Rural Communities, Scientists and Soil Erosion:

Common Ground at Cornfields?

G. G. Garland* & K. Pile**

• Geographical & Environmental Sciences, University of Natal, Durban, 4041, South Africa.
**** *Present address*: Geography & Environmental Studies, Wits University, Private Bag 3, Wits 2050, South Africa**

1. Abstract

Rural communities are often subject to pressures that threaten their survival, and soil erosion has been identified as one factor that can lead to the decline in living standards of a community. In the study we analyzed community perceptions of soil erosion and compared them to a scientific physical appraisal of land erosion at Cornfields, a 600 ha African freehold area with a current population of almost 2 500, near Estcourt in KwaZulu Natal, South Africa. Although agriculture is practiced and produce is an important contribution to household survival, the community has other sources of income in the form of pensions and remittances from migrant labour. Some residents own their land by title deed; others are tenants.

A scientific survey of the area encompassing geology, soil, rainfall and slope characteristics was the precursor to field and air photo analysis of current and historical aspects of soil erosion and an attempt to model current sediment yield. This was followed by an assessment of community perceptions of erosion elicited by semi-structured interviews, focus group interviews and community meetings.

Finally, results of the scientific and community surveys were compared with a view to establishing differences and similarities between opinions of scientists and those of the Cornfields community with respect to soil erosion. In general there was a fair degree of correspondence between the two groups. Both scientists and the community agreed that severe erosion was present at Cornfields, that the length of time the area had been settled has led to significant degradation and that excess runoff was the route cause of soil loss. There was less agreement on factors that caused in excessive runoff.

We were able to conclude that scientific and community evaluations of erosion were by no means as disparate as we expected them to be at the beginning of the work. In addition, since the study took place right at the end of the apartheid era of government, it provides a useful benchmark against which future changes of attitude, and soil conservation progress under a new dispensation might be measured.

2. Why Study Soil Erosion at Cornfields?

2.1 Land and Living Standards

Rural communities are often subject to which threaten their survival. Soil erosion and accompanying land degradation are typical of such stresses, and efforts to incorporate an

understanding of the land users role in soil conservation have been made internationally (Blaikie 1985; Stocking 1994). However there has been little research on the topic in KwaZulu Natal, and South Africa's political history has meant that state and development agencies involved in conservation have been slow to pick up this trend. In the light of nation-wide plans for reconstruction and development, a conservation policy that meets the needs of previously disenfranchised land users in a more democratic and effective fashion is in the process of development. There is much research to show that technological knowledge required to solve most erosion problems has been available for years, but experience with development has demonstrated that effective solutions require a sound knowledge of social, political and economic factors. Both Blaikie (1985) and Anderson and Grove (1987) suggest that environmental degradation is frequently place specific and that decisions concerning the implementation of soil conservation methods are largely affected by social and political subsystems. These influence the ways in which farms acquire knowledge and evaluate information, and also affect the nature of conservation policies and the organisations and institutions responsible for their implementation. In line with such international findings some South African researchers (Broderick 1987; Watson 1990) have called for land user's perceptions and attitudes to be considered, and for the broader political context to be brought into the purview of the practice and study of soil conservation methods.

We were first introduced to the Cornfields Community by AFRA, an NGO dealing mainly with land rights. Living standards at Cornfields are coming under continual pressure as population increases, although it is impossible for the community to expand their land holdings. Our overall aim was to investigate soil erosion in the area, and to try to establish the attitudes of the community to soil erosion and conservation

3. Social and Physical Conditions at Cornfields

3.1 Historical and social background

Cornfields farm is an area of 600 ha (1483 acres) located about 10 km NE of Estcourt, KwaZulu Natal. It presently supports a population of about 6 000 people (Bromberg 1991). It was originally established as a freehold area in the 1900's, having been purchased by the Reverend Cullen Wilcox, a baptist minister, with the intention of selling off the freehold to african people. He subdivided the site into a township of half-acre stands, with additional agricultural smallholdings of between 5 and 40 acres (Merrett 1991). During the period 1960-70 Cornfields, along with many other areas experienced a rapid growth in population, as evictions of black labourers from adjacent white farms gained pace. Effectively Cornfields became a dumping ground for surplus population, placing already exploited resources under even more pressure (Marcus 1989). Possibility for development in the community was severely restricted. The present situation is that some of the land is owned by African occupiers, some is leased to tenants, and some is controlled by the State, which took over plots from those who had accepted resettlement by the Government. The future of state-owned land is unclear, and it is very difficult to track down which government department has responsible responsibility for administration.

In 1937 there were 910 cattle in the area - a number far in excess of the recommended carrying capacity of 1 beast per 6 ha of land (Twiddy 1993). By 1946 the stocking figure was seven times higher than recommended figures (Merrett 1991). In 1948 the Secretary for Native Affairs contacted the Soil Conservation Board proposing that Cornfields be brought under control of the Soil Conservation Act of 1946. The Act empowered the Minister of Agriculture to form management strategies for any land that was severely eroded. It included measures to

protect land, soil and water, and measures for the control of stock grazing, and sub-letting to tenants. Thus from the mid forties onwards land degradation problems had been recognized, yet there is no record of any state initiated measures or encouragement to solve the problems. Since then the condition of the land and its ability produce has further declined. Most crops are for personal consumption, but harvests are small, and too unreliable to provide continuos nourishment.

Old people predominate in the community, and one of the main sources of income is a pension. Other sources include collecting firewood, making grass mats, rents from tenants and migrant labour. Potential for work in the immediate area was dealt a crippling blow in 1980 when nearby Colenso Power Station, a significant employer in the region, closed down. Some of the more fortunate residents have jobs in industry or as government employees, but these jobs are only in distant larger towns, some times as far away as Durban, some 200 km eastwards.

The community faces a number of problems. These include lack of infrastructural development such as roads, bridges, schools, electricity and water, and a shortage of grazing land. For various reasons the proposed “Thukela Biosphere” - a scheme to link a number of adjoining properties in the region in a conservation initiative is perceived as threat. The community believes that, if the Biosphere plan goes ahead, then their cattle will be moved to grazing land several kilometers distant, since cattle are not endemic in the area. All these problems are exacerbated by conflicts over grazing with adjoining white farmers, who often impound cattle from Cornfields that stray onto their land. Despite these difficulties Cornfields seems to be a peaceful and well-run community, where decisions are made by a democratically elected management committee.

3.2 The Physical-Geography of Cornfields

Mean annual rainfall for Estcourt, the nearest station, is 742mm. Only three months can expect more than l00mm, and there are on average 82 rain days per year. Mean annual erosion, at between 200 and 300 EI units (Smithen 1981) is not particularly high.

Underlying geology is dominated by weak, thinly bedded shales, siltstones and sandstones of the Estcourt Formation in the Beaufort Group, with occasional outcrops of Drakensberg dolerite. The shales once exposed have little resistance to erosion, but more significant, almost half of Cornfields is overlain by partly consolidated sediments, laterites and clays of the Quaternary Masotcheni Formation, a lithology in which much of the severe gullying in Natal occurs (Botha 1992).

Thirty-eight percent of the area has either extremely shallow stony soils, or no soil at all. Close to 40% of Cornfields supports duplex soils of the Estcourt and Uitvlugt Forms. These are amongst the most erodible soils in the country - SA Sugar Association have measured K values in the order of 0,3 (Platford 1979). This is almost certainly attributable to dispersibility caused by high ESP values.

The area is southwest facing and slopes are generally in excess of 10%, greater than that recommended for arable agriculture. Rainfall, soil and slope therefore combine to make Cornfields a marginal agricultural area at best, and slope and soil conditions render it highly susceptible to erosion.

4. Research Methods and Community Participation

Community-based research is always sensitive, especially when emotive issues like land are concerned. We felt it important to include the Management Committee or where possible the community as a whole at all stages of the work. With this in mind, after the initial approach a

number of workshops and meetings were convened with the help of AFRA. They served to introduce our researchers to Cornfields, and to appraise the community of the scientific objectives of the study.
The methods employed in this section of the work are grounded in the traditions of qualitative research (Knoedel 1989). For the perception work we decided on semi-structured interviews with the members of 22 households, using male and female interpreters to avoid gender bias. People from properties of different sizes, locations and degrees of erosion, both male and female household heads, and owners and tenants were included. The questionnaire, designed to stmulate conversation rather than elicit precise responses, first requested general information on land use, crops, numbers of livestock, perceptions of land fertility. It then went on to consider soil erosion in particular, and posed the questions:

- Do you think Cornfields is badly eroded?
- Why do you think that this is so?
- What causes soil erosion?
- How have you tried to combat soil erosion?
- What do you think that the community should do about this?
- Do you think it is possible to do anything badly eroded land?
- If so, what? If not, where do we go from here?

The interviews were backed up by focused group interviews with owners, tenants, and women farmers, conducted in such a way that the research team would simply approach a group of people, such as women collecting water. This was particularly successful in that in such informal conditions people were eager to discuss their problems. Finally, two community workshops each attended by about 120 people were held after the main survey.
The scientific assessment of the state and nature of erosion used historical information, air photos and field survey in an attempt to gain understanding of the nature and rates of soil loss. The data was then imported into IDRISI, a GIS package, for storage and representation.

5. Results of Questionnaire Survey, Interviews and Workshops

5.1 Agricultural Activity

Although some tenants, usually those with other jobs, elect not to farm the land, most residents try to grow something. Crops are usually for personal consumption, with pumpkin, beans, mealies and potatoes the main products. Many people have one or two apple or peach trees on their land. Ploughing is difficult and expensive, especially for those without cattle. When possible animal dung is used as fertilizer, and many residents expressed the wish to use chemical fertilizer, but were unable to afford it. They would also like to grow vegetables like spinach, but water is insufficient. This could change if an AFRA project to store and distribute water at Cornfields is successful. Cattle, although individually owned, wander and graze freely. Lack of fencing due to prohibitive costs means that they often stray onto arable lands and destroy crops. Cattle ownership and control is a particularly contentious topic. The Management Committee has tried to limit cattle numbers to 6 per household, but this seems to be unenforceable. Some occupants felt that the committee should not make rules about cattle, since they are the basis of many livelihoods. Owner-occupiers feel that several tenants have far too many cattle. A major problem cited by many was the lack of grazing land for cattle, and some residents said they would buy more land if any were available. Some neighbouring farmers encourage residents to graze goats on their land, as they tend to inhibit bush encroachment. Firewood is in continual demand,

although cutting down trees in common areas is forbidden. There has been no agricultural support service at Cornfields since its establishment.

6. Community Perceptions of Erosion at Cornfields

- **Is erosion a problem ?**

There is a general perception that erosion has increased and land is degrading, with an accompanying fall in fertility. Evidence cited includes development of gullies on previously ploughed land. Respondents seem to be aware of the link between soil loss and low production. One resident thought soil loss was decreasing, due to the fact that material brought down from the upper parts of catchments had been trapped in lower reaches of some gullies during the 1987 floods. The same man had also observed that some gullies were closing, and that many were not becoming deeper, as they had reached a local base level of resistant strata. Some respondents noted that Cornfields land was more eroded that of neighbouring white farmers.

- **What causes erosion**?

Respondents put forward several alternative causes of erosion;, a few natural and many linked to land use. Of the natural causes there is a strong suggestion that insufficient rainfall in general, and drought in particular irresponsible, since it reduces grass cover, which protects the ground. One resident thought that rain falling at an angle was the main problem - vertical rainfall was fairly benign. Others claimed that too much rainfall caused water to flow off the land, and not to soak in. Of land use causes, one of the strongest to come through in both questionnaires and community workshops was the role of footpaths, cattle tracks and poorly constructed roads in gathering and concentrating runoff. Equally to blame in the eyes of some was open, unused land. If a patch of land is not used for a long period it starts to erode. Several felt that the “absentee landlord-tenant” combination was bad, since neither the tenants nor the landlord cared for the land. Although some people believed that cattle were a contributory cause to soil loss increases the opinion was by no means universal. Similarly only one resident interviewed thought that there was a link between cropping and erosion.

- **What does not cause erosion?**

Many felt quite strongly that ploughing and associated activities do not encourage erosion - “There are no dongas on ploughed land”.

6.1 Erosion Solutions

There is no doubt that Cornfields residents feel erosion can be reduced, and they had a number of ideas on the subject. However it is noteworthy that many consider both soil loss and solutions to land degradation to be an integral part of the broader problems of finance, infrastructure, lack of water, poor community relations, inadequate land, uncertain tenure and so on. If these could be resolved then land degradation would cease. Nonetheless the committee and other residents thought that responsibility for rehabilitation and other necessary conservation work should lie with the Management Committee and the government, although with sufficient finance and tuition residents considered it possible to undertake rehabilitation themselves, or to contract outside help.

7. The Scientific Evaluation of Erosion

7.1 Current Extent of Erosion

Field inspection shows that sheet erosion is present almost everywhere, and is particularly severe on bare, compact ground near dwellings and other buildings. Similarly it is the norm on most cropped land. Paths, tracks and road drains not near buildings also account for significant soil loss.
Two sections of land together accounting for about 16% of the total are so severely affected by gully erosion that the topsoil has been entirely removed, and gullies have entrenched themselves to depths of a meter or more in underlying bedrock. No evidence of soil piping was noted.

7.2 Rates of Erosion

Without regular monitoring it is impossible to offer any reliable quantification of erosion rates. Certainly sheet wash is occurring, and most gullies at Cornfields are still actively eroding their sides and headwalls It is clear from the oldest air photos of the region, flown in 1944, that all the major gully systems were in place well before the 40's. There is no information available on the state of the land prior to the 1940's, but the shear size and severity of the gully systems suggests that they must be quite old features.

The state of the' land at the turn of the century, when Cornfields first became an African freehold area is something on which we have no firm knowledge. However it does seem unlikely that the Reverend Wilcox would have offered badly degraded terrain for agricultural use.

In 1942 the Assistant Native Commissioner from Estcourt wrote of Cornfields that: "The owners of these arable lands are leasing them to other Natives who have been ejected from farms. Newcomers have brought their stock onto the property and are making use of the grazing ground, with the result that most of the stock is being grazed on adjoining farms. The conditions on this farm are appalling and the land as we find it today is almost beyond repair".

No measured rates of soil loss for the Cornfields area exist, and since reliable measurements take several years to obtain they were well beyond the scope of this study. Soil loss estimates using standard empirical and semi-deterministic models are notoriously unreliable (Stocking 1993), and anyway were not possible for Cornfields due to inadequate input data. Regional assessments of other erosion parameters are for several reasons a poor substitute, but they do offer at least some indication of whether erosion at cornfields is high or low compared to the rest of the country.

For example Le Roux (1990) using a technique based on rate of accumulation of sediment in dams estimated that the annual rate of surface lowering for this region was between 0.05 and 0.075 mm yr^{-1}. Mean annual sediment yield for the relevant section of the of the Bloukransrivier catchment in which Cornfields is located, was calculated for this study using Rooseboom's (1992) empirical approach, for the determination of sediment yield for South African catchments. The result of 343 t ha^{-1} yr^{-1} is quite high but must be treated with caution since Cornfields forms a very small part of the whole catchment section. Further, sediment yield of river channels draining catchments may not accurately reflect soil losses in specific land areas, so this value may not be a good indicator of soil loss for Cornfields.

Attempts to quantify changes in erosion by stereoscopic examination of 6 generations of air photos were of limited success. Accurate measurement of erosional features was precluded by variations in scale, standard photographic distortions and changes in photographic quality. However it was clear from the photos that gully networks had not extended spatially, nor gully heads eroded back since 1944.

7.3 Causes of Erosion

Geology, soil characteristics and steep slopes combine to make Cornfields an erosion-prone area. This means that even without human influence we would still expect the region to experience soil loss. It would probably be episodic and related to short term climatic trends and extreme meteorological events. The terrain could, for example, remain relatively uneroded for a number of years, but experience cataclysmic soil losses from a long-return-period storm immediately following a drought. However this sensitivity is certainly exacerbated by current land use practices. Crop production of any sort on slopes and soils as susceptible to soil loss as those at Cornfields is certain to result in sheet erosion, and there is no doubt that this kind of agricultural activity is causing considerable soil loss.

Livestock density is difficult to assess, especially as it is a particularly sensitive and emotive issue. But casual observation suggests that it is far in excess of the carrying capacity recommended for that type of land.

Other sorts of land use are also responsible for accelerating soil loss. Soil compaction by humans and animals in the vicinity of buildings is exacerated by tracks, paths and poorly planned and maintained roads.

Of particular concern is the Cornfields graveyard. Injudiciously sited on an uneroded tract of shallow Escourt soils in the heart of one of the main gully systems, it is being eaten away at the sides by laterally expanding gullies and headward erosion. It has now reached the state where many graves are in danger of being exhumed. Expansion of the surrounding gullies is aggravated by the layout of the graves themselves. Placed in rows, the graves are usually less than 0,3m apart, the grave surfaces are raised about 0,3m above the ground surface by dry stone walls, and the surfaces are of bare, compacted soil. Narrow walkways between the graves are also bare, and livestock is permitted to range freely over the whole site. In wet periods the graveyard generates immense amounts of runoff which is channeled through the walkways and flows over into the surrounding gullies, adding to already existing flow in them. Thus an extremely efficient entrainment and transport system has been created in a situation which is anyway highly susceptible to erosion.

8. Comparison: Community versus Scientific Perceptions

8.1 Erosion Severity

Both the community and scientists conclude that erosion at Cornfields is severe, and certainly affects the quality of life of residents. Occupants of Cornfields appear not to have recognized the existence of sheet erosion, whereas scientists concluded that it was an important form of soil loss. Although community opinion is not unanimous, most residents believe soil loss has worsened over the years. Scientists are inconclusive on this point, believing that soil loss is certainly continuing at quite a high rate, although they have no evidence that rates have either accelerated or declined since Cornfields became a freehold area.

8.2 Causes of Erosion

Both scientists and residents agree that runoff is the prime cause of erosion, and that poor vegetation results in excessive runoff generation. However there is less agreement on land use factors affecting vegetal cover and runoff generation. Drought, paths, roads and tracks, and to a lesser degree overgrazing, feature in community and scientific perceptions of causes, but only the scientific view holds that the naturally high erodibility of Cornfields, arable cropping, and graveyard construction techniques are erosion-encouraging practices. Causes suggested only by the community included “unused land”, absentee landlords, and “angled” as oppose to vertical rainfall.

9. Conclusions

In general, community perceptions of erosion at Cornfields correspond quite well with the scientific soil loss evaluation. The fact that soil erosion is present and is quite severe at Cornfields was realized by most of the respondents, and the important link between soil loss and agricultural production seems to be established, as is the relationship between some natural factors and some land uses and erosion. There is evidence of this in some attempts at soil conservation work.

There is, however, a general lack of realization that land which **looks** uneroded, i.e. ploughed land producing crops, is extremely sensitive. This is vitally important in designing any soil conservation policy. In economic terms, financial return on soil conservation investment in land still in relatively good condition is far greater than that accruing from severely degraded land. Additional incremental erosion on degraded land has an almost negligible effect on economic returns, whereas there is a continual fall in return with each increment of erosion on productive land.

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