Developing and Communicating Science & Technology Agendas for Sustainable Living on Arid Lands

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Abstract

Sustainable living in arid lands is the goal of many. However, few people living in and understanding the parameters of arid environments can claim to have truly mastered it. Science and technology have the potential to significantly enhance the livelihoods of people living in arid lands. To strengthen the effective application of scientific insights and contemporary technologies, the active involvement of those who apply and use the benefits offered by science and technology is required. Ranging from integrated land and water resource management, to the application of renewable energy and energy efficiency, and local level monitoring of rangeland conditions, scientists and technologists have to address the vastly different components required to 'live sustainably'. To be successful they need to tailor their research activities and communicate their findings in a way that can be understood and readily implemented by communities living in arid lands. The challenges of making the necessary connections between science and technology agendas on the one hand and their effective implementation in arid lands on the other is explored. The findings of this paper are supported by several southern African case studies.

Introduction

Science and technology have long been and are increasingly recognised for their potential role in sustainable living in arid environments (Ezcurra, 2006). For much of the previous century, technical applications to enhance agricultural outputs have been a focus. These have ranged from water, fertiliser and pesticide applications to approaches to ploughing and tilling the soil in what are considered to be appropriate ways in arid environments. Few of these attempts to extend the ‘green revolution’ to deserts have been successful (Potter et al., 1999). Attempts to change rangeland management in drylands have met similar fates. Solar energy has proved its worth in generating energy under the sunny skies of arid lands but currently fossil fuels remain the source of choice in and outside of dry lands (Excurra, 2006). In these examples, science and technology have demonstrated their potential for sustainable living in dry lands but often have not adequately communicated the potential of these options to decision makers who would be responsible for their application. Here, the term decision maker refers to those individuals that have to make far reaching livelihood adaptations, including farmers and urban dwellers, or policy makers who identify and guide the application of various alternative approaches to address sustainable living.

Namibian experiences

Namibia, located on the south-western coast of Africa, is the driest country south of the Sahel (Mendelsohn et al., 2002). Three of its larger towns are situated in the coastal, hyper-arid Namib Desert while its capital is located in the semi-arid highlands. Only on the densely populated northern border is there sufficient rainfall for rain-fed agriculture, in some years, while livestock farming predominates elsewhere. In terms of energy, Namibia is dependent on grid electricity from neighbouring South Africa, supplemented by hydropower generated on one border river and a coal fired plant as back-up. Constraints on the one hand, and the opportunities offered by this arid environment on the other are only slowly being recognised, as understanding and communication of acceptable alternative development options increases.

Integrated land and water management

A high priority in the drylands of Namibia, which constitutes about 97% of the country, is rural water supply (MAWRD, 2004). Provision of improved services was initiated soon after independence (1990) through a consultative process that resulted in the Water and Sanitation Sector Policy. This policy included, *inter alia*, the statement that 'equitable improvement of services should be achieved by the combined efforts of the technology providers and the beneficiaries, based on community involvement, community participation and the acceptance of a mutual responsibility'. Moreover, 'communities should have the right, with due regard for environmental needs and the resource available, to determine which solution and service levels are acceptable to them' taking the cost of the services into consideration. This set the scene for interactions between technology providers and communities and led to the investigation of community-based water management and provision, partially based on solar power, desalination and other alternatives new to the drylands residents. Because of the consultative, community-based management approach, many of these alternatives have been adopted and are now the solution of choice.

On a somewhat different track, agricultural extension services adopted a drylands focused approach in collaboration with several international and civil society partners. Forums for Integrated Resource Management (Kambatuku, 2003a; Kruger et al., 2003; Kruger et al., 2006) brought the communities together with service providers from science, technology and other backgrounds in new partnerships based on communication, trust and mutual respect. This provided an avenue for a new rangeland management approach. Decision making with regard to the adaptation of new approaches was supported by a community implemented and science based local level monitoring approach, whereby the communities themselves track the condition of their livestock and rangeland and make appropriate decisions based on the shared results (Kambatuku, 2003b; Klintenberg et al., 2006).

Although both of these approaches are science and technology supported, their integration has been supported by policy and legislation promoting application of the basin management approach (Botes et al., 2003; Manning and Seely, 2005; Seely et al., 2006a). This requires input from science, technology and the community living in the basin and is supported by, *inter* *alia*, the type of multi-level communication inherent in the above two approaches.

Renewable energy and energy efficiency

Namibia has a progressive White Paper on Energy Policy (RoN, 1998) that envisions electrification of Namibia's unelectrified areas, many of which are in arid rural localities far from the conventional electricity grid. The policy document also foresees regional electricity distribution entities to ensure that the furthest corner's of the country will eventually benefit from affordable access to electricity.

Nevertheless, experiences with rural on-grid electrification have shown that the costs of conventional grid electrification are substantial, and vast distribution distances and generally low loads often render such supply services uneconomical. However, many rural communities no longer accept having no access to those energy services taken for granted in urban centres, which add a significant political dimension to a demand for services in general, and the rural electrification debate in particular. Here, science, technology and communication play an integral role in ensuring that the aspirations of rural people are met through the application of appropriate cutting-edge technologies and contemporary financing mechanisms. It is at this juncture that renewable energy and energy efficiency technologies are increasingly being considered by electricity supply and distribution entities to address the demand for off-grid energisation. The following examples illustrate how the effective application of scientific insights and contemporary technologies combined with the active involvement of those who use these newer technologies have advanced the gradual introduction of renewable and energy efficient technologies throughout the drylands of Namibia.

In response to the country's uncertain electrical energy supply situation which is dominated by electricity imports from neighbouring South Africa, the Namibian electricity generation and transmission company NamPower has recently established a Renewable Energy section. This unit is to focus on hybrid energy supply systems (for example diesel and photovoltaic hybrid plants, as demonstrated by the 26 kW hybrid plant at the Gobabeb Training and Research Centre in the Namib desert), wind energy systems, as well as the conversion of indigenous invader bush species to electricity by way of gasification. It is also clear however that the situation of those living in rural areas and having little or no prospect of ever being connected to the national electricity grid has played a significant role in the establishment of this section.

The Namibian Electricity Control Board (ECB) and NamPower have launched a national energy efficiency campaign, designed to raise awareness regarding the many positive aspects of more efficient use of electricity. Also, the Ministry of Works, Transport and Communication is investigating the feasibility of fitting solar water heaters on public buildings, and has generally accepted that this option is more cost-effective than electric water heaters. This realisation comes despite many years of budgetary limitations that make high-capital outlays difficult even though such initial expenditure is rapidly compensated by low-maintenance costs. Here, the fact that capital and operational budgets are sourced from different budget posts has for many years prevented modern technologies, such as solar water heaters, being acquired from public funds despite their superior lifecycle costs. This represents an unfortunate lapse of communication and mutual understanding.

Despite limited funding for renewable energy projects from the Ministry of Mines and Energy, which remain at about US$ 0.3 million per annum, other organisations are beginning to put funds in place to venture into technologies that show greater cost- and environmental efficiency. For example, the Erongo Regional Electricity Distributor, located on the hyper-arid coast, is pioneering a grid in-feeding wind turbine of 200 kW, while the Windhoek-based Waldorf School has installed 14.2 kWp of photovoltaic and 13.4 kW solar thermal plant. Also, NamPower has committed at least US$ 0.6 million in co-funding for various renewable energy projects, including biomass digesters and hybrid energy systems, while the Otjozondjupa Regional Council serving

Kalahari dryland areas, committed some US$ 0.4 million in co-funding for similar projects.

A United Nations Development Programme-Global Environment Facility (UNDP-GEF) funded project, the Namibian Renewable Energy Programme (NAMREP), has had a considerable positive impact on the various existing barriers that prevent the wide-spread application and adoption of renewable energy and energy efficiency technologies during the past four years. NAMREP emphasizes the importance of how scientific knowledge in combination with user demand can result in sustainable outcomes. The programme has just concluded its first implementation phase, focusing on off-grid master planning, a renewable energy strategic action plan, establishing an institutional framework for national renewable energy coordination, feasibility studies for solar water heaters (SWH) and photovoltaic pumps (PVP), as well as conducting several training courses on solar energy and general energy-related awareness activities.

NAMREP's feasibility studies on SWH replacing the more conventional electric water heaters, and on PVP replacing diesel-powered pumps, have shown clear economic potential as well as an increasing feasibility of these renewable energy technologies over the past 5 years. The outcomes of these studies have motivated some commercial banks to now offer loans to the public to purchase these technologies, thus making them available to a wide range of consumers including those living in arid rural areas.

In addition, NAMREP has revived and modified the Solar Revolving Fund (SRF), designed to provide low-interest loans for SWH, PVP and solar home systems, particularly for rural people. The SRF is administered by a fund administration company and a commercial bank. The response to the new SRF has attracted a greater than expected demand for loans from the public at large, which indicates that the awareness levels regarding the long-term investment value of renewable energy technologies is high once the costs and benefits have been clearly articulated to potential clients.

Lastly, in response to an increasing demand for solar home system (SHS) technologies from people living in rural areas, the available technical capacity required to install SHSs has increased from about 12 rural-based technicians in 2000, to more than 50 such technicians in 2007. The more entrepreneurial of them have started forming consortia, and are now participating in tendering for and the implementation of large-scale solar supply contracts, such as for example the solar electrification of schools, thereby competing with the larger established solar companies in Namibia. This awakening of a competitive spirit can be ascribed to three-way interactions between the scientific and technical institutions and individuals, the policy and governing authorities, as well as the end-users and beneficiaries of such technologies. Demand for services, created through awareness and targeted marketing campaigns, using factual and understandable messages, and facilitated by a supportive policy environment and rigorous translation of insights into tangible products and services is what has often brought about the phasing out of old, inappropriate and inefficient technologies and/or the penetration of new technologies into markets that have previously been perceived unreceptive or not in need of such products or services.

Communication of science and technology applications

As illustrated in the above examples, communication with, involvement and participation of the local level users and decision makers who will implement the results of science and technology is essential for ownership and use of these potentials. This requires those involved with science and technology to ensure that their words are clear and understandable to those who are expected to facilitate or use the results of the science and technology agenda (Seely and Moser, 2004; Seely and Wöhl, 2004; Seely et al., 2005). Formalisation of this type of communication is proposed and partially being implemented as illustrated in Figure 1, using the example of a proposed drought risk management centre.

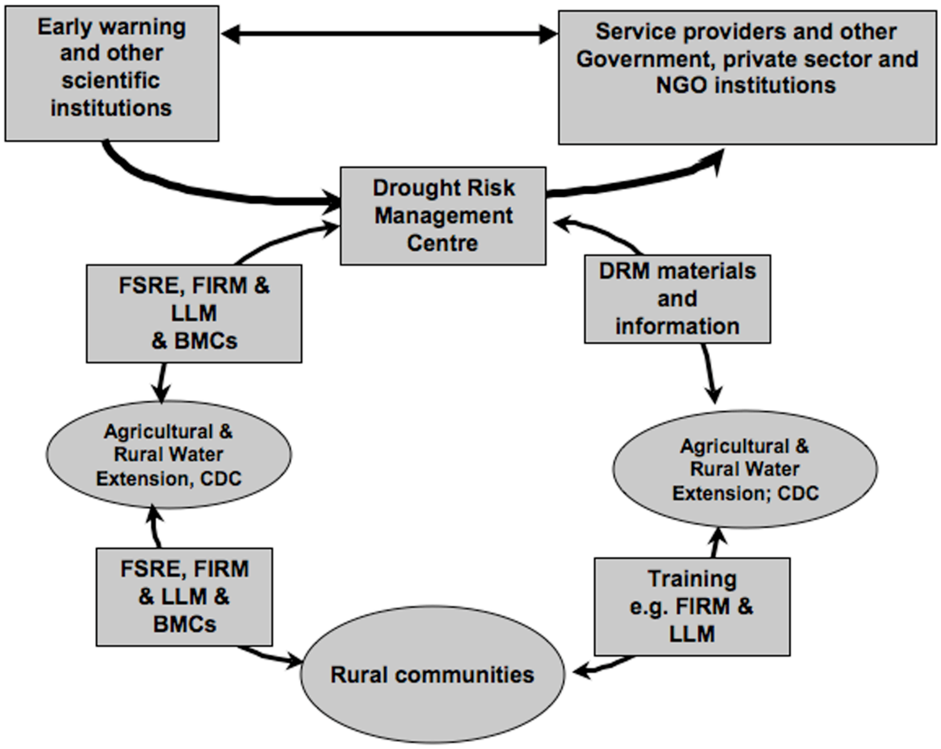

Figure 1. An illustration of interactions among different key stakeholders in the framework of a proposed drought risk management centre aimed at improving decision making from national to local levels. Abbreviations and acronyms: NGO: non-governmental organization; FSRE: Farming Systems Research and Extension; FIRM: Forum for Integrated Resource Management; LLM: Local Level Monitoring; BMC: Basin Management Committee; CDC: Constituency Development Committee; DRM: Drought Risk Management.

Similarly, communication with high-level decision makers is essential to ensure that policy and regulations take the outcomes of science and technology into account. In the examples above, this was undertaken in several ways. Single pages of information are provided to parliamentarians to inform and enhance understanding, but not to advocate for adoption of science and technology's recommendations (DRFN, 1996). High-level decision makers are included in project steering committees and, at every opportunity, provided with exposure to current developments (Napcod, 1999; Bethune and Pallett, 2002). Figure 2, adapted from (Seely et al., 2006b), illustrates the very simple three-way communication required to address the issues at hand.

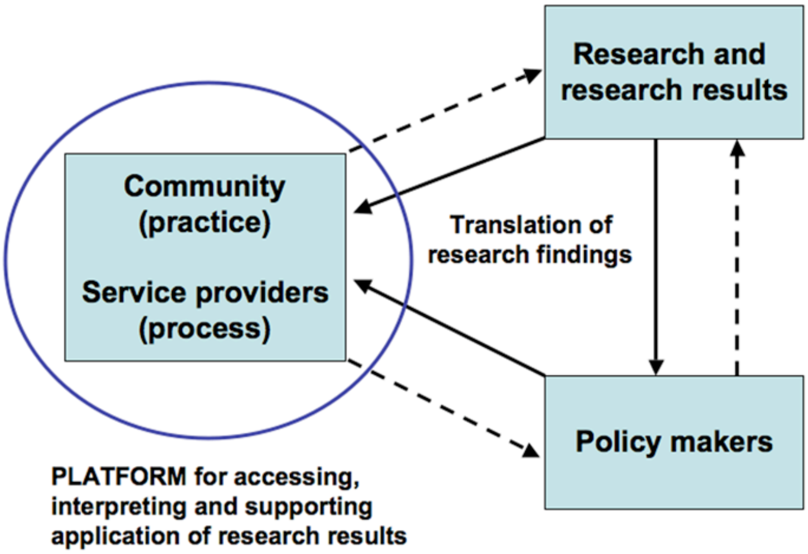

Figure 2. A conceptual model showing the three levels, scientific community, local communities and policy makers, and required interactions between these for successful communication.

Despite the necessity for mutual understanding and communication, it is often difficult for people on different levels to effectively communicate. Cash et al. (2003) have identified several issues to be considered when communicating scientific and technical information to decision makers. These include: credibility, or accuracy of the technical evidence and arguments; salience, dealing with the relevance of the information; and legitimacy, indicating that the production of the information and technology has taken into account stakeholders' varied valued and beliefs. These do not take into consideration issues regarding communication from the rural community level or urban users to service providers, scientists and high level decision makers. With respect to rangeland management, local level monitoring as described above could be contributing to this element of communication. In terms of appropriate energy technologies and services, the demand for and adoption by users is based on clear communication between scientists and technologists on the one hand, succinctly answering questions of why and how, as well as the service providers.

The Forums for Integrated Resource Management represent one platform to facilitate this multi-directional communication. They are dynamic and changing, while responding to the evolving interests of all stakeholders. As such they represent an incipient 'boundary organisation' as described by Cash (2001). Similarly, some of the energy projects, e.g. NAMREP, are acting as incipient boundary mechanisms that enhance communications in all directions. Communication appears to be the key element of more sustainable living in drylands supported by science and technology agendas.

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