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From Subsistence Agriculture to Commercial Enterprise: Community management of green technologies for resilient food production

C.J.K. Latham[1], L. Palentini[*1], M. Katemaunzanga[1], P. Ashton[1]

[1] Cesvi - Participatory Foundation and NGO, Bergamo, Italy

* Corresponding author's contact details: Email: *lorispalentini@cesvioverseas.org* | Tel: +263 772 283179

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Abstract

The aim of this paper is to emphasize the capacity and resilience of rural communities in regard to sustainable food security by adopting innovative approaches to irrigation. The shift from subsistence to commercial agriculture is promoted as a means to sustainable development. An analysis of the efficacy of irrigation schemes in Zimbabwe suggests that, in terms of providing sustainable agricultural production, they have neither been cost-effective nor have they provided long-term food security to their beneficiaries. This is certainly true of Shashe Scheme and most others in Beitbridge District. The Shashe Irrigation Scheme project represents a bold attempt at developing a fresh approach to the management of communal land irrigation schemes through a Private Public Community Partnership. The model illustrated represents a paradigm shift from subsistence agriculture to a system based on new technologies, market linkages and community ownership that build resilience and lead to sustainable food security and economic prosperity.

Introduction

Beitbridge district is situated in the south west lowlands of Zimbabwe. It is part of agro-ecological zone five (Vincent & Thomas, 1960) with altitudes averaging about 500 meters above sea level. It is characterised as a semi desert region. Maramani Communal Area is situated in the south west of the district and borders on the Shashe-Limpopo Rivers, the international boundary with South Africa and Botswana.

Zimbabwe's Communal Areas are reserved for Indigenous Zimbabweans where they live under traditional systems of (land) tenure and governance arrangements (Holleman, 1952; Rukuni, 1994). There is very little water inland from the Shashe and Limpopo rivers. Settlements are mainly concentrated near the rivers and scattered villages inland where some water is available from natural pools and springs. In the nineteen 1960s more people were moved into Maramani by the colonial government in order to avail more land for commercial farming.

Boreholes were drilled throughout the hinterland and irrigation schemes were constructed along the Shashe River to cater for the additional settlers. Shashe irrigation scheme (184 hectares) was constructed as part of a governmental plan for the overall development of the area. Shashe as the biggest scheme catered for at least half the villages in the southern section of Maramani while Jalukanga

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and Bili schemes serviced the northern half.

Shashe, Jalukanga and Bili, differ from most other colonial schemes in that the members do not live on the scheme in villages dedicated to this purpose, but are scattered amongst their home villages along the river and hinterland, in not a few cases as far as 16 kilometres away. The influence of this settlement pattern upon the emergence and development of the model described below should not be underestimated in terms of distribution of obligations and the rewards of participating in the scheme.

Shashe Scheme was built and run as a top down government controlled "technocratic" scheme (Bolding, 2004). The scheme was designed to provide livelihood opportunities to approximately ten villages in Maramani. From then until the early nineteen 1980s the scheme was productive, growing crops mainly for local consumption. Support from central and local government dwindled from the nineteen 1970s and almost completely ceased by the early 1980s as collateral damage of the independence war and the resulting lack of funds by the new government. The scheme slowly deteriorated and for all practical purposes it became defunct by the end of the nineteen 1980s. Devastating floods and cyclonic

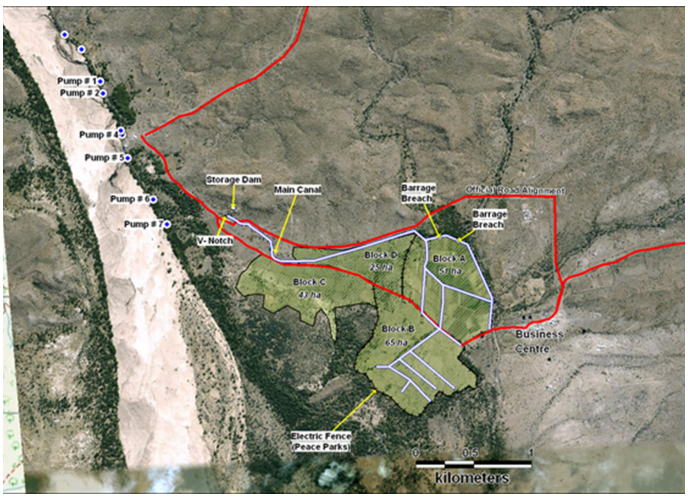

Figure 1: Shashe irrigation scheme superimposed to satellite map of the area.

events finally damaged remaining infrastructure so that by the mid-nineties no more than between ten and twenty hectares were being irrigated. A few attempts were made by well meaning but under resourced non-profit partners and the Department of Irrigation to revive the scheme but without success.

In 2003, Nottingham Estate, a large-scale commercial citrus farm some forty kilometres from Shashe, promoted a consultation with local plot holders resulted in a proposal submitted by CASS (Centre for Applied Social Science – University of Zimbabwe) to the FAO. The farmers wished for greater jurisdiction and ownership of the scheme (including irrigation infrastructure). They wished to foster the idea of a partnership with commercial institutions or NGOs with a view to raising capital to revamp the scheme. They also proposed a high value marketable crop be introduced and favoured the introduction of oranges.

The notion was expressed that if a new successful model could be developed, it could lead to Shashe being used as a template and training aid for other schemes in the area. A household survey and a start on capacity building were undertaken until the economic meltdown in 2008 meant that FAO funding ceased. By this time, the community had developed a vision of how the scheme might develop. In 2010 CESVI – Italian NGO active in the Southern Lowveld since 1998 having done extensive research in the Maramani area associated with the introduction of the Mapungubwe TFCA (Trans-Frontier Conservation Area) – with EU financial support accepted the challenge of a project for the resuscitation of Shashe scheme. A new model was proposed, which promoted a paradigm shift from the traditional subsistence agriculture to turn the community into a commercial enterprise by linking together: traditional knowledge of the area and its resources; local expertise from existing commercial ventures; market access through the local processing plant; commitment for the implementation of a long term strategy through traditional and local leaderships; and donor funds through the technical support of an NGO. Work commenced on the scheme in 2011.

Literature review

Research indicates that communal area systems of managing irrigation have rested heavily on two persistent models: the "Technocratic" model and the "Local" model. (Bolding (2004) refers to the two models as "factory" and "African" – labels that do not accurately describe their components). Neither model has proved to be sustainable. Analysis reveals essential institutional and economic flaws in

both. Thus, the model being introduced at Shashe seeks to create a sustainable system of management through a major paradigm shift involving three interlinked principal ingredients: (i) market viability, (ii) strategic partnerships and (iii) maximum devolved jurisdiction to local level.

Analysis has shown that these schemes generally collapse for the following reasons:

- The "technocratic" model fails because technocrats do not have the capacity to manage down to field level. The transaction costs if properly charged to the scheme (and thus the farmers) are not cost effective. If the government is unwilling or unable to subsidize the scheme, all technical and managerial inputs cease or are curtailed. Without the financial support supplied by Government or NGOs, the scheme's infrastructure deteriorates and collapses. Local level management lacks capacity to manage the financial, institutional, marketing capacity requirements for sustainability (Manzungu & Machiridza, 2005).

- The "local" model fails because technical knowledge is lacking, crops are grown largely for self-provisioning and do not realize sufficient income to provide adequate funds for maintenance and management costs. Local institutions fail to manage adequately as they lack capacity. Insufficient income is generated to levy the farmers and infrastructure collapses after a period of reduced productivity. The caveat to the above is that small schemes have a greater chance of sustainability and micro-schemes (irrigated gardens run by individual families) have a very high level of sustainability.

- Shashe Scheme was built and run as a "technocratic" scheme from about 1960 to the early nineteen 1980s. Because support from central and local government dwindled and almost completely ceased, the scheme collapsed. Since then the scheme has (de facto) been managed by the beneficiary farmers through an elected management committee. Devastating cyclonic events further damaged the infrastructure and it finally collapsed.

Case study

The present model introduced at Shashe (Figure 2) is based on research carried out over a number of years of regional and national level (i.e. Water Research Southern Africa (WARFSA) program) and confirmed by local participative research with and by the Shashe Community. The work undertaken by Mead (Mead, 2001), Cunliffe (Cunliffe, 2004) and Latham (Latham, 1999, 2005) as advisers/ consultants to CESVI, who has been active in the southern Lowveld of Zimbabwe since 1998, contributed to its evolution. Most important of all it incorporates the views and scenarios formed in consultation with the community, local leadership and other stakeholders.

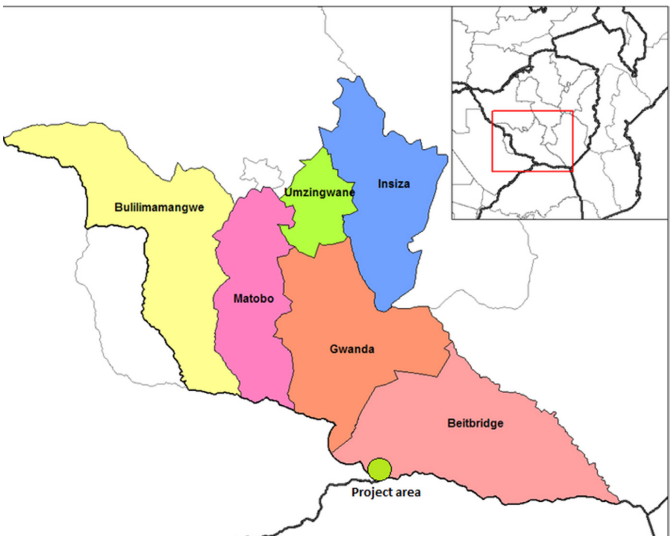

Figure 2: Project area

It includes the following:

- Devolution of "ownership" to beneficiary farmers who form a management organization with constituent representation.

- Considerable institutional development, the acquisition of skills and additional competencies sufficient to manage the complexities of a commercial enterprise. This is a long process that takes time – up to five years – and patient understanding (Murphree, 2004).

- The creation of partnerships with the private sector, focused upon seeking market guarantees, crop loan finance and technical support for economically profitable crops to be grown in

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preference or addition to crops grown for food security.

- Support from extension agencies (NGOs, local and central government and private) is confined to assisting the farmers to make the transition to one of commercial sustainability with a food security element or Maize Equivalent Income (MEI) (Osofsky, 2005, p. 42).

Replacement of obsolete technologies (well points

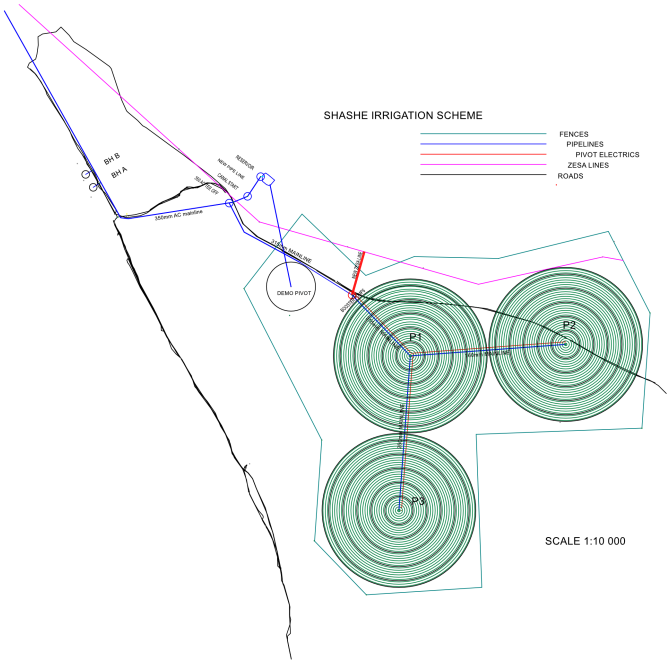

Figure 3: "Shashe Citrus Orchard" installation

and flood irrigation) with a modern and sophisticated irrigation system (submersible pumps and ultra-high center pivots) (Figure 3) designed and modified to fit the needs of the community and the agricultural regime (coexistence of citrus and inter-cropping) . Citrus represents an innovative introduction on a community-managed scheme.

The adoption of inter-row cash cropping at the behest of the community, in order to enhance immediate returns of food and funds for development and maintenance, represent a further innovation departing from the traditional citrus culture. In doing this, immediate cash returns are made available by utilising land between the trees, normally remaining uncultivated on citrus monoculture. The 'shift' from subsistence agriculture to a community-based commercial enterprise.

The development of the new model is based on regular and iterative use of systematic, strategic, scenario planning referred to as adaptive management (Jiggins & Roling, 2000; Latham, 1999, 2005; Murphree, 2001).

By goal setting, and regular, iterative self-assessment, farmers are assisted to develop and change perceptions in the light of newly perceived opportunities, technologies and agronomic innovations and to adapt and change their short-term goals while retaining their vision and overall objectives. Facilitators, advisors and techno-bureaucrats are also facilitated to understand perceptions and worldviews other than their own. The new model emerging thus embraces a common worldview and vision that is centred upon rural perceptions of food security ("food crops") as a principal objective, but now married to one of long term commercial sustainability – citrus – ("high value crops") and the investment of acquired income in scheme management and maintenance with individual profits accruing to participating beneficiaries (shareholders). A demonstration/trial plot (Figure 4) or 'mini-farm' started at the outset of the project was and continues to be a useful adjunct to the development and introduction of farming and technological innovations, hands on management, and identification of problems. The rural resource and training centre, offices and workshops situated adjacent to the demonstration plot, makes what the community now calls "The Demo", the nerve centre of the scheme. The creation and maintenance of an on-going learning organisation with the resilience and vision to embrace a partnership between the community and its external partners becomes an essential element of the centre. All activities and practices are viewed as part of an on-going learning process, and help develop a "learning organisation" (Senge, 2006; Senge & Sterman, 1992).

Partners are sensitised to the fact that the scheme is premised on common property management with tenure ("ownership") vested in the community of beneficiaries (Rukuni, 1994). Thus techno-bureaucrats and other resource providing agencies have to understand and adapt their own interventions to the reality that their empowerment and status lies in delivering an innovative, sapient support role, not a directional or authoritarian one. Moreover, man-

Figure 4: Demonstration plot with 3 ½ year old trees ready for harvesting (June 2015)

agement structures of the scheme are responsible to their constituents and not to outside officials or institutions (NGO officials, Rural District Council, line ministries, etc.) Through lengthy debate and practical trial and error a dynamic institutional framework develops, upon which the organization and management of the scheme can move forward. This includes the formulation of a constitution and by-laws that are applicable, enforceable and enforced in partnership with traditional institutions (courts of headman) and local law enforcement agencies (Police, Environmental Management Authority and Wild Life Management). This answers one of the essential requirements of common property management (Ostrom, 1990).

Hand in hand with the institutional development at Shashe is the task of upgrading the infrastructure. Introduction of the centre pivots and related installations fell to CESVI. It involved some bold decisions such as the sinking of boreholes for submersible pumps deep in the Shashe River bed to replace the unserviceable old well point system, replacing degraded asbestos-cement delivery lines from pumps to field edge and extensive bush clearing and land preparation for three 30 hectare centre pivots that replaced the in-field trapezoidal canals, siphons and flood irrigation system that had been completely destroyed by neglect and cyclonic events.

In addition 22 000 orange trees were supplied by CESVI and planted by the community. Intercropping between the young trees became an established practice. Crops such as seed beans, squash, sweet potatoes, rape (canola) cabbages and maize are cultivated, either on contract for cash, or for basic food requirements or both.

While this activity was underway, the community was also involved in attempts to renovate the two arable blocks known as A and B (see Figure 1). This included work on a breached barrage, construction of a weir and work on canal repairs. Alas, all this demanding work was for nothing. An exceptional flash flood in a minor tributary of the Shashe that is normally diverted by the barrage was breached in several places and wrought havoc over the two blocks, destroying all the gains that had been made. This disaster illustrates the nature of projects such as Shashe, surprise events can never be ruled out.

The Management Committee had to deal with this disaster as well as supervise its members for the urgent need to plant orange trees under the third pivot commissioned by the end of 2014; complete allocation of trees to beneficiaries; negotiate contracts with Agri-businesses for seed bean and crops; tend to existing trees planted in previous years; maintain inter-row crops; attend meetings and workshops (some unrelated to the scheme) as well as maintain their social responsibilities. This daunting array of activities they have managed with commendable

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energy and maturity. This proves that communities, given the incentives and authority over their own affairs, are generally resilient and responsible. None the less, the learning organisation that is Shashe community, has still to experience their first season of mature trees when they harvest their first major orange crop, transport it to market and receive payment and budget their income against expenses.

A major strategic objective inspiring the colonial and post-colonial policy on irrigation schemes was an attempt to provide food security, to mitigate or avoid having to provide famine relief in the vulnerable low veld districts. This was certainly the case in Maramani. Shashe was designed to help the ten southern villages, Jalukanga and Bili the 10 northern villages. Indeed, this objective went some way to justifying the expense of the primary develop ment of the schemes and the subsequent heavy subsidisation (Bolding, 2004).

We have given an analysis of why these schemes eventually collapsed and the rationale behind developing a new sustainable model. It is necessary to demonstrate that this model when it reaches maturity should once more be capable of providing the food so necessary to augment other livelihood strategies in Maramani and similar environmentally disadvantaged districts. The Shashe case study illuminates this important component of the model's design and purpose. It must be born in mind, that the final concept of the Shashe model was largely influenced by local knowledge, which proved to be generally wiser and more aware of local dynamics and indigenous knowledge systems (IKS) and strategies than some theories and implementing plans brought by development practitioners, technocrats and commercial operators. In particular, their leaders were acutely aware of the community's need for the assurance of food security and for all agricultural plans to include this perceived element so vital to their well-being.

When the CESVI plans for the Shashe Project were being drawn up by the technical and administrative professionals, they logically included all four blocks in the projected citrus orchards. Only after the project was accepted and became operational did serious discussion with the local community ensue. The farmers were adamant that Block A and B be reserved for food crop production (the maize and wheat cycle). They drew attention to a workshop held in 2007 where this arrangement had been agreed. Despite arguments and scenarios presented to them about the advantages of cash crops (as MEI) and particularly citrus they remained obdurate. Wisdom acquired by outsiders may now see the logic behind their stance. No one at that stage (and indeed ever) will be able to guarantee that citrus will, for ever, be the cash crop that it currently appears to be. Bolding (ibid) points out that his extensive research in the Save Valley area (similar to Shashe in climate and livelihood strategies) noted that a constant strategy amongst irrigation farmers was to place food security before economic gain. The time honoured peasant belief in securing enough food before contemplating any adventurous farming innovation holds true. Also, more enlightened thinkers at these early discussions were concerned about the obvious risk of "putting all their eggs in one basket".

In the light of the above, Blocks A and B will remain reserved primarily for food security. It is an unfortunate turn of fate that the efforts to restore them to productivity failed. Nevertheless, it is a firm commitment of the community to bring them back into production.

Findings

In the light of the experience gained at Shashe the following scenario illustrates that the new model being developed may well prove to be the template for success not only at Shashe but for replication (with suitable modifications to fit the needs, aspirations and technical requirements) on other schemes in the area. The figures indicate that not only can food security be enhanced, but the general livelihoods of all the people of Maramani would be significantly improved.

Notional scenario

Maramani has a population of about 4 000 people. Assuming the basic maize requirement per person per annum at 250 kg (Osofsky, 2005, p. 42), the need for feeding Maramani population per annum is 1000000 kg (1000 tons).

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Table 1: Shortfall for whole Maramani

@ 5 tons per ha scenario	@ 4 tons per ha scenario
Shashe	
750	600
Shortfall	
1 000 – 750 = 250	1 000 – 600 = 400
Less Jalukanga + Bili	
400	320
Surplus = 150 Tonnes	**Deficit = -80 Tonnes**

Therefore:
If 100 hectares (unutilised Block A & B) are going to be cultivate and assuming two scenarios @:

a. 5 tonnes/hectares = 500 tonnes
b. 4 tonnes/hectares = 400tonnes

Assuming inter-rows cropping can be cultivated under pivot on approximately 50 ha

a. @ 5 tons/ha =250 tonnes
b. @ 4 tons/ha =200 tonnes

By promoting the same model to the other two schemes in the area:

Jalukanga (≃ 60 ha)
a. @ 5 tons/ha = 300 tonnes
b. @ 4 tons/ha = 240 tonnes

Bili (≃ 20ha)
a. @ 5 tons/ha = 100 tonnes
b. @ 4 tons/ha = 80 tonnes

BUT: If Jalukanga and Bili halve their "food security section" and adopt the Shashe model of half food security and half cash crops, they can only reasonably aspire to reap 200 tonnes at 5 tonne per hectare scenario or 150 at 4 tonnes per hectare.

Thus, the Maize Equivalent Income (MEI) must equal or exceed this shortfall and provide sufficient income for repairs, maintenance and management costs and provide a disposable income to the farmers.

Citrus plus intercropping can provide much more than the projected shortfall plus any additional for repairs, maintenance and management costs but only after 5 years, when citrus reaches its commercial viability.

NB: The figures in the above scenario only reflect a single food crop per annum. Irrigation schemes can grow a minimum of 2 crops / p.a. – one for food security (or its maize equivalent) and one MEI crop dedicated to generating cash for repairs, maintenance and management etc. and for farmers' income to be used to supplement food or in good years to be disposable income.

Thus, the new model developed for Shashe is not only economically sound and sustainable but can theoretically also feed the whole of Maramani from the small cluster of Shashe, Jalukanga and Bili.

Our research and conclusions also suggest that increased resilience is achievable by introducing solar power to replace expensive and unreliable grid energy thus promoting environmental conservation and increased profitability of the scheme.

It is clear that these ideas need further research in order to prove the practical benefits, which seem to be self-evident. Perhaps most importantly research should be undertaken to establish the empirically held notion that the trickle-down effect of benefits accruing to farmers and their families on such schemes does in fact reach out into the wider community – and the actual impact of such interventions. If the current programme at Shashe (CESVI/EU) and the FAO/EU engagement with Jalukanga and Bili are to go ahead for another two to three

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Figure 5: Shashe beneficiaries at work

years (funding permitting) this final stage of the "Shashe experiment" may well set the pattern for schemes throughout Zimbabwe and beyond, into SADC and the continent. That would certainly be a fulfilment of the vision and mission of those involved, no least the Shashe community itself.

Conclusions

From what we have illustrated in the preceding paragraphs, it becomes clear that managing an irrigation scheme incorporates counterbalancing sets of essential ingredients. There is the need for efficient and effective means of delivering cost effective water to the crops in sufficient quantities and reliability and it is necessary to have effective, appropriate, resilient and adaptable management in place. The Shashe model illustrates the implementation of a programme designed to maximise the benefits of deriving from these primary requirements. State of the art technology, in the form of submersible pumps replaced well points supported by prime movers mounted on the riverbanks. Polyethylene pipes replaced asbestos cement delivery pipes, canals and furrows. Booster pumps and generators (to overcome power outages) insure water delivery. Finally, centre pivots provide water to citrus and inter-row crops with maximum accuracy, efficiency and reliability. Coupled with the introduction of these technologies, novel and untested by the community, has been the introduction of citrus and on a scale both in terms of hectares and lead-time (5 years for its commercial viability) unprecedented in the experience of the farmers.

All these innovations require management. More importantly, they require a sense of ownership by the community. Thus, the development of a management paradigm must have three primary ingredients. First, it must be developed as part of the community's own vision and mission and fit with its worldviews and perception of how best to improve its livelihood strategies in a harsh and unforgiving environment. Second, it must develop in circumstances which allow a conservative and cautious community to adapt to the changes brought about by the technology, the demands of a market driven economy and reliance on outside agencies for support and expertise. Third, and perhaps most important is the powerful imperative of ownership of the scheme being firmly in the hands of the community (This is achieved by the creation of a 'Trust' which incorporates the ownership of the scheme by the community).

From the outset, the facilitators (CESVI and the Beitbridge Rural District Council) employed the methodological tools of scenario modelling and planning linked to adaptive management. Farming at best is an enterprise that has to be able to respond to unforeseen changes in weather, markets, disease and other unexpected events. Adaptive management is thus a natural extension and improvement on normal agricultural cultures. The term was first described as far back as 1999 seeking to balance the conflicting sets of conditions imposed by the clash

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between economics and ecology (nature is cyclical while industrial systems are linear). Thus adaptive management "is an approach to the management of complex systems based on incremental, experiential learning and decision making, buttressed by active monitoring of and feedback from the effects of outcomes and decisions." (Jiggins & Roling, 2000). While experience and research has proved the efficacy of such a methodology, the caveat is that it is a process. It strengthens resilience, creates a culture of learning and a capacity to use experience blended with new ideas to cope with situations not normally encountered. Ownership and pride in their ability to cope with internal and external challenges is enhanced and management improved. Thus, the gains achieved by adaptive management must be balanced against the reality that the process takes time. Murphree (2004) suggests that at least five years would be a conservative estimate for any large scale innovative programme. It is a view shared by others, including these commentators. In fact, if properly implemented it creates a self- perpetuating system of management or as indicated in the above definition, a "learning organisation" (Senge, 2006).

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Conflict of Interests

The authors hereby declare that there is no conflict of interests.

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