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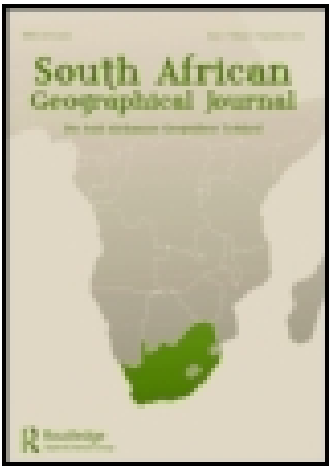

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Soil erosion and dam dividends: science facts and rural 'fiction' around the Ntabelanga dam, Eastern Cape, South Africa

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Soil erosion and dam dividends: science facts and rural 'fiction' around the Ntabelanga dam, Eastern Cape, South Africa

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Large dams can play an important role in rejuvenating economic and social development but are often associated with environmental degradation. The Mzimvubu Water Project will involve the building of two large multi-purpose dams, namely Ntabelanga and Laleni. A key anticipated benefit of the former is the expansion of irrigated agriculture. This article reveals that large areas surrounding the dam are, however, severely affected by soil erosion and that irrigation on these areas is likely to be unsustainable. Focus Group Discussions (FGDs) and interviews were held with members of two communities that will be affected by the dam to gauge community sentiments and anticipations. The FGDs revealed that despite respondents lived experiences of soil erosion, local narratives about it appear irreconcilable with geophysical facts. The one crucial anticipated dam dividend appeared to be support for large-scale irrigated agriculture. Rural anticipations that irrigated agriculture can counteract soil degradation caused by erosion are not supported by scientific evidence, and without appropriate community awareness programmes by the dam developers, the divergence between science facts and local views may in the future engender conflict between the community and other stakeholders.

Keywords: digital soil mapping; Mzimvubu Water Project; dam dividends; rural development; soil erosion; local knowledge

Introduction

Globally, large dams are pivotal development infrastructure. They help society to meet a wide variety of needs – water for domestic and industrial use, irrigation and hydroelectric power. Dams can also help to 'reduce peak discharge of flood water' and 'increase the depth of water in a river so as to improve navigation' (Altinbilek, 2002). Countries continue to invest in the construction of large dams on the basis of these and other benefits. South Africa, a country that already has several big dams, has in the last few years announced plans to build its seventh biggest dam in the Mzimvubu River Basin in the Eastern Cape. According to the Department of Water Affairs, the Mzimvubu Water Project will involve the building of two multi-purpose dams in the Tsitsa River, namely Ntabelanga and Laleni. (When this study was conducted, only Ntabelanga dam was envisaged; hence, it is the focus of this article.) The government expects the dams to catalyse economic and social development. Ntabelanga was chosen following a study of 19 potential sites. The envisaged benefits of the dam include job creation and agricultural rejuvenation (DWA, 2012). The official thinking is to ensure that the dam project is in tandem with the Eastern Cape Government's vision for the Mzimvubu River Basin, which includes afforestation, irrigation, hydropower, water transfer and tourism (DWA, 2012). The Mzimvubu River is the largest undeveloped

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river in South Africa. This is despite its having a high annual run-off, high environmental status (NFEPA Report, 2011), high tourism potential, and its suitability for afforestation and moderate suitability for dryland/rainfed and irrigated agriculture (NWRS2, 2012).

While the real and potential benefits of large dams have been widely documented, a number of studies have highlighted the fact that dams pose real social and environmental sustainability challenges for communities. According to McCully (2001, p. 31), a 'dam [dam construction] can be regarded as a huge, long-term and largely irreversible environmental experiment without a control'. Dam construction has a direct impact on the environment through permanent inundation of previously dry areas, alteration of stream flow regimes (reduction in natural flooding) and fragmentation of river ecosystems, thereby reducing species diversity in almost all cases. Indirectly, land-use change associated with dam constructions can significantly alter the equilibrium of ecosystems. These changes generally lead to more intensive land utilisation. The irrigated land previously used for rainfed cropping or grazing, for example, can result in more strain on the environment and often lead to severe land degradation through increased soil erosion, and in the worst case result in desertification.

Put differently, the success of a dam project is no longer just a matter of whether it is technologically feasible or whether it will drive economic development: success is increasingly being measured by the extent to which the project coheres with specific environmental and social dynamics in the local area in the short, medium and long term. For instance, while protests against dams or, for that matter, pro-dam advocacy are sometimes ideologically and politically motivated and have little to do with observed impacts (Biswas, 2004; Raina, 2000), studies have shown that a failure to pay close attention to specific sociocultural dynamics in the local area could expose the project to invidious local resistance, if not immediately, then certainly in the long run (see Bisht, 2009; Uphoff, 1996). Indeed, difficulties could arise even though local residents appeared to have initially welcomed the project (Akpan, 2006).

The Ntabelanga dam offers an important opportunity for investigating some of these concerns and, perhaps, raising new questions for policy and scholarship. For example, what benefits do residents of the rural dam communities anticipate? Above all, given the geophysical conditions of the Ntabelanga area, to what extent are the anticipated benefits – that is benefits as articulated by community members – realisable?

These are the key questions examined in this article. They are based on the premise that local discourse matters, but, more importantly, that in the terrain of rural infrastructure provisioning, the clash of 'facts' and 'fiction' – the possibility of dashed hopes and expectations – poses a threat to the sustainability of development interventions.

The article focuses on soil erosion – and related local narratives – and is based on an interdisciplinary pilot study of the socio-ecological status quo in the Ntabelanga area before the start of the dam construction (scheduled for the last quarter of 2014). It combines insights from physical geography, sociology and agricultural science. First, the extent of erosion in the area is highlighted, followed by an attempt to identify erosion-sensitive areas. Local narratives about anticipated benefits of the dam and the soil erosion problem (causes and impacts) are then elucidated. Thereafter, the findings are discussed and deductions made. In the main, the article contends that without appropriate awareness programmes, science facts and local narratives about specific geophysical phenomena (such as soil erosion) could appear irreconcilable, with the result that communities 'embrace' major development projects (such as a large dam) on the basis of 'false' hopes.

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Soil erosion and rural livelihoods

In general, soil erosion (the pilot study focused only on soil erosion caused by water) involves two processes, namely detachment or dispersion of soil particles and transportation of particles along a slope gradient (Ben-Hur & Agassi, 1997). The factors promoting the generation of overland flow generally increase the susceptibility of the land to erosion. These include high intensity rain events, steep slopes, absence of vegetative cover and soils with low infiltration rates (Brady & Weil, 2009). Fine textured soils are, therefore, more sensitive to coarse textured soils and duplex soils, with textural discontinuity varying with depth. This can promote the formation of perched water tables and the generation of lateral discharge, making them exceptionally sensitive to erosion (Guang-Hui, Bao-Yuan, Guo-Bin, Xiao-Wu, & Nearing, 2003; van Tol, Hensley, & Le Roux, 2013). Likewise, high sodium content promotes the dispersion of soil particles and enhances the susceptibility of soils to erosion. Management practices can significantly increase the sensitivity of the land to erosion, for example overgrazing can result in compaction (lower infiltration rate) and the removal of vegetative cover, through overgrazing and inappropriate agricultural practices, disrupts the soil structure by making the soil more prone to erosion.

Soil productivity is the capability of a soil, in its natural environment, to produce a particular crop or a sequence of crops under a certain system of management (Pile, 1996). The loss of soil (especially fertile topsoil) through erosion is one of the major causes of the reduction in soil productivity. It triggers food insecurity, affecting both humans and livestock. For rural communities, whose livelihoods depend heavily on agriculture, the decrease in soil productivity can have devastating consequences.

However, the perceptions of the people in the areas affected by soil erosion are of high significance. For one thing, such perceptions often determine local people's attitudes towards rehabilitation and conservation of soil resources. In other words, how well people understand the erosion problem and its implications could determine their involvement in the solution (rehabilitation) and their support in the adoption of alternative conservation practices (Vetter, 2009). Even so, an insight into local perspectives might reveal socio-economic constraints, which are of utmost importance when dealing with soil rehabilitation and erosion containment. In addition, the lack of ownership of land has often made people oblivious to erosion problems as there is little long-term incentive for rehabilitation and conservation, as in the case of traditional land tenure system. Studies have found that rural people, especially the older generation, tend to see erosion as an act of a 'higher power' (Tengberg & Lindskog, 1994); natural causes often not considered as a possible cause of erosion (Fairhead & Scoones, 2005). Economic pressure has been found to play a major role in people's inability to adequately respond to the erosion problem, especially when it comes to land management. Vetter (2009), for example, has found that while rural communities acknowledged that reduced grazing pressure would benefit rangeland conditions, people were incapable of reducing livestock numbers as that would have an adverse effect on their economic situations. Yet, as stated earlier, the success and sustainability of major infrastructural projects hinge on the planners being sensitive to local narratives.

Materials and methods

Study area

The Mzimvubu River falls within the Mzimvubu-Keiskamma Water Management Area 12. The Tsitsa River is one of the main tributaries of the Mzimvubu River and falls within tertiary catchments T35A–E. An area of approximately 370 km^2 surrounding the inundation footprint of the proposed dam was selected for this study (Figure 1). The area falls within the semi-arid area of the old Transkei homeland – an area that receives approximately 700 mm rain per annum, mostly during the summer months. The geology is dominated by mudstone and sandstone from the Beaufort Groups of isolated dolerite instructions.

The study area falls within the *Maize Mixed Farming System* (No. 9) as classified by Dixon, Gulliver, Gibbon, and Hall (2001) for sub-Saharan Africa. The land tenure system in the study area is characterised by state-owned land that is administered through the Tribal Authority system. The rural communities are widespread, and most families devote between 0.1 ha and 0.5 ha of the 1 ha homestead land allocated to them by the tribal authorities to subsistence agriculture. The arable lands are typically consolidated rainfed farming areas, which can be made up of several plots (1–3 ha or more). These lands are in the vicinity of the villages, whose residents cultivate the plots. Distances between homestead and farming area are, in some cases, quite substantial. Large areas of communal land – the higher-lying mountains surrounding the communities – are typically used for grazing of livestock, especially cattle. These areas are communally owned.

For the purposes of the pilot study, two communities were selected, namely Lower Sinxaku Village and Ntzebe Village (Figure 1). Lower Sinxaku is closer to the wall of the proposed dam; Ntzebe Village is located approximately three kilometres downstream. From the point of view of a physical-environmental status appraisal, these two communities are almost self-justifying choices. Sociologically, there was equally a need to appraise the prevailing social sentiments in a typical (soon to be) 'dam wall' community, as well as in one that lies a few kilometres downstream. As indicated above, both communities – like the rest of the broad network of villages of which they form part – share striking similarities – physically, socio-economically and culturally. The main

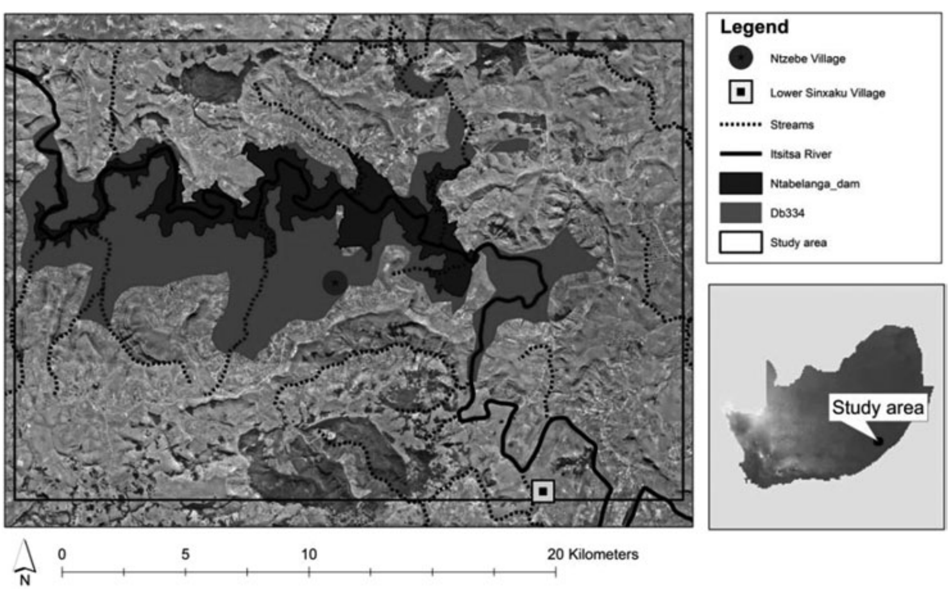

Figure 1. The proposed dam footprint (courtesy of DWA and Jeffares & Green (Pty) Ltd.), dominant streams and location of communities in the study area.

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economic activities of the greater majority of residents, but especially elderly men and women, is livestock farming and subsistence crop production. Although the younger men play a visible role (as herders) in the livestock sub-economy, they do not describe themselves as being 'centrally involved' in farming. Strikingly absent in both communities are modern commercial activities, at whatever subsistence level. For instance, there were no spaza shops. The hub of buying and selling for the two villages were the towns of Maclear and Tsolo, respectively.

Quantifying the extent of erosion

The extent of erosion was determined by visually identifying and demarcating erosion gullies from 1:10,000 aerial images using Global Mapper v14.2.1 (Blue Marble Geographics, 2013). This method only accounted for gully erosion and not for sheet and/or interrill erosion. Land types (Land Type Survey Staff, 1972–2006) were used to explain the prominence of erosion in certain areas. A land type is an area with similar climate, topography and soil distribution patterns at a scale of 1:250,000. ArcMap v10.1 (Environmental Systems Research Institute, 2010) software was used for all GIS-related work, except for the identification of the erosion gullies.

Determining the erosion sensitive areas in land type Db344

Land type Db344 covers large areas (7 417 ha) adjacent to the dam (Figure 1). This land type was selected to identify erosion sensitive areas based predominantly on surface colours. Large areas of the surface in the Db344 have been exposed either by erosion or by cultivation, and prominent red and grey colours could be identified and were demarcated manually using ArcMap. The surface colours reflect inter alia the geological formation and soil moisture regime and can therefore be interpreted in relation to the sensitivity to erosion (Table 1). The vegetative cover of some areas in Db344 was too dense to accurately identify the surface colour. The sensitivity to erosion of these areas was determined with approach similar to that followed by Van Zijl, Le Roux, and Turner (2013), where the sensitivity to erosion was determined by the ability of the land to promote overland flow (Table 1). Soil associations are groups of soil that will behave similarly with respect to a certain characteristic. Db344 was divided into three soil

Table 1. Surface colour, interpretation and soil association group of land type Db344.

Surface colour	Interpretation	Sensitivity to erosion[a]
Grey	Parent material: mudstone. Saturation of surface horizon, leading to bleached colours of A-horizon. Removal of dark-coloured surface horizon, subsurface horizons exposed. Complete removal of solum, mudstone exposed. High Na content	High
Red	Parent material: dolerite. Free drained soils. Stable and rich in Ca and Mg	Low
Vegetative cover	Steep (> 10%) convex slopes: overland flow likely	High
	Concave positions with flow accumulation (> 100 cells): promote gully erosion	
	Moderate (3–10%) convex and concave slopes with limited flow accumulation: overland flow possible but not dominant	Moderate
	Flat areas (slope < 3%) overland flow unlikely	Low

[a] Soil association group.

association groups in terms of the sensitivity to erosion based on the surface colour and soil forms occurring in the area as reported in the land type inventory (Land Type Survey Staff, 1972–2006).

Soil forms as classified by the South African Soil Classification System (Soil Classification Working Group, 1991) encompass a number of different properties which can be interpreted in terms of sensitivity to erosion. The accuracy of the soil association map was determined by classifying 43 randomly distributed soil profiles in accordance with the South African Soil Classification System and relating the classification to the sensitivity of the soils to erosion in terms of the three soil association groups.

Collecting the sociological and agricultural data

Focus group discussions (FGDs) and in-depth interviews were held in the two communities. Three FGDs were held in Lower Sinxaku Village among a purposively constituted, mixed group of elderly residents (males and females), a women-only group and a youth-only group (males and females). Two FGDs were held in Ntzebe Village – among purposively constituted groups of 'elders' and 'youth'. In addition, a subset of FGD participants in the two villages was selected as in-depth interview respondents. The sociological data were collected over two days (13 and 14 June 2013). The June 2013 data collection was preceded by an initial visit to the communities earlier in the year by the authors. Contacts made with the Headmen and other residents of the two villages during the initial visit enabled the researchers to properly plan the June 2013 data collection. The FGDs and interviews took place in neutral venues (primary school classrooms) were conducted in IsiXhosa (the main language spoken in the area), recorded on digital audio devices and later transcribed by the research assistants. Visual data (photographs) were collected during the two visits. In keeping with good social research practice, all respondents signed informed consent/voluntary participation forms.

To ensure that the study helped to shed light on both concrete community development issues relating to the dam project in question and on broader issues of sociological scholarship, the researchers dissected the research question ('What do the local people perceive to be the potential socio-economic benefits of the proposed dam?') utilising a humanistic sociological approach (specifically, 'sociology of hope') and the asset-based community development (ABCD) framework. One interesting insight in humanistic sociology is that communities possess an inner resilience and a deeper rationality that transcend the outer decay, poverty and brokenness that appear to define their social existence. It is such resilience and rationality that enable community members to sometimes achieve success despite daunting socio-economic adversity. It is within the discourse of hope that conventional sociology – and conventional social science in general – has been, rightly, criticised for being unduly fixated with 'aspects of social phenomena that merely present a shock value' (Akpan, 2010) and for being obsessed with pathology and the negative (Glass, 1970; Jeffries, 1999). The study was thus guided by a need to understand the dam communities from a perspective of hope rather than simply of deficit, poverty, despair and brokenness.

Utilised as a complementary conceptual resource, 'asset-based community development' helped the researchers to interrogate the extent to which the community members were likely to convert the proposed dam into, among other things, an economic opportunity. The 'asset perspective' emphasises a shift from a view of community as an eternal target of charity and welfare to that of a community as a repository of 'assets' – a treasure trove of strengths, talents and opportunities. In other words, while dam was a

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government-sponsored project, could the community claim it as a developmental asset, and could this be done in a realistic way?

Results

The extent of erosion

The extent of eroded land overlain on different broad land types in the study area is presented in Figure 2. Approximately 3°820 ha have been severely eroded. Erosion is prominent on Db, Fa and Ab land types with approximately 30%, 18% and 15% of the land affected by gully erosion, respectively.

Fa land types are young landscapes and with shallow soils on relatively steep slopes. The shallow depth and steep slopes limit the suitability of Fa land types for crop production and increase the likelihood of erosion occurring.

Ab land types refer to regions where freely drained yellow and red dystrophic and mesotrophic soils occupy more than 40% of the land area. The soils of Ab land types are generally considered to be good for crop production and suitable for irrigation with low sensitivity to erosion. It was therefore rather surprising to observe the degree of erosion on these land types. Aerial photographs suggest that gully erosion originates on old cultivated lands (Figure 3). Even with contouring the removal of natural vegetation and disruption of the soil structure by cultivation resulted in significant erosion on these land types.

In Db land types, duplex soils with non-red B horizons cover more than 50% of the land area (Land Type Survey Staff, 1972–2006). These soils are prone to erosion; the textural discontinuity often results in the generation of lateral flow and the B horizons are often marked by high Na contents making the soils highly dispersive, especially for duplex soils formed on Beaufort sediments.

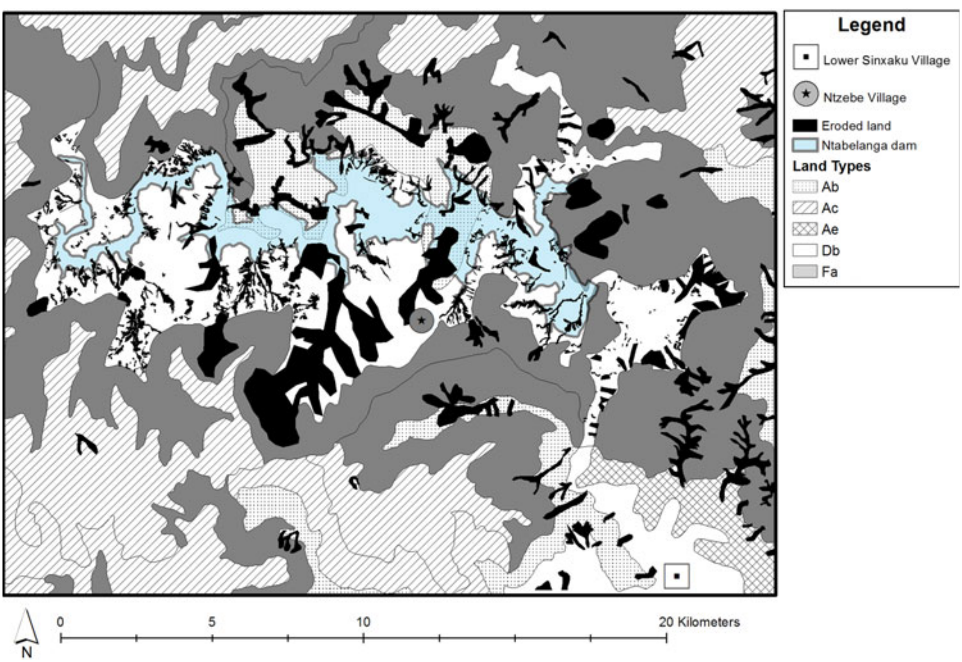

Figure 2. Severely eroded land and broad land types of the study area.

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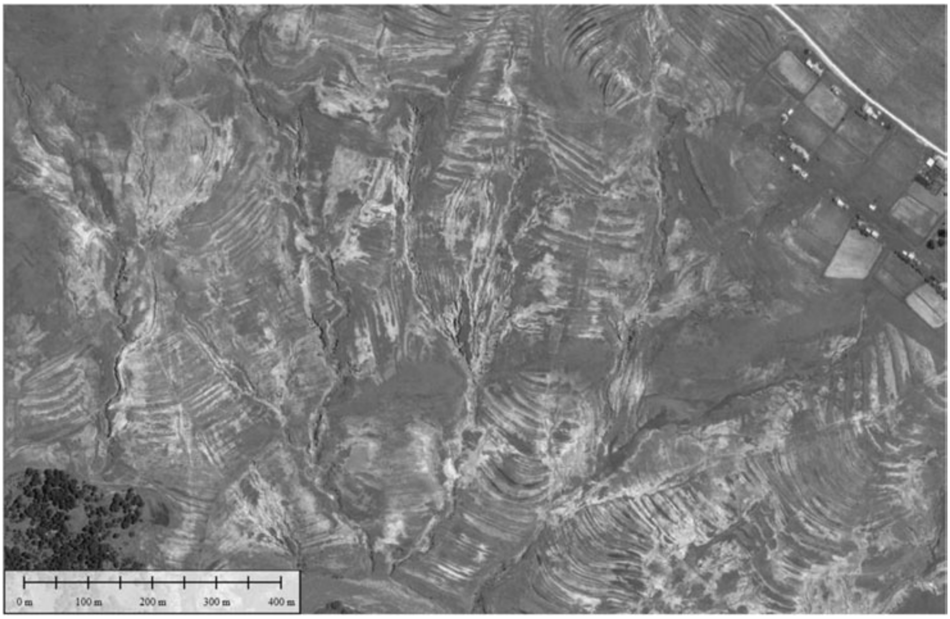

Figure 3. An example of gully erosion commencing on old cultivated lands in land type Ab.

Distribution of erosion sensitive soils in Db344

The coverage of erosion sensitive soils in land type Db344 is presented in Figure 4. This soil association map was validated using 43 randomly distributed profiles classified according to the South African Soil Taxonomy (Soil Classification Working Group, 1991). These observations and their sensitivity to erosion is briefly summarised in Table 2.

The erosion sensitivity was predicted correctly for 31 of the observation, yielding an acceptable map accuracy of 72% according to Van Zijl et al. (2013). Noteworthy is that the

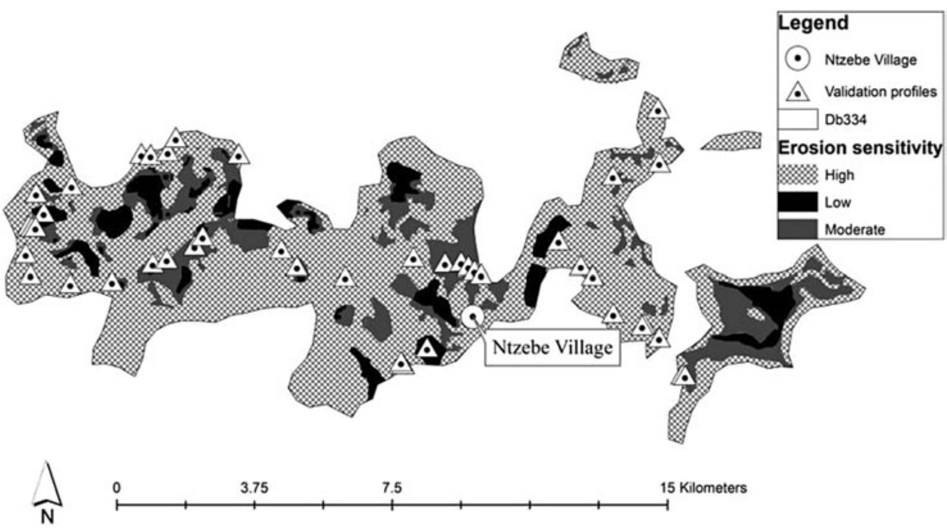

Figure 4. Sensitivity of soils to erosion in land type Db344.

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Table 2. Summary of soil observations and their sensitivity to erosion in Db344 (the number following the soil form indicates the frequency of occurrence).

Soil forms	Erosion sensitivity
Cartref (1), Glenrosa (2), Katspruit (7), Mispah (6), Sterkspruit (9), Westleigh (1)	High
Bonheim (1), Valsrivier (4)	Moderate
Avalon (1), Dundee (1), Hutton (1), Montagu (2), Mayo (3), Oakleaf (2), Tukulu (2)	Low

majority of erroneous predictions was between 'moderate' and 'low' sensitivity classes (75% of error).

Only 756 ha (10.2%) of the soils in Db344 have a low sensitivity to erosion. The majority (5°286 ha or 71.3%) of Db344 is covered by soils highly sensitive to erosion with the remaining 1375 ha (18.5%) having moderate sensitivity to erosion. Current crop production practices are closely associated with the soils having low sensitivity to erosion. Based on the extent of eroded land (Figure 2) and the dominance of soils with high sensitivity to erosion (Figure 4), any large-scale expansion of crop production practices seems unlikely on Db344.

Dam dividends: anticipations and narratives from below

As expected, the dam-environment and dam-livelihoods nexus came out strongly in the narratives gathered in the two study communities – a clear indication that these are important dynamics upon which the socio-ecological sustainability of the multi-purpose Ntabelanga dam could depend. However, a sociologically interesting problem is confronting a situation where science facts (about soil erosion, as presented above) could clash with local conceptions and misconceptions about both this phenomenon and the putative benefits of a large dam.

One striking finding made during the initial visit to the communities in March 2013 and during the formal data collection visit in June was the near-total absence of awareness about the dam project in the two communities. Local residents in the two communities had virtually no awareness that there was a project of that magnitude coming to the area, nor were they knowledgeable about important scientific facts about how the project might benefit them, and how they must prepare for the array of attendant consequences. This was surprising considering that by the time of the researchers' initial field visit in March 2013, the dam had featured prominently in the South African President's State of the Union Address earlier in the year. By the second field visit, a nationally televised Parliamentary Speech by the Minister of Water Affairs, in May 2013, had further brought news of the proposed Ntabelanga dam to the South African public. The size of the proposed dam (seventh biggest in South Africa), its importance in the scheme of national infrastructure priorities (the much-publicised 'infrastructure build' programme) and its potential social and environmental impact all make the dam a pivotal project, especially considering the impoverished social backdrop of its location. The fact that even members of the 'dam wall' community lacked awareness about the project was difficult to explain.

So that the awareness gaps did not create credibility gaps in the data collection process – but also, in order that the entire research endeavour did not amount to false alarm – participants were informed about both the President's 2013 State of the Nation Address and the Water Affairs Minister's 2013 Budget Speech in which the proposed dam was

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underlined as urgent, important and impending. Appropriate verbal and visual techniques were employed to give the participants an idea of the size of the proposed dam. The point was to create the right levels of intersubjectivity, since the term ‘dam’ is widely used in the study communities to describe what should more accurately be termed a ‘pond’. None of the research participants had yet seen a dam of the magnitude and scale proposed for the Mzimvubu River Basin.

Despite the fact that almost every FGD participant prefaced his or her remarks with strong scepticism about such a project ever materialising, participants’ imaginings of the dam-environment, dam-livelihoods intersect was one of optimism and excitement. For the participants, the multi-purpose dam heralded renewal and development:

> We would like to have a proper irrigation scheme so that we could access water, so that we could start planting. Our community used to be sustained through planting crops. We want to plant crops again. The existing river (Tsitsa River) doesn’t help much. Having this new big dam will change the people’s lives for better; we would then be able to feed our families through agriculture. (Elderly FGD participant, Lower Sinxaku)

It seemed noteworthy that respondents appeared to want to return, using the new irrigation possibilities offered by the dam, to a ‘past’ in which crop production suffered lesser stress, or be transported to a future of water abundance for agriculture and other purposes:

> We do not have anything that we depend on, we no longer have big harvest; we now only plant crops in good season. We do not have crops in winter as we do not have water supply, we only depend on the rain to water our crops. (Participant, Women FGD, Lower Sinxaku)

Hopes were expressed that the dam would usher in a new era of economic opportunities and self-reliance, especially given the prevailing unemployment and social-grant dependency in the community.

The data suggested that ordinary community members were prepared to leverage the livelihoods and empowerment opportunities offered by the dam. The list of irrigation-related expectations included the following:

(1) Acquisition of better agricultural skills – for commercial agriculture (moving beyond subsistence farming);
(2) Improved growth in agricultural production due to better irrigation;
(3) Improved community nutritional status (ready availability of milk from healthy, cabbage-fed cows); and
(4) Healthier livestock production due to better irrigated grazing fields.

Turning to the crucial issue of soil erosion, the researchers found a high level of awareness of the problem among the interviewees and FGD participants. Most respondents reported that erosion had become ‘worse’ in the community over the years.

Surprisingly, there was little direct mention of erosion as a possible reason for the low agricultural output in the community. The silence in this regard was noted particularly among the youth respondents, who maintained that they were not ‘familiar’ with crop farming (‘we are not very familiar with crop production, the crop fields are at the bottom of the stream’ – as one FGD participant in Lower Sinxaku pointed out). The direct impacts reported by most participants were mostly related to housing, community artefacts and other facets of social existence. The remarks below were recurrent in the various FGDs sessions:

> It is erosion that has caused the cracks you see on the walls of people’s houses here. Because of those cracks, some of the houses have collapsed; only walls are left as evidence that there

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> were houses. Graves have also been affected by the erosion. (FGD participant, Lower Sinxaku)

Respondents blamed the pervasive erosion on 'water from the mountains'. One FGD participant elaborated as follows about soil erosion causation – a view shared by most of interviewees and FGD participants:

> The village is situated under the mountain; because of this water from the mountain – after it rains – finds it difficult to go into the soil. The water just flows and that is the cause of erosion.

As a way of stopping or preventing erosion in coming closer to the houses, they said that they used to have 'IZIKREKELA' which is the process whereby both men and women carry big stones to stop the furthering of erosion (Interview, Lower Sinxaku).

A number of FGD participants and interview respondents in the two communities were also of the view that the introduction of a good irrigation system would help to control rainwater, and thus curtail erosion.

Discussion

The foregoing findings reveal, among other things, intrinsic ideational divergence between science facts about soil erosion in the two communities and rural narratives about, especially, the anticipated agricultural dividends of the Ntabelanga dam. The divergence relates not necessarily to what rural citizens viewed as the causes and consequences of soil erosion, vis-à-vis the geophysical data presented earlier; rather, it is about the fact that local residents expect that, through improved irrigation, the dam would drive large-scale expansion of agricultural activities in the area.

As demonstrated earlier, of the five land types identified in the study area (noted earlier as Db, Fa, Ab, Ac and Ae), two of these (Db and Fa) have been rendered virtually useless from the point of view of large-scale crop farming, by reason of erosion. Soil type Ab is ordinarily known to be irrigation- and crop-friendly because of its low erosion sensitivity. However, in the study communities, even the land areas with this soil type have been devastated by gully erosion. There is a further irony: the widespread gully erosion shown in Figure 3 appears to originate from the previously cultivated areas. The implication here is that due to the prevalence of erosion-sensitive soil types in the study communities any attempt to expand crop cultivation has the likelihood of eventuating large-scale topsoil denudation and complicating the erosion problem.

Why then are the local residents, knowledgeable as they are about the extent and destructive impacts of soil erosion – and about erosion 'causation' – oblivious to the possibility that large-scale 'improvement' in irrigation was neither possible nor likely to make a difference by way of engendering large-scale crop farming in the study area? Indeed, why do local residents hang their hopes on all of the redeeming potentials enumerated earlier?

One possible explanation is that local knowledge about the physical environment – and development interventions – only goes so far. It has the crucial attribute of making the complex seem simple, and the simple, complex; of making facts out of fiction and vice versa. In so far as the multi-purpose dam project is being profiled as 'pivotal development infrastructure', rural people, especially the poor and marginalised, are bound to see it as cornucopia (Biswas, 2004). This outlook may well fit into what Akpan (2010) has termed indigenous 'rationality of hope'. However, the problem is that the ideational divergence highlighted in this study is a veritable seedbed of future grass-roots opposition to the dam project, or the so-called 'dam conflict' (Akpan, 2006; Raina, 2000).

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To avert such conflict, or at least keep it at a minimum, it is imperative that communities become stakeholders, and are fully aware of the *true* benefits and risks, of major development projects. More than anything else, this level of engagement is important for bridging the gap between science facts and local knowledge, and prepares all stakeholders to keep their anticipations at a realistic level. The one surprising finding reported in this regard is that of very low awareness among community members about the fact that Ntabelanga was soon to become the host community of South Africa's seventh biggest dam.

Conclusion

There are various soil types in the host communities of the proposed Ntabelanga dam, with varying degrees of sensitivity to soil erosion, and hence varying levels of ability to support large-scale irrigation and crop farming. Although the soil types with low-to-medium erosion sensitivity – that is soil types that can support large-scale crop farming – occur in only a small land area, even this area is devastated by gully erosion. The gully erosion appears to originate from the previously cultivated areas – an indication that crop cultivation is itself a threat to the sustainability of the physical environment in the study area. Due to high erosion sensitivity, the greater portion of the land in the study area is hopelessly unsuitable for either large-scale irrigation or crop farming. However, community members see the proposed Ntabelanga dam as holding the key to a vibrant future of commercial agriculture.

Despite this ideational divergence, the foregoing findings and discussion also suggest that science facts and local knowledge about the geophysical environment and development interventions are not necessarily irreconcilable. In the case of the two Ntabelanga villages, what gives the impression of irreconcilability – and what could sow the seeds of future dam conflict – is the absence of prior mutual engagement between the government and the communities before the commencement of this major project. An avoidable, conflict-inducing scenario appears to have been created through the way the dam project has progressed. Local residents could end up viewing science facts as an imposition, while dam developers could view local knowledge about the geophysical environment as 'fiction' and their anticipations about an impending dam-community and dam-environment nexus as misplaced.

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