MAKING INNOVATION AND SCIENCE RELEVANT FOR POOR COMMUNITIES: THE CASE OF A WATER MANAGEMENT PROJECT IN SOUTH AFRICA

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1. INTRODUCTION

This paper sets out the conceptual underpinnings for an empirical investigation of the conditions under which science, technology and innovation can be relevant for poor communities in a developing country context. It forms part of a series of studies that aim to explore the implications of better integration of social dimensions into the study and practice of science, technology and innovation.

The paper is organised in five sections, the first after the introduction presents a set of conceptual propositions; this is followed by a brief review of innovation in South Africa; section four provides a descriptive account of the case site where the research will be conducting and positions the methodological discussion in light of the arguments made earlier about needed departures in defining, understanding and investigating innovation and in the final section, the paper concludes with remarks about the implications for South Africa and the intellectual project of crafting new models for innovation and development.

2. CONCEPTUAL PROPOSITIONS

This section sets out the conceptual underpinnings of an approach to improving the understanding of the social dimensions of science, technology and innovation and their role in social and economic development. The discussion offers a summary review of academic and development programming approaches in innovation, proposes a working definition that we believe is relevant and attractive. The working definition is useful for framing the questions to be asked both generally in the discussion of new models of innovation and in the specifics of a South African context. While it is not possible in the scope of this paper to provide a thorough review of all the contributions, the aim is to convey a sense of how the thinking around innovation in social and economic development has evolved and what at the time of writing are the areas of convergence, the gaps identified and research agenda. In this section we will identify the variation in focus across countries but will leave the discussion about implications to subsequent sections.

FRAMING THE PERSPECTIVE

Innovation plays a significant role and makes a contribution to economic development in a variety of countries. There is compelling evidence that innovation is closely correlated with economic performance, measured by an increase in GDP. More importantly, empirical evidence also confirms that innovation contributes to measures of improvements in human welfare such as the Human Development Index and there exists a positive relationship which is stable across a number of countries (see Fagerberg , Srholec and Verspagen (2009) for a comprehensive survey of the academic literature). Martin Bell (2009) makes a contribution that is particularly worth noting in this context, where he argues that innovation (and capability building) have implications not only for the rate of growth but can influence the structure of the economy and in particular the composition of output and trade. Innovation is therefore also central to developmental objectives associated with diversification and international competitiveness. These results have led to increased attention in policy circles on innovation, and in particular technological innovation as reflected in national policy agendas as well as in the outputs of multilateral organisations such as the OECD, World Bank and the UN system (UN Millennium Project 2005, UNIDO 2005).

There are a number of alternative approaches to understanding the process of innovation and developing policies, among them: systems of innovation, knowledge ecologies and innovation ecosystems perspectives. A comprehensive survey of these approaches is outside the scope of this summary paper (see World Bank (2011 and 2010) for a summary of the historical development of innovation policy). This paper focuses here on the main features of the innovation process, the factors that influence effectiveness of innovation and other key requirements and conceptual issues are discussed drawing out the implications for South Africa. Over the years and particularly since the 1990s, the system of innovation concept has become the most widely used as a framework for policy making and implementation. In the systems approach, patterns of innovative processes and outcomes arise from or are generated by a complex interplay between firms, financial institutions, industrial networks, public institutions, governments, universities, consumers, communities, and other organizations. In this approach the focus is on interactions across and between these agents (Edquist, 1997, Freeman 1982, Lundvall 1988, 2010 and Nelson 1993). A large body of conceptual and empirical work proceeding from a systems perspective has shown that variation in innovation performance is explained by differences in the combination of institutions involved in the process and the nature of their interactions. While the early studies focused mostly on developed countries, the systems approach has now been applied in a number of developing economies, particularly the Asian newly industrializing economies, which are categorized as being learning intensive (Kim and Nelson, 2000, Hobday 1995) and in Latin America (Cimoli 2000, Casas 2005 and Casas et al 2003 cited in Metcalfe and Ramlogan page 6). The innovation systems approach it has been argued also has implications for wider economic development strategies, such as those formulated for Africa, which present specific challenges and opportunities (Muchie, Gammeltoft and Lundvall 2003). This view is echoed by Latin American scholars Arocena and Sutz (2002). To summarise, there is compelling evidence that innovation plays a significant role in influencing the economic performance and prospects of countries and this extends also to the structure of their economies and the composition of output, trade and the extent of diversification. However, the nature of innovation is not well understood and the complexities associated with the phenomena, as described by conceptual work, has had relatively little influence in practical based policy making either at national or multilateral level. This has had negative implications on the extent of investment in innovation and in shaping the direction of innovation activities in developing countries.

WORKING DEFINITION

This paper suggests that innovation should be defined as follows: innovation is a process of generating, acquiring and applying knowledge for economically and socially beneficial purposes and takes place through efficient unfolding of various learning processes, rather than being determined by the mastery of science and technological knowledge (Marcelle 2012, 2011 b,c and 2004). This definition contrasts substantially with views of innovation that define it as a science-centric process that is concerned with generating technological novelties through a process of accumulated investment in formal centralized research and development (R&D) or purchase of technological imports. This definition draws on evolutionary economics and neo-Schumpetarian analyses that characterise the process of innovation as being a complex, non-linear process that is interactive, full of uncertainty and must be managed through intentional effort and investment (Dosi 1982 Perez 2004, Srinivas, S. and J. Sutz 2008, Mowery and Rosenberg (1979)). While the paper considers this perspective to have a great deal of merit, being based on forty years of research, it also acknowledges that it will not be easily accepted by policy makers -- who are by and large not comfortable with

ambiguity and blurred operational boundaries or concepts that do not fit into familiar types of standardized data (Bell 2009).

Within this definition and the related perspective, broad notions of innovation and not only activities that are intended to produce radical innovations, new to the world products and services or activities at the technological frontier are contemplated (Nelson 1993). In this definition, the non-science based aspects of innovation, and those that are market and society facing are considered to be significant and important. Context matters and therefore, the alignment of innovation efforts with local contexts and culture influence its effectiveness. It has also been shown that innovating under conditions of scarcity is very different from doing so under abundance (who pointed out the need to *couple* the science system and the production system, the definition proposed here and its implications point to the accumulation of scientific and technological knowledge as inputs to some aspects of the process of innovation rather than being the entirety of the innovation process. This working definition explicitly does not reduce the process of the system of innovation only to activities related to formal science and research and development (R&D). This is particularly relevant when the aim is to understand innovation and improve its effectiveness in developing countries (See for example, Ernst and Kim (2002) and Mytelka and Smith (2002). It also permits consideration of innovation from the point of view of users and intended beneficiaries. The perspective suggested in this paper also argues that in order to understand innovation, it is best to proceed from gaining a better understanding of the nature of the innovation process and the role of innovation performers, and intended beneficiaries. This includes conceptual understanding and empirical analyses at the micro level, whether the innovation performers are profit-oriented firms or non-profit seeking organisations or individuals organised at community level. These microlevel factors are important and are often overlooked. This position is in line with the influential article by Rothwell (1994), expanded on by Hobday (2005) and policy reports to funders such as (Arnold and Bell 2001).

This working definition also would require policy makers to draw from lived reality and experiences of weak policy effectiveness to ask deeper questions rather than accepting the status quo. In our view, a better starting point for understanding innovation will open up many more degrees of freedom and improve the likelihood of policies being meaningful. There is a lot at stake in getting the identification of the nature of the innovation process right. Lundvall (2007 cited in Lundvall et al 2009 p.3) suggests that this misidentification of the nature of innovation and its scope has led to divergence in outcomes and underperformance even in advanced nations in Europe. He also invokes work done in the 1990s by Christopher Freeman, which showed using evidence from advanced countries, that even for radical innovations, the largest proportion of economic value added is created only when the goods and services based on the technical breakthrough are consumed or diffused throughout the economy.

The working definition and the underlying perspective proposed here render non technological based innovation more visible, and explicitly include the notion of applying innovation to social purposes. We believe that the biggest challenge facing countries in the developing world include poverty, inequality, poor health services, lack of affordable housing, challenges to environmental sustainability, energy poverty, lack of responsive urban management, and a range of other issues that affect quality of life. In the view of the authors what is needed is a conscious and determined reorientation of science, technology and innovation to tackle these societal problems.

We believe that innovation including its science and technology components, where these are relevant, ought to be directed at developmental challenges. Societies need to become mobilised and focused on

finding solutions and even when these do not require the deployment of intensive scientific and technological knowledge, this process ought to become the main objective of the innovation agenda.

The approach proposed here therefore suggests that innovation should be directed at addressing societal challenges through generation, acquisition and application of knowledge. This objective should become the defining for national innovation agendas.

EFFECTIVENESS IN INNOVATION OUTCOMES

Scholars have shown that the effectiveness of innovation is influenced by the interaction of six key dimensions, namely: enabling conditions such as social institutions, macroeconomic regulation, financial systems, education and communication infrastructure, and market conditions (Lundvall et al 2009, World Bank 2010; well functioning and appropriate institutions including values, norms, levels of trust (or mistrust), degree of integrity and low levels of corruption as well as formal organisations or agencies involved in the system such as private firms, universities, government laboratories and other public agencies (Edquist and Johnson, 1997, p. 55 cited in Niosi 2002 p. 292; actors, activities and functions which are involved at national, subnational, sectoral and geographic level (Lundvall 2009, Chaminade and Vang 2008, Edquist (2004), Metcalfe and Ramlogan (2005), (Cooke 2001), Malerba (2002); knowledge flows and interactions that confer the ability of knowledge producing agents and actors to link effectively with agents in the real economy and with actors in social sectors and local communities for example, Freeman (1991) provides an insightful analysis of the type of complex and sophisticated infrastructure required by actors in the system and Gupta (2007a) has focused on the challenges of linking formal and informal actors; governance and architecture that improve coordination across the various actors and enhance coherence in the purpose and overall objective of the system (Ernst ,2000; Arnold 2004, and Reid 2009); and a cultural and psychological disposition that facilitates science, technology and innovation (Lundvall 1992) including because of the availability of cultural capital and the functioning of social networks (Landry (2002).

As we noted earlier, the social dimensions of innovation have not received a great deal of attention. The perspective adopted here suggests that the extent to which a nation and (groups within it) benefits from or is negatively affected by changes in the science and technological paradigm is influenced directly by the social context and nature of social relations in that country. We therefore suggest that economic inequity, racial imbalances, differentiation in access to opportunities across race, class and gender lines have a place in understanding the outcomes intended and otherwise of science, technology and innovation policies.

Despite the original framers of innovation systems approaches including cultural and societal variables in the analysis, this aspect has not received as much attention as the more economically related elements of the conceptual framework and there is a dearth of empirical research. This means that the academic work on innovation is dominated by examples of success and little explanation of failure, inertia and slow progress. Further, particularly because of the framing of much of the discussion as an imperative, there is almost a silencing around the studies that have questioned the virtual circles associated with innovation and identified trends such as growing inequality and marginalization that is associated with restructuring of economies and shift to knowledge based production and consumption. The practices and methods associated with innovation studies theorising are for the most part not participatory although this is beginning to shift as more concern and attention to the link between innovation and environmental and economic sustainability emerges.

Conceptual and empirical work on linkages and its role in innovation has shown that constituent actors benefit from linkages and interactions most when these are bi-directional and permit and encourage knowledge to circulate freely. This requires actors in the knowledge circulation process to have shared meanings understanding and objectives and does not imply a trade-off between openness to knowledge sourced outside national borders and the strengthening of domestic technological capabilities (Marcelle 2004, Bell 2009). Governments around the world have designed agencies that aim to support the innovation performance of firms – both small and large – and the most effective have paid attention to the need to have active, meaningful linkages and interactions with firms. There are also efforts to improve the extent to which firms interact among themselves. These interactions are considered as useful sources of knowledge about technological trends, production processes, and competitive intelligence and may extend to joint projects of technology development and exploitation. It also includes communication between suppliers of goods and services and their customers. Working from a systems perspective Arnold and Thuriaux (1997) provide very useful frameworks that can assist governments in providing innovation enhancing services to firms. These authors in their advice to governments emphasised the need for segmentation. They provided a generic typology of four types of firms ranging from firms with no meaningful technological capability, through to firms with minimum capability, onto firms with some technological components and finally to firms who are research performers. Building on this typology, these authors recommended that the design of networks and interaction interventions, should take into account the segmentation of firms, particularly in terms of size and capabilities. These authors suggest a progressive approach starting with proactive mentoring, moving from basic capability development, onto specific capability development before transitioning to technological development and research services. This approach is highly recommended in the case of developing countries because it recognises the issue of the importance of gaps between the suppliers of innovation support services and their "users" that is firms that actual operate in the productive sphere. Recent research in developing countries, such as findings of periodic Innovation Surveys, confirms that the majority of developing country firms do not regard interaction, particularly with public sector bodies and universities, as being important for their innovation processes. In the view of this paper, this may be explained in part by a failure to have a segmented approach to designing and delivering the services of these public bodies. In terms of the specific focus of this paper, it will be suggested that there is considerably less work done, both at a conceptual and empirical level to understand linkages between and among non-profit orientated organisations and with communities. We suggest that the work on social and cultural systems and on segmentation requires much more attention and focus.

SUMMARY

This paper suggests that a more realistic and relevant definition of innovation is needed if innovation policy is to become more relevant. The paper makes use of a definition of innovation that is based on how this process actually takes place and which covers the aspirational dimension of innovation by focusing on its outcomes rather than only on a narrow set of inputs. A final word needs to be said that the approach proposed here explicitly rejects technological determinism (Winner 1993) and adopts a social construction of science, technology and innovation approach (Bijker et. al 1987).

Further, the authors are aligned with perspectives that regard participatory approaches to development as inherently superior to those that are more technocratic and authoritarian. In the innovation studies literature and practice, these elements receive much less attention and are often subsumed under the labels of demand-led rather than supply-push approaches to innovation. In the work that underlines this paper, there is much more of a political and even ideological content to

ensuring that issues of power, control and ownership of resources, and governance in the innovation process are on the agenda for interrogation. We return to these issues when we describe the methods to be used in the empirical phase of the study.

3. INNOVATION IN SOUTH AFRICA

This section summarises the key strengths and weaknesses of the South African national innovation as reported and analysed in academic literature and official evaluation reports. It incorporates insights of empirical assessments undertaken by one of the authors including as part of a national review of the innovation landscape in South Africa.

At the level of formal statements such as those in policy documents, South Africa does well; there is a clear link among the domains of technology, innovation, and enterprise development as well as between these domains and broad goals such as economic growth, competitiveness, social cohesion, and improved quality of life. However, conceptual understanding, awareness of the complexity involved as well as real policy implementation lags far behind policy formulation. The country has much strength in terms of its potential for innovation including good linkages between major industries and the mainstream formal knowledge infrastructure, including higher educational institutions. While there is a strong disposition towards networking, including with international peers, and strong representation of business in innovation activities, the country continues to be plagued by the legacy of poor-quality schooling which has resulted in chronic human resource shortages at all levels involving mathematics, science and technology.

Particularly in recent years, there has been increasing concern over the extent to which the innovation system is delivering services to the non-formal economy and is integrated with local communities. For example, the National Advisory Council on Innovation has set up committees to deal explicitly with this link and the Department of Science and Technology has initiated programmes on poverty alleviation (NACI 2009). This lack of alignment with socioeconomic development objectives, in the view of the authors of this paper, is exacerbated by the trend towards a proliferation of large-scale projects, often involving infrastructure components, without careful selection, focus and monitoring and evaluation against development impacts.

Several evaluations and peer-review of the innovation system in South Africa have acknowledged these key strengths and challenges, in studies such as as Mahdi (2002) and OECD (2007c) and these have been updated with recent comparative analysis (OECD 2011). Structural changes in DST suggest that the science, technology and innovation policy system is beginning to become more responsive to these as real concerns requiring action, and there have been changes in terms of programming and budgeting that are encouraging.

In addition to these comments on the structure of the innovation system, recent scholarship and commentary has identified the following features, many of which identified weaknesses. The system may not be mutually reinforcing and may not demonstrate features of an ecosystem (Ramphele 2010); there is continued fragmentation and fractures with major economic policy (Marcelle 2011a); there is an urgent need for greater focus on private sector firms as producers and performers of innovation (Marcelle 2011b,c); there is a need for increased alignment with socio-economic challenges and imperatives (OECD 2007c, NACI, 2009) and greater emphasis needed on the poor and demand led innovation (Lorentzen 2010). In terms of university/industry linkages, there is evidence of great

concentration within a limited range of sectors (Kruss 2010). The national innovation system and its related policies may be producing inequalities and reinforcing exclusions (Abrahams and Pogue 2010, Maharajh 2010). In South Africa, there has been a recognition that there needs to be considerable attention paid to improving the measurement of innovation outcomes (Storey and Kahn 2010, Alzugaray et. al 2011) that would adapt and extend the OECD framework for measuring innovation outcomes (OECD 2007b). Some authors have recommended adopting a portfolio approach to manage innovation expenditures (Walwyn and Sithole 2010). However, South Africa is yet to have built a strong evaluation culture into its innovation policy mix and data where this does exist it places more priority on comparability with OECD measures than on detailed analysis of context and differentiation. This paper recommends that other examples of innovation policy design, assessment and evaluation such as that undertaken by Thailand be considered (Intarakumnerd 2011 and Intarakumnerd et al 2002).

4. THE CASE OF A RURAL WATER MANAGEMENT PROJECT

This paper examines the relevance of a water management project designed, developed and implemented by formal science and technology organisations in a rural setting in South Africa plagued by problems of poverty, unemployment and other forms of deprivation. In this section, details of the technology, its objectives and aims; a description of the organisation responsible for technical design and project management as well as key features of the local community in which the project was implemented. The sources of data presented here are secondary and include internal project documents, academic materials and official government documents. Once the final paper is completed, the full assessment will draw much more extensively on primary data collection with the specialist researchers as well as with the intended beneficiaries.

Water management project

According to the internal project reports, the project under investigation had the following objectives:

> The Accelerating Sustainable Water Service Delivery (ASWSD1) aims to demonstrate how to expedite the provision of reliable safe drinking water (potable water) to underserviced, or unserved, communities living in remote rural areas through the application of science and technology.

The initiative was conceptualised by a national task team of various departments and role players and is funded by the national Department of Science and Technology (DST). The project engages two science councils in implementation, namely: The Council for Scientific and Industrial Research (CSIR) and the Human Sciences Research Council (HSRC). It was designed as a pilot, where the intention was to test for sustainability and to develop a replicable implementation process for delivery of an intermediate level of water services in remote rural areas. There was an explicit intention to view these projects as a supplement to rather than as a replacement of municipal water service delivery systems.

The project implementing agencies were appointed in 2009 and the project has been executed in two rural locations, namely the Amathole District Municipality and the OR Tambo District Municipality (ORTDM). The CSIR assumed responsibility for technical research and development, as well as the project management in the ADM. The HSRC was responsible for the community mobilisation and training in both district municipalities, as well as project management in the ORTDM. At inception, the project began with identification and selection of intervention sites/communities, the conceptualisation of the communal water station and associated community mobilisation activities. The commencement of the ASWSD 1 project was officially launched in February 2009 at Cwebe village

in the ADM and at Mnxekazi village in the ORTDM by the then Deputy Minister of Science and Technology, Mr Derek Hanekom.

The design specifications for this project focuses on the construction of communal water stations (cws) at traditional water collection points near rivers in these villages and ensuring aims to ensure sustainability through the establishment of participatory institutional arrangements for the operation and maintenance of both these communal water stations and existing boreholes. In terms of the formal scientific and technological content, there are three elements, viz.

- The installation of a communal water station (cws) to abstract and treat water from a river.
- The development of a borehole management plan that aims to improve safety of borehole water and minimise breakdowns.
- The provision of a household-based water treatment technology for the purification of water in the home.

The communal water stations for the villages in the ADM were conceptualised to produce a volume of at least $3m^3$ potable water per hour and to consist of at least a flocculation and settling tank, pressure filters, a chlorination tank and a storage tank. Potable water is pumped from the storage tank in the cws to a reservoir, from where safe water is distributed to pipelines and then to taps in the respective villages through gravity. Interestingly, the design of the cws envisaged using its energy system as a communal cellphone charging system. The cws is placed above the floodlines of the rivers and close to houses for added security and protection. This was particularly important in Mbelu village, where solar panels are used that are more vulnerable to theft and damage. The energy sources for the water stations in Cwebe and Ntilini were diesel generators, while solar energy as used as the primary source in Mbelu with a diesel generator as back-up.

In the ADM, the project was rolled out in three villages; Cwebe, Mbelu and Ntilini. The main agricultural activities in these locations are vegetable gardening and dry land farming of maize with cattle manure used as an organic fertiliser. All these villages are all located relatively close to rivers. Almost all the households are located on top of a ridge along an access road. The river in these villages is some distance away in a ravine. Households rely mainly on springs and these rivers as their water source. All springs are located down slope in relation to the dwelling places, at an average distance of 50 - 100m. There are only a few sanitation facilities/toilets in these areas and as a result, most households practice open defecation. Human waste is often as close as 10m from water sources. Households and animals share water sources, with cattle and domestic animals using the same rivers and streams as humans and there are few if any fences or other forms of protection. The project aimed to allow the community to use traditional paths to fetch drinking water but to greatly improve safety of the water and instil greater attention to operation and maintenance of system components.

The project aimed to serve an estimated 1 200 households; internal assessment reports suggest that 1 775 households (8 989 people) benefitted from the ASWSD 1 project by obtaining access to clean drinking water. To date, the project has not been subject to any independent evaluation and the internal project reports have not been finalised by the funder.

Formal science and technology organisation

The Council for Scientific and Industrial Research (CSIR) is one of the several science councils in South Africa which are responsible for scientific and technology research, development and implementation. South Africa's CSIR was established in 1945 as a science council by an Act of Parliament. It is a parastatal that is required to contribute to R&D in South Africa by undertaking integrated, multidisciplinary research across diverse areas of science.

The detailed mandate of the CSIR is set out in the Scientific Research Council Act, (Act 46 of 1988, as amended by Act 71 of 1990), section3 is as follows:

> The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest and in the fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this act.

The CSIR works closely, either as a partner or a client, with tertiary educational institutions, other science councils, research institutions and a range of private sector organisations locally and abroad. According to internal corporate documents, the CSIR places a focus on quality science, skills and socio-economic improvement.

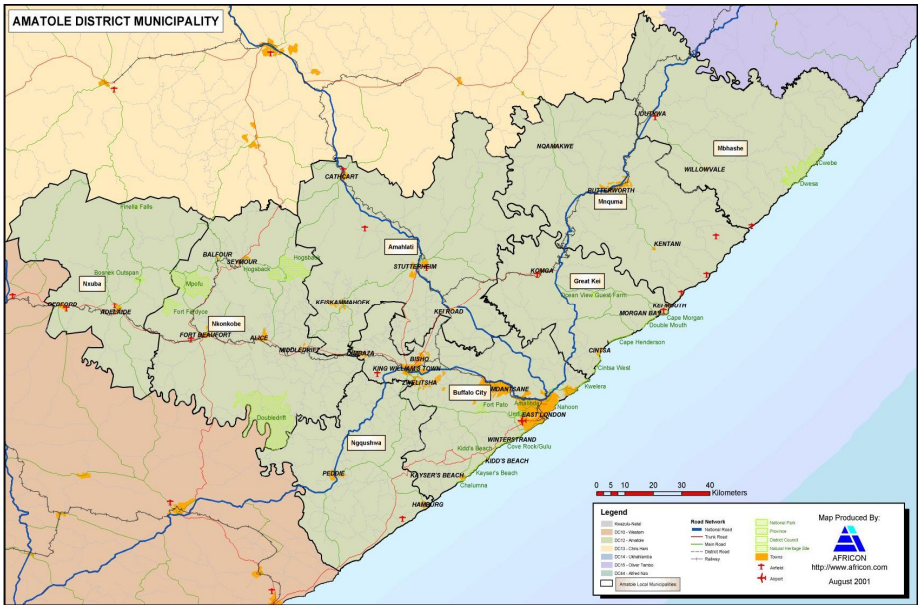
The CSIR owns and/or manages a number of specialist facilities of national importance. These include centres for laser technology, satellite applications, nano-structured materials, high-performance computing, notational analysis of sports performance, coastal engineering and other modelling facilities, as well as testing facilities for wind resistance, mine hoist equipment, environmental samples and more. CSIR receives an annual grant from Parliament through the Department of Science and Technology (DST), which accounts for some 40% of its total income. This is invested in knowledge generation, scientific infrastructure and enhancing skills. The CSIR's total operating income is more than R1 billion per annum. Income generated from contract research for public and private sector clients, locally and abroad, as well as from royalties, licences and dividends from intellectual property (IP) management and commercial companies created by the CSIR is added to the income directly from government. CSIR earns in excess of R30 million in royalties per annum and also earns fees from consulting and analytical services that range from project management and fieldwork, and specialist testing. CSIR has a dedicated unit for enterprise creation to facilitate the implementation of community-owned, technology-based businesses that generate innovative products and employment opportunities. CSIR has a staff complement of around 2 300, of which close to two thirds are science, engineering and technology (SET) specialists; of these 50% are qualified at Master's level and higher. CSIR invests in human capital development through under and postgraduate bursaries, internships and a range of training interventions to foster young talent and further develop expertise.

Local community

Amathole is one of the seven districts located on the eastern seaboard of South Africa in the Eastern Cape province. Over 90% of its 1,664,259 people speak Xhosa (Census 2001). The district code is DC12. "Amathole" means calves, and is similar to the name of the mountain range and forest which forms the northern boundary of the district (du Plessis, 1973). A municipality in this location with the district code DC12 The district municipality, was established after the first local government elections under a democratic government in December 2000. The seat of Amathole is East London and the district is further divided into eight local municipalities, each containing at least one urban service centre, these are: **Amahlathi Municipality** (Cathcart, Stutterheim and Kei Road); **Great Kei** (Komga, Kei Mouth, Hagga-Hagga, Morgan's Bay and Chintsa); **Mbhashe** (Dutywa, Willowvale, Elliotdale); **Mnquma** (Butterworth, Nqamakwe, Centane); **Ngqushwa** (Peddie, Hamburg); **Nkonkobe** (Seymour, Fort Beaufort, Alice, Middledrift) and **Nxuba** (Bedford, Adelaide).

As shown in Figure 1, the district stretches from the Indian Ocean coastline in the south to the Amathole Mountains in the north, and from Mbolompo Point (just south of the Hole-in-the-Wall along the Transkei Wild Coast) in the east to the Great Fish River in the west.

Figure 1, Map of the Amathole District Municipality



This is a rural location and one that is ravaged by high levels of poverty. The majority of the poorest of the poor live in dwellings that are constructed with mud and low quality building materials which are vulnerable to being affected by severe weather conditions. This area suffers from a heavy backlog in provision of formal housing. Household grant dependence is higher in Amathole (66%) than the provincial average for the Eastern Cape (64%) (Statistics South Africa 2007). The people of ADM relay on many national departments such as Departments of Social Development and Rural Development and Land Reform for relief and assistance as well on provincial and local authorities. Unemployment continues to be a challenge in the area. According to (South African Led Network 2010) the following sectors provide employment in the formal sectors, with the number of jobs across each being: public services (75,000); manufacturing (27,000); trade (25,000); and agriculture (17,000).

There has been a rapid growth in informal settlements in Amathole which puts a great deal of pressure on health and environmental standards. Public agencies struggle to provide basic services such as housing, safe water and sanitation, education, reproductive health, and youth development. There are funding and organisational challenges and local as well as national government departments have a poor track record in terms of delivery of impactful development projects. The District Municipality is made up of a few former homelands.[1] Here limited or no development has taken place over a number of years. The public sector dominates the region's economy, there is a limited production base and there has been very limited private investment growth into the ADMs economy.

As a result of these characteristics, this site provides a potentially rich source of data and insight about the challenges of achieving knowledge flows between formal knowledge producers and the poor. In this context, the structural and behavioural factors that have been summarised in earlier sections are compounded by high level of poverty, deprivation and marginalisation. It is in this context that the study wants to probe conditions under which formal science and technology organisations can make a difference and be relevant. This study uses a combination of primary data collection and document analysis. The water management projects implemented by the CSIR Built Environment operating unit in the Amathole Municipal District are the case site. When the study moves into its empirical data gathering phase, the researcher will elicit data from specialists such as the R&D Managers and

[1] Homelands are areas where Black Africans were forced to live, according to their ethnicity as per the policy of separate development. These practices were reversed in 1994 at the onset of democracy in South Africa but former homelands remain plagued by low rates of development (South African History online).

researchers, this will be analysed together with the information gained from interviewing community members and stakeholders. A number of different methods of data collection at community level will be employed; these include participant observation, focus groups and individual interviews. In working with local communities, particularly in rural settings, it is also important to negotiate access through traditional and culturally relevant authority systems and this has been taken into account in the design.

A process of triangulation will be used in later stages of the research design so that the views of senior management in CSIR are incorporated into the analysis. The study aims to access 25 community members representing the intended beneficiaries; 10 specialists and 5 independent commentators. The intention is to complete the fieldwork by end June 2013.

In terms of the framework for analysis, the instrument and protocols for collecting secondary data have sought to identify several dimensions for assessing relevance of this project, these include the extent of ownership and participation of the community intended beneficiaries; notions of technological suitability in terms of cost, ease of use and familiarity; an assessment of technological appropriation; the environmental impact both intended and unintended of the intervention and its alignment and impact on existing social structures and patters of life.

The project team have an intention to engage actively with CSIR and with the project funders to suggest that these elements of evaluation and assessment are as if not more important than the simple technical criteria that have been used to date.

5. CONCLUSIONS AND RECOMMENDATIONS

This study is an intervention into innovation practice in South Africa, which attempts to place the social dimension and insights about innovation dynamics at the forefront.

From the point of view of conceptual evolution, we use a working definition of innovation that places an emphasis on knowledge and usefulness. We suggest that innovation is best understood as a process that involves a number of actors arrayed in a complex system. Further, in line with much scholarship, we suggest that for optimal effectiveness, the system components engage in bidirectional knowledge flows or linkages and these are central to performance. We have shown that in many developing countries, this continues to be a serious challenge as public bodies are still learning how to interact effectively with other actors and components in the system. Very little progress has been made with respect to firms, not for profit organisations, civil society actors and communities. This intractable weakness therefore provides an opportunity for learning and policy experimentation (for Europe, see Arnold, E and Thuriaux, 1997), a number of OECD innovation reviews and some studies from developing countries (Khan 2008, Chaminade and Vang 2009, Intarakumnerd, 2002 and Intarakumnerd et al., 2011).

Recent research carried out by one of the authors of this paper, suggests that in South there is much work to be done to engage innovation performers; while that work focused on the lack of articulation with the private sector, we suggest that the same is true for other non state actors, and in particular poor communities (Marcelle 2012, 2011 b,c). That analysis suggested that South Africa n innovation policy the approach both at national and regional levels relies on blunt instruments which do not acknowledge or respond to variation in innovation positions, paths and processes. These undifferentiated policies result in a number of persistent problems and relevance to poor communities is one of them.. These weaknesses despite government intention call for a major departure from current mode of operation.

Making reorientations in the scope and design of innovation programmes will not only foster improved partnerships but will contribute to the political problem of demonstrating the relevance of science, technology and innovation spending. There is therefore a timely opportunity for South Africa

to emerge as a thought leader and practice catalyst in a few specific areas of innovation. These could include societal challenges which exist in South Africa and are particularly well suited for holistic application of innovation concepts, these may include improved access to low cost housing; promoting transition to sustainable low resource production systems and improved access to affordable and high quality health care. If South Africa were to identify focusing areas for its innovation effort, it could find that there were fruitful partnerships available with international development partners that are already interested in and active in Science, Technology and Innovation.

We suggest that a problem-solving approach to innovation should be adopted as an urgent priority rather continuing the current approach which is orientated more to the prestige and seduction of large scale science-based projects aimed at producing radical breakthroughs. These projects are often started without sufficient resources to deliver against these ambitions and under circumstances that pay little attention to demand conditions. South Africa needs to continue efforts to build its stock of relevant STI capabilities but to guard against a supply-push-based approach to Science, Technology and Innovation policy and focus much more on developing a problem-solving, developmentally aligned approach to innovation policy.

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