by '*adjustments for societal objectives*' (Rogers et al., 1998: 12), e.g. food security objectives, multiplier effects of irrigation agriculture, positive impact on rural development, income redistribution, and social benefits (Sampath, 1992: 968-969; Briscoe, 1999: 480; Jamin et al., 2005: 66). Besides food self-sufficiency, achieving net profit over the long term is the motivating factor that sustains irrigated agriculture. Economically acceptable irrigation systems provide lifestyle and social options for farmers and also contribute to the wider economy and community. Molden (2007: 60) reports that many studies indicate a multiplier effect of investment in irrigation in the range of 2.4 to 4, benefiting the whole economy.

In spite of these alleged benefits, both domestic and international financial resources aimed at irrigation development are becoming increasingly difficult to obtain, due to limited availability and competing needs. Therefore, increasing attention is being paid not only to the generation of financial resources to meet the operation and maintenance expenses of existing projects, but also to the recovery of capital invested in the past to fund new projects or to rehabilitate old ones (Sampath, 1992). In many places, irrigation under public-sector management has long been characterized by poor technical, financial, and economic performance, and overall suboptimal use of irrigation facilities (Sampath, 1992: 997-998). As a consequence, the degree of capital, operation, and maintenance cost recovery in developing countries remains far below financial autonomy (Briscoe, 1999: 477).

Worldwide, irrigation schemes are now faced with decentralization and privatization policies, aiming at increased local participation, and at relieving the Governments from the burden of financial and technical support (IWMI, 2003). During the past three decades, a large number of formerly State-owned and public sector managed schemes have been transferred to users (through the so-called Irrigation Management Transfer -IMT), who are now expected to bear at least the expenses incurred by operation and maintenance (Vermillion, 1997). In 2000, The Hague's World Water Vision clearly recommended that full-cost pricing be promoted and implemented (Cosgrove and Rijberman, 2000). Briscoe (1999: 478-479) reckoned that full cost pricing proves feasible in developed environments (e.g. in Australia). However, while acknowledging that '*the recovery of full cost should be the goal for all water uses …*', the International Commission on Irrigation and Drainage (ICID) alternatively recommended that [to achieve sustainability] *'it need not necessarily be charged to the users'* (Tardieu, 2005: 252).

Molden (2007: 34) states that irrigation water pricing is inefficient as a demand management tool, and '*risks aggravating water deprivation and poverty*'. De Fraiture and Perry (2002) have documented and explained why agricultural water demand is inelastic at low price ranges. Yet, pricing might have different, essential, objectives altogether: to recover some costs related to water delivery service (Perry, 2001), and possibly to act as an incentive for farmers to intensify and augment land and water productivity. Although irrigators' willingness to pay for water remains generally well below operation and maintenance costs (Backeberg, 2006: 6), it should not be overlooked; it reflects the mere fact that irrigators do value water, and acknowledge its role as a production factor.

All in all, if irrigation agriculture is considered a major contributor to achieving United Nations' Development Millenium Goals (MDGs) towards global sustainable development, there are still many pending questions with regard to its inner sustainability, especially in financial terms.

South Africa's irrigation sector makes no exception to the global situation, and typically illustrates the changes in irrigation policy and management. During the apartheid era, South Africa embarked on the development of irrigation schemes through public investment. These government-initiated then –managed smallholder irrigation schemes have performed very poorly (Bembridge, 2000; Backeberg, 2003: 151). These schemes were neither financially viable nor self-sustained since capital or operation costs were never covered by operation outputs and profit. Instead, under-pricing and government subsidization of water infrastructure and services, and management by parastatal agencies generated dependency and ignorance, since farmers were often reduced to functioning as workers on their own land (IWMI, 2003), ignoring the cost of infrastructure, the actual value of water as an input to production, and all stakeholders being unaware of its opportunity cost (Briscoe, 1997: 154).

Smallholder irrigation schemes (SIS) were mostly built during the 1950s and 1960s, as a measure to achieve food security and economic crop production in the semi-arid areas of the homelands (Bantustans). Such schemes cover a total area of about 50 000 ha (Denison and Manona, 2006b: 11), while the total irrigation area in South Africa is about 1.3 million ha (Backeberg, 2003: 150). About 180 of these schemes are located in the Limpopo Province of South Africa (Denison and Manona, 2006b: 11). Their key features include a gravity-based supply system, a limited average farm size (about 1 to 2 ha per beneficiary), and a marked subsistence orientation (maize being the major crop) (Perret, 2002: 287-289) (see case study scheme in Box 1).

Nowadays, subsistence farming prevails in these schemes, with low productivity and virtually no commercialisation, as a results of decades of central management, lack of initiative or decision-making by the beneficiaries, lack of input, credit and produce markets, low land productivity, infrastructure degradation, massive male out-migration, unsuccessful financial management, and weakened land-related institutions (Bembridge, 2000; Perret, 2002; Backeberg, 2003).

An overall decentralization process of water resource management is being implemented, and more specifically, IMT is underway (Perret, 2002; Backeberg, 2003). Such process supposes that, following revitalization (in the form of infrastructure rehabilitation, technical and managerial training, institutional and organizational facilitation), farmers are soon in charge of their schemes, in institutional and financial terms. Each scheme is to be managed by a water users' association (WUA), which will take charge of both water management, and cost recovery for water services. In other words, the WUA will supposedly achieve financial sustainability by selling water and water services to willing-to-pay farmers (Perret, 2002: 291-292).

At macro-level, water scarcity is a critical issue in the country. Multiple users increasingly demand more water (e.g. for domestic, industrial, mining, power generation purposes). Agriculture as a whole extracts about 60% of the resource while it directly contributes only about 4% of GDP (about 12% when including food and fibre processing) (Ortmann & Machethe, 2003). Smallholder irrigation farming uses only 4% of all irrigation water (Perret, 2002).

The National Water Act of 1998 (NWA) establishes a strategy that includes water use charges specific to end-user sectors (Backeberg, 2006: 4). Regarding irrigated agriculture, there are charges (1) for funding water resource management and (2) for funding water resource development and the use of waterworks. The latter charges are meant to recover the cost of these schemes, and include depreciation and the full operation and maintenance (O&M) costs. Exception is made for subsistence and emerging farmers, for whom O&M charges will be subsidized on a reducing scale over five years, where after depreciation charges will be phased in. In practice, the 5-year moratorium has long expired, and smallholder irrigators are still hardly charged whatsoever (Perret, 2002: 289; Denison and Manona, 2006a: 48; Backeberg, 2006). Two facts may explain this. At present, only a few WUAs are established and operational in smallholder irrigation systems (Backeberg, 2006: 4). Also, most smallholder irrigation schemes are inadequately equipped and designed to measure water flows and actual consumptions. When they exist (rarely), water charges are based on land (cropped area) (Perret, 2002).

In spite of decentralization and privatization processes looming, public authorities are still committed to provide these schemes with a fresh start before management transfer and State withdrawal, in the form of revitalization and rehabilitation programmes. The Government has been, and still is investing substantial amounts of public money in smallholder irrigation, with very low return, and at no real cost for private users. Denison and Manona (2006a: 48) report that the Limpopo provincial Department of Agriculture plans to spend R1.08 billion between 2006 and 2010 in rehabilitation of smallholder schemes. In the Eastern Cape, R100 million have been allocated in 2006 for the same purposes. Such investment represents a subsidy to smallholder farming, mostly related to social equity, food security, and rural development concerns, whereas the nation's overall liberal trend includes giving up subsidies to agriculture (Ortmann and Machethe, 2003).

In view of the gap between intended policies, expectations, and the field reality, this paper investigates the financial costs of irrigation services and the capability of farmers to cover costs, on a case study basis in South Africa.

3. Concepts and methods

Different costs incurred by irrigation

A comprehensive definition of costs is given by Bouma et al. (2001): costs represent the value forgone in producing a good or service. Briscoe (1997), then Rogers et al. (1998) outlined the theoretical underpinnings of the idea of ’water as an economic good’, and suggested a conceptual framework for both direct costs (supply financial costs) and indirect costs (opportunity costs, costs of externalities).

Public irrigation usually covers only internal operation and maintenance costs, at best, while capital costs and opportunity costs are ignored. Irrigated agriculture may generate negative externalities such as soil salinization, non-point source pollution with fertilizers and pesticides, losses of aquatic habitat, lowering of the water table, and the like. The cost of mitigating those externalities are usually equally ignored. Externalities may be positive, especially in the form of return flows from irrigation. None are currently considered in South Africa. Also, Tardieu (2005) considers resource costs, which are not internalized. Such costs are accounted for in the water pricing strategy of South Africa in the form of a water resource management charge.

Regarding the evaluation of financial costs, an ’opportunity cost‘ approach (i.e. considering the return that could be made from an alternative use of the capital invested) may not be relevant since past and current investments into smallholder irrigation schemes in South Africa were aligned with social and equity concerns, rather than with economic performance concerns.

The following list displays the different costs for irrigation water, which form the full economic cost of water (Rogers et al. 1998: 6-10), and exclude environmental externalities.

- Operation and maintenance (O&M) costs; these are associated with the daily running of the supply system (e.g. electricity for pumping, labour, repair materials, input costs for managing and operating storage and distribution); they often include administrative and other direct costs (e.g. internalized environmental and resource costs); in practice, there is usually little dispute as to what are considered O&M costs and how they can be measured;

- Capital costs; these costs should include capital consumption (depreciation charges) and interest costs associated with infrastructure, reservoirs and distribution systems; cost-benefit analysis (CBA) approaches to full financial costs stress a forward-looking accounting stance and look for the costs associated with replacement of the capital stock with increasing marginal costs supplies;

- Opportunity cost, which addresses the fact that by consuming water, the user is depriving another user of the water; if that other user has a higher value for the water, then there are some opportunity costs experienced by society due to this misallocation of the resource;

- Economic externalities, which include the positive or negative impacts of irrigation use upon other activities (e.g. pollution, salinization, upstream diversion, downstream recharge).

The first two costs form the direct full financial costs. Tardieu and Prefol (2002) suggest that these two ones be covered for sustainability purposes. They form the so-called ’sustainability costs', which recovery ensures the scheme's operation, at least in the short- and medium term, and is acceptable by users (if charged).

This paper focuses on these direct financial costs. It exploits basic principles of cost-benefit analysis (CBA), applied to waterworks, with emphasis on cash flows (Rieu and Gleyses, 2003; Perret and Geyser, 2007).

Evaluating full financial costs

Rieu and Gleyses (2003) have drawn from previous work (especially Rogers et al., 1998), and came up with a methodology for assessing existing and future costs of irrigation services. The proposed methodology focuses on two features that are specific to water supply schemes:

- They consist of assets with varying lengths in working service life, often beyond the terms of the loans contracted to finance them;
- Subsequent maintenance costs grow over time and are difficult to foresee.

The costing model relies on basic economics, including financial evaluation techniques, and the discounting principle. Its final objectives are to assess the total effect of irrigation water management on welfare, and to allow for comparison of costs between various settings, schemes and countries (Rieu and Gleyses, 2003).

The methodology focuses on direct financial costs to economic agents, leaving second-order effects on employment, prices, and competitiveness out of the analysis. This means that such estimation of the contribution to welfare does not address its distribution among stakeholders. Although a useful complement to the economic approach, such social approach is not addressed in the proposed approach.

Also, the water supply system is clearly delineated, from the abstraction point to the irrigation hydrant; it includes abstraction and storage infrastructures, conveyance equipment, collective pumping and filtration facilities (if any).

Necessary data, assumptions and issues

The following data and information are necessary to perform the calculations:

- The so-called **Public Works Index**, which takes account of inflation, and allows for evaluating the current value of assets; such index is available in European countries, not in most developing countries
- The **discount rate**; common financial practices suggest using a discount rate being equal to the borrowing rate, excluding inflation
- The **service life**, or working life, which allows for estimating the average annual cost of capital; such data vary dramatically depending on type of asset, service and use conditions, etc. It usually is long, up to twenty to fifty years in the case of irrigation infrastructures; in developing tropical settings, service life may de dramatically reduced and show specific characteristics as discussed hereafter
- **Depreciation** is an important concept in the long-term management of assets, since it addresses the issue of asset replacements (at the end of the service life); linear depreciation along the service life (cost / service life) is often used; however, evaluating the annual depreciation proves sometimes difficult; a method of determining the annual depreciable amount is to use the utilisation method where

depreciation is calculated according to the usage of the asset; the more the asset is used, the quicker it loses its value; the straight-line method was used in this study since the yearly usage of the assets were not known.

Perret and Geyser (2007) have shown that evaluating O&M and capital costs after these principles is not that straightforward, owing to some specific traits of smallholder irrigation in developing countries, and requires some adaptation. Several specific issues have been identified and discussed on a case study basis (Perret and Geyser, 2007), such as the lack of records on infrastructure and initial costs, the multiple purpose and actual uses of certain equipment and infrastructure, the shift in purpose of others over time, the inclusion of certain small, yet indispensable equipment in the calculation, the partial refurbishment works on particular assets, and the lack of a standard basis for calculation under tropical, developing conditions (e.g. on service life, maintenance requirements). Box 1 illustrates these issues and introduces the situation of a case study scheme.

Box 1. Issues pertaining to infrastructures and capital costs in Dingleydale – New Forest (Limpopo Province, South Africa) (source: Perret & Touchain, 2002; Perret and Geyser, 2007)

The scheme was built in 1965. It covers about 1600 ha, with about 1400 beneficiaries. While the Agricultural and Rural Development Corporation (ARDC, a parastatal management agency) was managing the scheme, farmers were never supposed to pay for costs incurred by water supply. From 1996 onwards, ARDC collapsed and withdrew from any form of support to the farmers; the scheme has been left moribund, with few productive activities happening. Currently only about 700 ha are being irrigated with cropping patterns, mostly extensive and little productive, and benefiting about 900 farmers. In 2000, the scheme has been included as a pilot, being part of an ambitious revitalization program by the Provincial Department of Agriculture (Limpopo). At that stage, consultants had to establish lists of infrastructures in order to identify and budget the needs for refurbishment, since there was little information available.

When it came to evaluate the capital costs incurred by water supply (limited to a depreciation approach, with regard to self-management by farmers), the research team involved had to apply the 2000 value of the items listed, knowing that certain items had been well refurbished. Some few sections of canals, or weirs were rebuilt as new, while other items have just been abandoned (former "tobacco project" area, turned into a grazing area), while others had been left as is (e.g. dams), hence a huge heterogeneity and some confusion from the initial situation (Perret and Touchain, 2002). The establishment of management committees in the two main sections of the scheme does not imply the setup of any cost recovery system in the short term. As to capital costs, there is no repayment of loan involved since the initial funding of infrastructures was considered a grant by the public sector. Also, recent refurbishment works have been shouldered by the public sector with no expected repayment or cost recovery.

A case study in Dingleydale-New Forest

Perret and Touchain (2002) listed all irrigation-related assets and infrastructures in Dingleydale-New Forest. The current value (year 2000) of these assets was established, along with information such as service life and date of construction. This information was mobilized to establish the yearly total financial costs for a period from 1965 (construction) to 2000 (refurbishment and value assessment).

The model required the initial investment costs and maintenance/replacement costs of the irrigation scheme from construction to 2000. Since evaluation was based on figures obtained in 2000, the costs had to be discounted back to 1965, the year of construction (Perret and Geyser, 2007). Similar regression is possible in Europe by means of a 'Civil Engineering

Index‘ (Rieu and Gleyses, 2003). In South Africa, such CEI was calculated only until 1970. Alternative indexes or discount rates were therefore needed to fully determine the initial investment costs and maintenance/replacement costs, as shown in table 1.

In irrigation schemes and many other agricultural projects, initial capital expenditure leads up to a steady state of increased production after several years. Cash-flow discounting is a way of setting initial capital expenditure against future benefits or, more generally, of balancing costs incurred and benefits received at different periods in the future.

Initial assumptions

Various assumptions and choices were made in the development of the model, since limited information was available. A first necessary set of choices refers to the relevant cash flow. To evaluate the project, it must be considered whether changes in cash flows add value to the scheme. The first step is to identify the cash flows that are relevant to the decision. Relevant cash flows are those that result in changes in or increments to the project's existing cash flow and are called the incremental cash flows associated with the project. Given the nature of the project (government-funded), taxes, as cash outflows, were ignored since government does not pay any taxes. In determining the relevant cash flow another choice was to ignore opportunity costs. It was assumed that the farmers had not given up any existing benefit from usage of the land prior to the irrigation scheme. Changes to net working capital have been further ignored since the crops farmed on the land were seasonal in nature and working capital completed a full cycle within a year.

Assumptions were further necessary regarding **inflation**. Inflation affects the value of a capital investment project by changing the nominal values of the cash flows over the life of the project. The gauge of expected inflation included in these measures is the Consumer Price Index (CPI) (Firer et al., 2003). If, however, some of the sources of inflation facing the project’s cash flows are not CPI related, then alternative indexes must be used, as shown in table 1.

Assumptions on the **discount rate** were also made. The general principle guiding the choice of the discount rate is that it represents the expected rate of return required by the providers of the capital used to fund the project. Since the project under consideration was a project funded by government, no lending (borrowing) rates could be used. The most tradable instruments on which to base a lending rate are Treasury bills (T-bills), bankers' acceptances, Land Bank bills and promissory notes, prescribed asset bills and negotiable certificates of deposit (NCDs). Perret and Geyser (2007) have drawn from several works and established that NCDs were a better basis to use in determining the risk-free rate of an investment, and can be regarded as representing the true cost of money (Firer et al., 2003). Faced with limited information availability (e.g. only construction cost for 2000 was available), Perret and Geyser (2007) exploited various alternatives, and followed several methodological steps, as follows.

Determining the initial value of the irrigation scheme (1965)

As no specific escalation index is available for the irrigation industry, three different inflation-related indexes, namely the CPI, the farming requisites index and the civil engineering index, were used to determine the initial value of the irrigation scheme. This was to ensure that some of the sources of inflation facing the project’s cash flows are not CPI related (for example, a key input e.g. a measuring flow device, is imported and its price (in rand) depends on international inflation and the rand depreciation), then another index might be more appropriate. Using three different indexes ensures that the true initial cost of the irrigation scheme is calculated, as the best available measures of price inflation.

Table 1 provides instances of infrastructures involved in irrigation water supply and related management requirements in Dingleydale-New Forest (Perret and Touchain, 2002), discounted back to 1965 (initial investment year) under the three different indexes used (Perret and Geyser, 2007).

Evaluating yearly maintenance costs

Both the risk-free rate observed in the bond market and the cost of debt represent nominal rates, i.e. rates that include the effects of expected inflation over the life of the bond. Yearly maintenance cost has been adjusted in order to take effect of inflation into consideration, using the following equation:

$$\text{discounted CF} = \text{CF}.(1+i)^{\text{n}} \qquad \text{(equation 1)}$$

where: CF = yearly cash flow ; i = inflation rate (CPI); n = number of years

The gauge of expected inflation included in these measures is the CPI. Complete information on annual maintenance rates (percentage of present value) and service life (replacement date) and the calculation of the total yearly maintenance cost and replacement cost under the three different initial investment scenarios may be found in Perret and Geyser (2007).

Table 1. Examples of infrastructures involved in irrigation water supply and related management requirements in Dingleydale-New Forest (values based on initial investment year)

		Initial investment value in 1965 based on:		
Item	**Cost in 2000**	**CPI-values**	**Farming requisites index**	**Civil eng index**
Main canal - concrete - DD	R 25 426 800	R 856 883	R 549 769	R 339 706
Secondary canal - concrete - DD	R 43 260 000	R 1 457 862	R 935 351	R 577 960
Balancing dam	R 510 000	R 17 187	R 11 027	R 6 814
Main dam	R 9 000 000	R 303 300	R 194 595	R 120 241
Flow measuring device	R 90 000	R 3 033	R 1 946	R 1 202
Secondary pipe - concrete	R 10 867 250	R 366 226	R 234 968	R 145 188
Silt trap	R 200 000	R 6 740	R 4 324	R 2 672
Large siphon	R 3 150 000	R 106 155	R 68 108	R 42 084
Main weir	R 2 000 000	R 67 400	R 43 243	R 26 720

(Source Perret & Touchain,, 2002, Perret and Geyser, 2007)

Determining the net present value (NPV) of the yearly cash flows and the yearly contribution to settle the loan

In finance and cost-benefit approaches, the discounted cash flow model operates as the basic framework for most analyses. The conventional view is that the net present value of a project is the measure of the value that it will add to the firm taking it. Thus, investing in a positive (negative) net present value project will increase (decrease) value. The net present value (NPV) of the yearly cash flows has been determined over the 35-year period by:

$$\text{NPV} = \sum \frac{CF_t}{(1 + d)^n} \qquad \text{(equation 2)}$$

where: d = discount rate (NCDs at 6.5%)

CF = annual cash flow for year t

n = number of years

A government cost of capital is needed for the pricing of government outputs in financing appraisals. Perret and Geyser (2007) discussed options for discounting public investment, and suggested the use of several rates to broaden the various alternatives available to our model. In this paper, and along with Firer et al. (2003), only the 75-year average yield on negotiable certificates of deposit (NCD) (6.5%) was used.

The yearly contribution necessary to settle the loan is determined with the following formula:

$$\text{PV} = PMT.\left[\frac{1 + (1 + d)^{-n}}{d}\right] \qquad \text{(equation 3)}$$

where: PV = present value (the various NPVs calculated above)

PMT = yearly payment

d = discount rate (NCDs at 6.5%)

n = number of years

Table 2 gives the NPV, the total yearly payment (PMT), and the Required Net Profit per ha (to achieve targeted Return on Assets) under each inflation scenario (for the 700-hectare scheme under actual irrigation).

Table 2: Net Present Value, total yearly Payment, and Required Net Profit per hectare to achieve targeted Return on Assets of 4%, per inflation scenario and under NCD as discount rate 6.5%

	NPV	Total PMT	PMT/ha	Target of 4% ROA	
				Required Net Profit	**Required Net Profit / ha**
CPI-index NCF	R -5 264 716	R 384 652	R 550	R 210 589	R 300.84
Farming requisites index NCF	R -3 385 175	R 247 329	R 353	R 135 407	R 193.44
Civil engineering index NCF	R -2 101 826	R 153 564	R 219	R 84 073	R 120.10

The total asset values (NPV and PMT) are calculated and presented in Table 2. The net profit levels can then be determined to achieve the four-percent Return on Assets (RoA) targeted by Government. It implies that the Dingleydale – New Forest irrigation project must achieve a net profit per hectare between R120 and R301 as indicated by Table 2, to meet Government's objectives.

With respect to the National Water Resources Strategy confirmed that a return on assets RoA) of four percent, as suggested by the 1999 Pricing Strategy is correct and cannot be adjusted downward. The formula to determine the ROA is:

$$RoA = \frac{Net\ \ profit}{Total\ \ assets} * 100 \qquad\qquad \text{(equation 4)}$$

All the NPV's of the capital investment calculated under the various methods are negative. This is due to the fact that only the costs were taken into consideration, since the intention was to calculate how much farmers should pay for the irrigation scheme if it were not government funded. The yearly cost per hectare for the 700-hectare irrigation scheme varies from R219 to R550 under the various inflation assumptions. Perret and Touchain (2002) and Perret (2006) found that maize yields (as the main crop) were ranging from about 1 ton per hectare to about 7 for the few most intensive farmers. However the average yield for dry maize is about 2 tons/hectare. Considering this figure, and a net farm gate price of R800/ton during 2000, the cost of irrigation per hectare represents between 13.7% and 34.4% of total income (R1,600). Further, since maize production input costs form about 60% of maize total income in low-yield, subsistence situations (Perret, 2006), an average net profit of about R600 to R700 /ha is only made. Full financial costs of irrigation represent 35 et 85% of that net benefit, which seems far beyond willingness and capacity to pay by subsistence farmers, if yields remain around 2 tons per ha on average.

Increasing maize yields requires increasing input (production costs). According to GrainSA, input cost for irrigation dry-maize must reach at least R2,200 per hectare if 7 tons become the target-yield. At a market R800 per ton, and if a farmer achieved a yield of 7 tons per hectare, his net profit will amount to R2,000 per hectare, thus achieving the target ROA of 4% set by Government. Under such intensification scenario, any yield below 3 tons per hectare will not be sufficient to meet the target RoA of 4%. In other words, only successful, intensified dry-maize farmers may be in a position to cover full financial costs of irrigation. Such farmers currently form only minority type and farming style in smallholder irrigation schemes such as Dingleydale-New Forest.

Conclusion

A method worth applying in South Africa

The paper assessed the full financial costs of irrigation in a case study in South Africa, and the capacity of farmers to cover those costs.

The financial analysis requires choices in terms of inflation and discount rates. While it was chosen to use several inflation scenarios, the average yield on Negotiable Certificates of Deposit (NCD) is suggested as a surrogate for treasury bills, hence for the discount rate.

Besides the choice of proper parameters, calculations may prove difficult owing to specific traits of irrigation infrastructure in developing countries. The evolving purpose of certain items over time, the widespread, informal and multiple side uses of irrigation water and infrastructure by neighbouring communities, the lack of existing basic information, records, and water measuring systems, the lack of established standards on service life of equipment and infrastructure under harsh tropical and developing conditions constitute hindrances to straightforward and accurate calculations of capital and O&M costs.

Yet, the method, using backwards-discounting approach to determine initial value of assets at construction, then net-present-value approach to determine yearly cash flows, proves feasible and yields unique insights onto full financial costs of irrigation project in the absence of records.

The farmers' performance does not tally with the high cost of irrigation services

Results show the high costs of irrigation services, as compared to the usually low income derived from irrigation by prevailing subsistence farmers.

In a similar subsistence scheme (Thabina), close to Dingleydale-New Forest, Yokwe (2005) found that annual O&M costs amount to R174 per ha. In that scheme and quite uncommonly in South Africa, farmers pay currently R120 per ha per year, which covers only 68% of O&M costs. Net benefits from maize production range between 0 and R850 per ha per year (that figure concerning only the few most commercial farmers). Responses to contingent questions indicate that farmers are willing to pay an average R235 per ha per year, although with huge variability among farmers. Actually, the few commercial pensioner farmers in the scheme skew the WTP distribution, and theirs far exceeds the current O&M costs.

In other situations, Easter and Zekri (2004) also found that operating and maintenance cost of small-scale irrigation systems in South Africa are high in relation to income. The full cost of South African irrigation as a percentage of gross farm income is 12 percent to 16 percent. This results in a full cost as percentage of net farm income of 30 percent to 35 percent.

In other terms, full cost pricing proves unrealistic in developing environments with subsistence-oriented smallholder irrigation schemes.

A sector in need of attention and support

Such results back up the approach adopted by the Department of Water Affairs and Forestry in South Africa regarding the water pricing system. It includes phasing in of charges, waiving options and ceiling principles regarding "depreciation charges". Furthermore, subsidies on O&M charges will be phased out over 5 years, and farmers should pay for full O&M costs from then on. In contrast, capital cost subsidies will be granted to WUA members.

There is still uncertainty as to how such subsidies will be organized. Subsidies for periodic rehabilitation or modernization are indeed still needed, and yet Vermillion and Sagardoy (1999) warns that they should be re-designed so as to stimulate, not discourage, investment in maintenance by the water users. Recent history of smallholder irrigation in South Africa shows that massive rehabilitation / modernization works are carried out at times (e.g. every 20 years or so), fully funded by the public sector. Vermillion and Sardogoy (1999) promote the alternative idea of users contributing to a capital reserve fund (possibly completed with a Government matching fund) so that incremental infrastructure improvement can take place. The Department of Water Affairs and Forestry strives to introduce these ideas of a smallholder's contribution to the capital of the infrastructure they use. At the moment, it seems that the more urgent issue is to make farmers realize that at least O&M costs should be covered (the so-called 'sustainability cost' promoted by Tardieu and Prefol, 2002), not only for the sake of a sustained functioning at present, but also to prevent future failures and quicker degradation, which incur even higher costs.

In many other places, irrigation under public-sector management has long been characterized by poor technical, financial, and economic performance, and overall suboptimal use of irrigation facilities (Sampath, 1992: 997-998). As a consequence, the degree of capital, operation, and maintenance cost recovery in developing countries remains far below financial autonomy (Briscoe, 1999: 477).

Developing an irrigation investment strategy that can be effective for small-scale farmers is a real challenge.

Some key challenges that face irrigated agriculture, in South Africa and elsewhere, are economic in nature. Numerous and recent factual experiences, observations and well-documented case studies throughout South Africa (Bembridge, 2000; Perret, 2002, Backeberg, 2003; Denison and Manona, 2006b, among others) challenge the usual political discourses underlying massive investments in smallholder irrigation (Denison and Manona, 2006a): it is clear that subsistence or non-commercial smallholder irrigation farmers is not significantly contributing to food supply in rural areas, employment and livelihoods, and multiplier effects on the local economy. There is intense pressure for irrigated agriculture at large to forgo all subsidies, including those related to the water resource, and to compete on a level field with other users of water.

Literature and this analysis show that SIS costs incur mainly to the whole society, while benefits are gained mostly at meso / regional level (multiplier effect). The so-called beneficiaries themselves (irrigators) do not really benefit since most face poverty and food insecurity, in spite of being irrigators. It looks as if the current policies and measures towards subsistence agriculture were neither economically efficient nor really equitable or socially efficient.

In such a context, any investment and financial support by the public sector to smallholder irrigation schemes undoubtedly falls under the "equity" objective of the National Water Act. Besides, any attempt to evaluate the full cost of supplying water to smallholder irrigation schemes may look suspect, being seen as a first step towards a comprehensive charging system for the poor.

Owing to their current situation, smallholder farmers must be granted specific attention and support, opportunities and some time to become more productive and to join the mainstream economy. This further suggests considering costs, value and charges separately (Rogers et al., 1998; Briscoe, 1997; Tardieu, 2005), and avoiding charging smallholder farmers on a full cost recovery basis. And yet, time has probably come to consider water charges as incentives towards increased water productivity, improved maintenance and sound inner management in smallholder irrigation schemes, and not anymore as deterring measures and additional burden shouldered by smallholder irrigators. Productivity and profitability of subsistence schemes must occur. These can only be improved through better marketing practices, higher yields and/or better production skills. Government-funded capacity building and extension remains very necessary.

Financial assessment, using the paper's suggestions for South Africa, might be a first step towards more transparency and better-informed decisions on cost recovery strategies and approaches in the smallholder irrigation sector.

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