Testing scenarios on the viability of smallholding irrigation schemes in south Africa: a participatory and information-based approach

S.R. Perret

Working paper: 2002-16

Department of Agricultural Economics,
Extension and Rural Development
University of Pretoria
Pretoria, 0002
South Africa

University of Pretoria

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S. R. Perret

University of Pretoria & CIRAD, Department of Agricultural Economics, Extension and Rural Development, Pretoria, South Africa

ABSTRACT

Government smallholder irrigation schemes were developed in former homeland areas of South Africa during the apartheid era. Although experiencing serious financial, technical, and institutional problems, most of them are now earmarked for rehabilitation and transfer to water users' associations. Transfer operators find it difficult to evaluate the potential for viability, then to organise the transfer accordingly. The paper refers to a multi-disciplinary, action-research approach that has been proposed to address such issues. It has been implemented in a case study scheme of the Northern Province in 2001. A simulation tool has been developed. Its main features involves simulations and scenario-testing on the costs incurred by scheme management, the possible contributions by farmers to cover these costs, the possible charging system to be set up, and finally the impact of certain measures or decisions, or certain farmers' strategies on the financial viability of the scheme. The paper mainly presents and discusses some principles of the approach, especially the need for a sustained and multi-disciplinary partnership during scenario development and discussion, including farmers and transfer operators. Such an approach shows huge potential for information and decision-making support towards transfer operators, for training, and for farmers' participation.

INTRODUCTION

Over the past three decades, the world's irrigation sector has been increasingly exposed to a global trend towards decentralisation and privatisation. Many countries have embarked on a process to transfer the management of smallholding irrigation systems from government agencies to local management entities (Vermillion, 1997). This process of Irrigation Management Transfer (IMT) includes state withdrawal, promotion of water users' participation, development of local management institutions, transfer of ownership and management. South Africa has just cautiously initiated IMT in government smallholding irrigation schemes located in former homeland areas and most transfer operators are still unsure about how to design and implement the process. At present, South Africa has an estimated 1.3 million ha of land under irrigation. Owing to history and past policies, different types of irrigation schemes have been developed (Perret, 2001). Most smallholding irrigation schemes (SIS) were developed during the early apartheid era. They cover approximately 47000 ha (Bembridge, 2000), and account for about 4% of irrigated areas in SA. It is estimated that 200000 to 230000 rural black people are dependant at least partially for

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[1] *Paper presented at the conference of the International Farming Systems Association, Orlando, Florida, USA, November 2002.*

a livelihood on such schemes. In spite of such a relatively small contribution, it is believed that those schemes could play an important role in rural development, hence the rehabilitation and transfer policies. Also, the new National Water Act of 1998 promotes the creation of Water Users' Associations (WUAs). It is envisaged that such local institutions take over most irrigation management functions, i.e. water allocation and distribution, maintenance, water charging system, financial management, and so on. The situation is however concerning as most SIS are currently moribund and have been inactive for many years (Bembridge, 2000). Several causes have been mentioned (IWMI, 2001): infrastructure deficiencies emanating from inappropriate design, management and maintenance, both beneficiaries and government-assigned extension officers lacking technical know-how and ability, absence of people involvement and participation, inadequate institutional structures, inappropriate land tenure arrangements, local political power games, a history of dependency and subsistence orientation, low land productivity and high cash costs. Following the dismantlement of apartheid, management parastatal agencies were liquidated and government gradually withdrew from its past functions in SIS (extension, marketing and financial support). With regard to a rehabilitation and IMT process, all the above raises a series of questions at different levels: national and provincial governments (rehabilitation policy and implementation, IMT procedure), WUA level (collective management of newly transferred irrigation schemes, institutional arrangements), and farmers' level (farming and cropping systems management).

The objective of the approach presented here is to help investigating on the sustainability of SIS in a context of IMT, and to accompany and support decisions and actions undertaken by development operators. It promotes collective solution seeking through scenario-testing. The present paper limits itself to a presentation of the approach, its principles, the model's conceptual framework, and broad results. Further technical details about the model, the scenarios and the case study area may be found in Perret and Touchain (2002).

MATERIAL AND METHODS

Principles, theoretical background

First, the approach acknowledges that there are costs incurred by supplying water and water-related services to farmers, and that an objective of financial viability is pursued at scheme level (involving partial or total cost recovery) (Perry, 2001). In a IMT context, this means that (1) the management entity (WUA) provides irrigation water and related services to farmers, (2) such services generate costs (capital, maintenance and operation costs, and personnel-related costs), (3) the management entity charges the farmers according to a system to be established, and (4) the farmers tap into their monetary resources (generated by irrigated or rain-fed cropping systems, by off-farm income-earning systems) to pay these water service fees.

Second, smallholders' agricultural and resource-management systems face a quickly changing economic, legal and social environment. For the necessary adaptations to occur, renewed approaches require facilitation of collective learning and negotiated agreement (Jiggins and Roling, 1997). Action-research strives to play this facilitation role. As defined by Liu (1994), it combines (1) the convergence of a will for change and a research intention, which entails a two-fold objective, i.e. problem solving and knowledge generation (with local and generic scope), (2) an ongoing long-term joint project between researchers, development operators and users, and (3) a common ethical framework negotiated and accepted by all stakeholders. The difficult and essential point is to implement properly the participation of stakeholders, not only for data collection but also during recurrent, interactive workshops (Perret and Legal, 1999).

Third, SIS are not only constituted by individuals and assets, but also by knowledge, rules and information. Such information may be organised and take different forms such as a database, indicators, maps, worksheets, management boards, schedules, and production forecasts among others. It may be used to monitor and assess the activities performed, and to support decisions. These formalised representations are called management tools and form an information system (Moisdon, 1997). Owing to the increasing complexity and dynamics of organisations, and to the increasing uncertainty of their economic environment, management tools no longer seek optimal solutions and one-way prescriptions or recipes, but rather favour information, learning processes, adaptability, discussion, collective awareness, and the like. Developing information systems and management tools goes along with developing the organisation itself, and its strategy (Moisdon, 1997). From the information system, simulation tools may be developed to support and accompany the knowledge and exploration of reality. The objective is then not only to manage and monitor, but to fuel discussion and make people interact, challenge hasty judgements and support sound decisions, raise new questions, foresee issues and problems, and test solutions.

Implementation features

The approach implies three phases: (1) data collection at household and scheme level, on one given scheme, (2) data processing and information-system development, which requires a typology of farmers, and (3) running the model on a scenario-testing basis, evaluating the impact of certain measures or decisions, or certain farmers' strategies on agricultural and production features, land allocation, costs and cost recovery, and sustainability-related indicators. This supposes interactions with experts and local stakeholders (Perret and Le Gal, 1999). Developing a farmers' typology is a prerequisite, as one can neither address all farmers individually nor consider them all similar. Different farmers' strategies and practices co-exist within a scheme. Grouping irrigation farmers into several types helps representing this reality, as shown by Lamacq (1997).

The more accurate and reliable the data, the better the modelling and simulation development. The approach makes use of questionnaire-based, individual interviews of farmers (sampling proved necessary in the large case study scheme), discussions with local experts, literature review and secondary data gathering. Engineers, agronomists, extension officers, economists, development operators, farmers, and policy makers are first involved on an individual basis. Then some key experts and stakeholders are involved in an informal and flexible steering committee for the last phases.

The approach was developed in a case study scheme (Dingleydale-New Forest SIS, in the Northern Province). The scheme displays a number of traits that are common to other SIS, e.g. a large majority of non-farming plot occupiers, a diversity of practices and performance among irrigation farmers, yet generally little productive and subsistence-oriented, a simple conception of infrastructures (a gravity-fed system with dam, canals and furrows), yet deteriorating, a lack of support services, a weak agri-business environment, and missing markets, water allocation and water availability problems, especially in winter. At the time of the study (2001, beginning 2002), the scheme was being rehabilitated, and transfer would occur as soon as the water user's association is socially and legally set up.

Developing the model: conceptual framework

The approach as a whole takes root in the above principles. The model's conceptual framework takes into considerations the economic and financial aspects of scheme's management, and addresses some technical indicators in order to check out that scenarios are realistic (e.g. water resource availability). Five input modules form the basis of the information system, as interfaces for data capturing by the user (see figure 1). Each cost-generating item is listed in the "cost" module. This module generates output variables that reckon the costs incurred by the scheme and its management (i.e. capital costs, maintenance costs, operation costs, personnel costs). Such information answer the question as to how much does it cost to operate the scheme in a sustainable manner, regardless of who is going to pay for it. In the "crop" module, each irrigated crop is listed with its technical and economic features (e.g. management style, cropping calendar, water demand, yield, production costs). This module generates micro-economic output variables (e.g. gross and net margins) that allow comparative evaluation of crops in terms of profitability, land productivity, and water productivity.

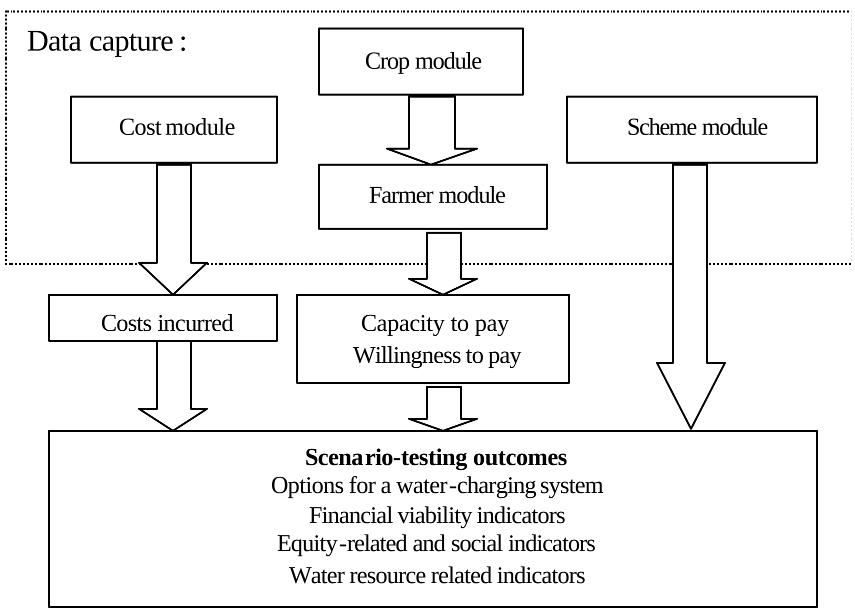

Figure 1. The model's conceptual framework

A "farmer" module captures the different farmers' types, with their cropping systems (combination of crops that have been documented in the "crop" module), average farm size, percentage of scheme's size, willingness to pay for irrigation water services. This module generates type-related output variables (e.g. aggregated income per type, crop calendar) and scheme-related output variables (e.g. number of farmers, aggregated water demand) when combined with the "scheme" module. A "scheme" module lists the scheme's characteristics (e.g. size, rainfall and resource-availability patterns, tariff structure). This module is combined with the "farmer" and "cost" modules, and generates output variables on water pricing, tariff, cost recovery rate, contribution per type. This allows answering the question as to who may pay, and how much, for water services. It also generates some social and equity-related indicators, and resource-related indicators (e.g. total number of farmers, area per type, number of farmers per type, type net income, scheme total net income, total water consumption, overall weekly water balance).

The initial inputs (real data) form the base scenario. Additional scenarios may be tested through the capture of non-real / prospective data, especially when the given scheme has not yet been rehabilitated or transferred (e.g. alternative crops and cropping systems, emerging farmers' types, changes in scheme's management patterns, options for a charging system, new infrastructures, and so on).

RESULTS AND DISCUSSION

A first pilot simulation tool has been developed on Microsoft Excel™ (Perret and Touchain, 2002), based on such a conceptual framework, and from data collected in the case study scheme. A base scenario has been defined, reflecting the current situation, and a realistic management system has been discussed with local stakeholders (see figure 2). The simulation tool makes it possible to display results in a simple and comprehensible way for all stakeholders, through figures, graphs and tables. Simulations on the current situation showed that costs are not covered, and they can hardly be reduced as the bulk lays on capital and maintenance costs. The biggest issue is the majority of non-farming plot occupiers, with low capacity and willingness to pay water fees. Low land productivity also strongly limits farmers' income and capacity to pay back water services. Then a number of realistic alternative scenarios have been defined. They consider changes that are very likely to occur and/or that are likely to affect much output indicators.

Modules	**Current situation**	**Hypotheses on non-existing components**
Cost	Existing infrastructures once rehabilitated	Basic management assets and personnel that are deemed necessary
Crop	Existing crops with their current features (gross and net margins, yields, etc.)	
Farmer	Existing types (non farming land occupiers, subsistence farmers, transition farmers), with their existing features (farm size, crop combinations, net income, willingness to pay, etc.)	
Scheme	Current size	Farmers are charged per hectare (cropped or not)

Figure 2. Features of the base scenario

The definition of scenarios has been done in close partnership with a number of stakeholders and experts. Several work sessions took place to discuss the scenarios and their outcomes. The most interesting scenarios that were tested considered the major issues currently facing the scheme, and involved land redistribution options, the emergence of commercial farmers, the set up of small size food plots, intensification and diversification of crop production at farmers' level, water charging systems options, and rehabilitation options. The approach demonstrates that realistic changes may significantly improve the situation and financial viability prospects. A number of recommendations measures and decisions have been drawn from the simulations. Operators and decision makers should especially address inner land tenure/access arrangements in order to downsize the proportion of non-farming land-occupiers. Farmers' training and proper extension services are also required. Laptop-borne demonstrations of the simulation tool will be presented during the posters and tool bazaar sessions at the 17th IFSA Symposium.

CONCLUSION

Although not capturing the actual complexity of a SIS, the model makes it possible to share a common representation on the subject, to highlight the issues, then to get the stakeholders focussed on the search for alternative strategies on a very open and flexible manner (scenario-testing). Although requiring accurate and reliable background data, the approach shows interesting potential as it allows more information to flow between stakeholders involved in the rehabilitation and transfer process. It helps pointing out where responsibilities, prospects and potential lie. It also shows huge potential for training purposes.

The approach is not completed yet. Further developments are currently taking place, with two major orientations: (1) addressing other situations (current studies from March to September 2002, in two provinces of the country), and (2) developing a more generic tool, as a basic information system (database) and a simulation tool allowing easy scenario-testing (a software is being developed and will be released in October 2002). The two orientations are indeed very interactive. It is expected that the first one feed the second, providing some generic character to the software. In turn, it should be easier to collect relevant data in line with the existing framework. The National Departments of Agriculture, and Water Affairs of South Africa are currently including this approach into their official guidelines for pre-feasibility studies on rehabilitation and transfer of SIS.

BIBLIOGRAPHY

Bembridge, T.J. (2000) *Guidelines for rehabilitation of small-scale farmer irrigation schemes in South Africa*, WRC report Num. 891/1/00, Pretoria, SA

IWMI (2001) *Can poor farmers in South Africa shoulder the burden of irrigation management?* IWMI website document: www.cgiar.org/iwmi/home/IMTSAf.htm

Jiggins, J. & Roling, N. (1997) Action research in natural resource management. Marginal in the first paradigm, core in the second. *Etudes et Recherches sur les Systemes Agraires et le Developpement*, 1997 (30): 151-167.

Lamacq, S. (1997) *Coordination entre l'offre et la demande en eau sur un perimetre irrigue. Des scenarios, des systemes et des hommes…* Unpublished Doctorate Thesis, CEMAGREF-ENGREF, 134p.

Liu, M. (1994) Action-research and development dynamics. *In : Systems-Oriented Research in Agriculture and Rural Development.* International Symposium, Montpellier, France, 21-25 nov. 1994. pp. 111-116.

Moisdon, J.C. (co-ordinator) (1997) *Du mode d'existence des outils de gestion. Les instruments de gestion a l'epreuve de l'organisation*. Seli Arslan publ., Paris, France

Perret, S and Touchain, E. (2002) A simulation-based approach to access the economic viability of smallholding irrigation schemes in South Africa. University of Pretoria, CIRAD-Tera, research report num. 02/02, Pretoria, SA

Perret, S. and Le Gal, P.Y. (1999). Analyse des pratiques, modélisation et aide à la décision dans le domaine de l'irrigation : cas de la gestion d'une retenue collinaire collective à la Réunion. *Economie Rurale*, 254 (1999): 6-11.

Perret, S. (2001). *New water policy, IMT and smallholding irrigation schemes in South Africa : institutional challenges*. FAO International E.mail Conference on Irrigation Management Transfer, Rome, Italy. 14p.

Perry, C.J. (2001). Charging for irrigation water: the issues and options with a case study from India. IWMI research report num. 52, Colombo, Sri Lanka

Vermillion, D.L. (1997). *Impacts of irrigation management transfer: a review of evidence*. IWMI research report num. 11, Colombo, Sri Lanka

Corresponding Author Contact Information:
S.R., Perret, University of Pretoria, Department of Agricultural Economics, University of Pretoria, Pretoria, 0002, South Africa, Phone: +27 12 420 5021, Fax: +27 12 420 3247, sperret@nsnper1.up.ac.za , ORAL, Engaging Stakeholders in Support of Small Farms