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The need for socio-economic and environmental indicators to monitor degraded ecosystem rehabilitation: a case study from Tanzania

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Abstract

This paper documents the events leading to the imminent collapse of an attempt to rehabilitate a degraded ecosystem in central Tanzania, focusing on the consequences of the failure to systematically monitor socio-economic and environmental indicators. A decision was taken in 1979 to evict all grazing livestock from a 1200 km^2 semi-arid area, the so-called Kondoa Closed Area, in central Tanzania due to their destructive effect on contour ridges and bunds that had been constructed in an attempt to arrest land degradation. Although the closure was successful in that the vegetation quickly regenerated and soil erosion was arrested, the evictions resulted in severe hardship for the agro-pastoralists in the area. As a result, it was decided a decade later to allow the reintroduction of cattle on condition that they were totally confined and were of improved dairy breeds. Although performance and economic data have generally been positive, the top–down approach to the introduction of the cows, the lack of baseline data, followed by the withdrawal of external funding, have resulted in increased illegal free-grazing and the near collapse of the attempt to convert a degraded ecosystem to sustainable use. It is concluded that the probable collapse of the ecosystem in the Kondoa Closed Area is a result of the initial top–down approach to the introduction and implementation of the project, inadequate monitoring of socio-economic and environmental indicators, and ultimately to the withdrawal of donor funding.

Keywords: Degraded ecosystems; Livestock; Tanzania; Environmental indicators; Socio-economic indicators

1. Background

A soil conservation program, the HADO (Dodoma Soil Conservation) project was started in central Tanzania in 1973 with the main objective of arresting land degradation in a rapidly deteriorating area through physical soil conservation measures. However, it quickly became apparent that these were not having the desired effect, mainly due to their destruction by grazing livestock and uncontrolled water runoff from higher slopes denuded by overgrazing. As a result a political decision was taken in 1979 to close the most severely affected area of over 1200 km^2, the so-called Kondoa Closed Area (Fig. 1), to grazing livestock, which involved the eviction of over 85,000 cattle, goats, sheep and donkeys.

The regeneration of the vegetation and the arrest of ecological degradation in the area were initially dramatic. However, the decision caused severe hardship to the agro-pastoral societies in the region, as mortality in some of the evicted herds that were moved to the surrounding plains was reportedly around 50% or more (Östberg, 1986). The local livestock owners were given to understand that some form of livestock keeping would be allowed when the land had recovered,

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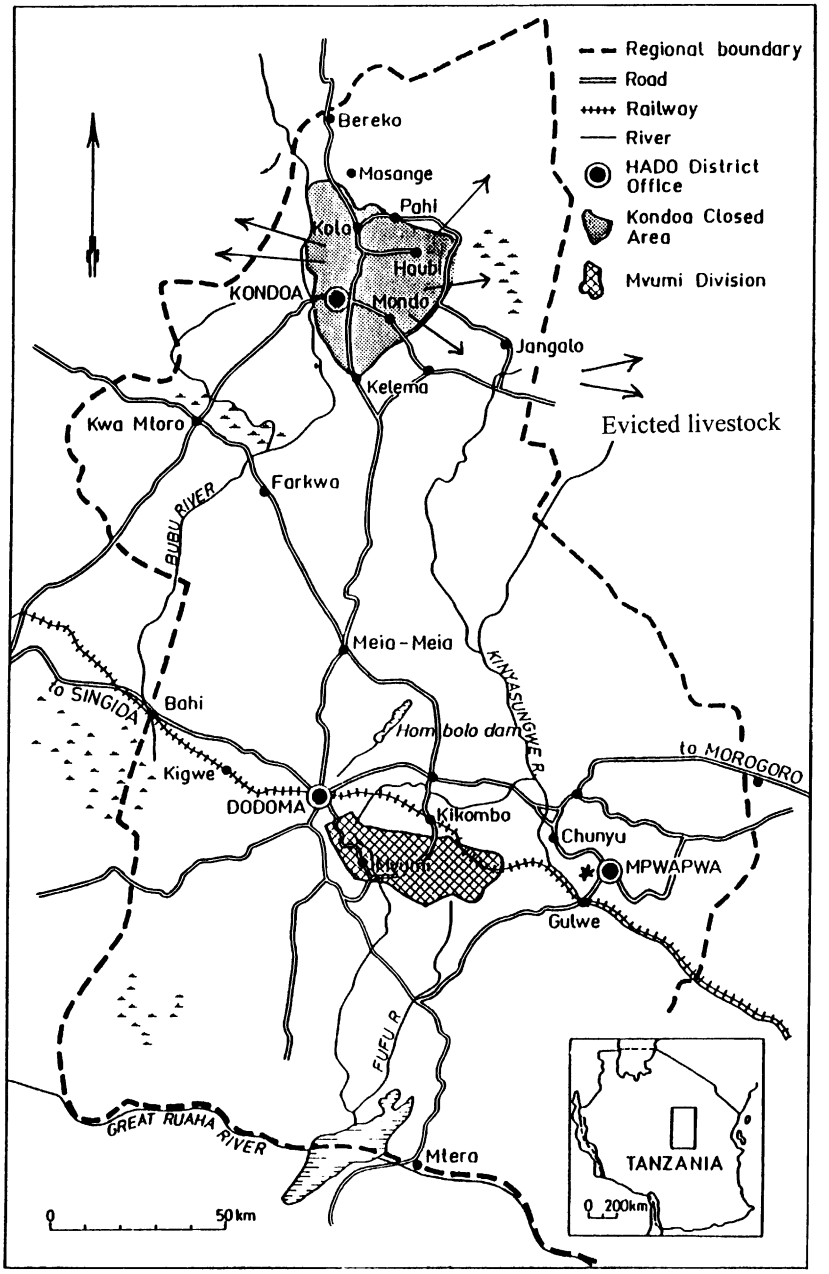

Fig. 1. Dodoma region, with the Kondoa Closed Area marked, and areas to which evicted livestock were moved.

and, as it was generally accepted that to attempt to restrict herd sizes under traditional grazing systems would not have been feasible, the government of Tanzania decided to allow the introduction in the closed areas of some form of stall-feeding system as the only real alternative. These were introduced in 1989, and focused on zero-grazing systems for improved dairy cattle.

Because of the withdrawal of donor funding, however, there is once again the danger of imminent collapse of the ecosystem in the Kondoa Closed Area. This paper attempts to outline the sequence of events leading to the present situation, and discusses the contribution to the collapse of the ecosystem of the initial top–down approach to the introduction and implementation of the project, the lack of baseline data and the failure to systematically monitor the effects of the interventions, particularly with respect to farmer-generated indicators.

2. Project design and implementation

2.1. Administration and donor support

The HADO program was financed mainly by the Swedish International Development Authority (SIDA), while the livestock component was supported from 1989 up to the end of 1996 by another Swedish development agency whose mandate is research co-operation (SAREC). Considerable problems resulted from the fact that the HADO program was administered by the Division of Forestry and Bee-keeping of the Tanzanian Ministry of Tourism, Natural Resources and Environment, and was never linked with the Ministry of Agriculture and Livestock or integrated with the regional and district administrative organizations. The initial focus was on the establishment of nurseries and tree planting, with little emphasis on crop or livestock production, on which the people of the area were and are dependent. The SAREC zero-grazing project, which started in 1989 in co-operation with the Mpwapwa Livestock Production Research Institute (LPRI) and the Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences, introduced, developed, monitored and evaluated zero-grazing systems based on improved dairy cows within selected HADO project villages.

2.2. Introduction of zero-grazing

The decision to close the HADO areas to grazing livestock was imposed from above, with little account being taken of the immediate interests and opinions of those affected. It seems that implementation has generally followed this top–down approach. For example, in 1989 a series of meetings were organized for farmers interested in joining the zero-grazing scheme, but in most cases their wives did not attend, even though later studies (Ulotu, 1994) confirmed that they are equally responsible for the management of the confined animals, although this is not the case for free-grazing livestock, which are the sole responsibility of the men and boys. At these meetings the farmers were informed that they had to meet a number of preconditions before being allowed to purchase cows at subsidized prices, i.e. construction of an approved stall, proximity to a permanent water source, access to an improved bull, and the ability to purchase veterinary drugs, tick sprays, etc. Only improved (crossbred) cows were allowed, with a maximum number of two per farm. The prices were heavily subsidized, and loans provided, with the condition that the first female calf be returned to the project. Because of difficulties in obtaining improved dairy cows, permission was later given to farmers to keep local Zebu cows, and in the more arid areas, dairy goats. The introduction of stall-feeding was extremely interesting in that confinement systems are very unusual in semi-arid areas of the tropics, and the farmers in central Tanzania had little or no previous experience of such systems.

3. Monitoring and indicators

The zero-grazing research has focused on the biophysical inputs to, and outputs from the system, with relatively little emphasis on the collection of socio-economic data. No baseline socio-economic data were collected before the introduction of zero-grazing, and no formal indicators were put in place at the time. Rather, comparisons between the situation of participating and non-participating families within selected villages, and between villages in and outside the project area, have been made in ad hoc isolated studies, which have indicated some of the reasons for the ultimate failure of the project.

3.1. Biophysical indicators

3.1.1. Cow performance data

Data relating to performance traits, such as mean daily and total lactation milk yields and detailed

reproductive data, were collected weekly from 30 farms between 1991 and 1993 in order to monitor the progress of the zero-grazing project, and have been presented in a number of reports and scientific articles (Eriksson, 1993; Ogle et al., 1993, 1994; Ogle, 1996; Ulotu, 1994). The data have been used for quantifying the effects of feeding strategy and breed type on milk production, calf growth rates and mortality, etc. and for comparisons between different seasons. It was found for example, that average daily milk yields were around 8 kg for the improved cows and 3 kg for the local Zebus (Ogle, 1996). Calf mortality was less than 5%, and 6 months live weights were 94 and 129 kg for improved female and male calves, respectively (Ogle et al., 1994).

3.1.2. Feed supply and feeding strategies

Information on individual feeds used (mainly crop residues, agro-industrial byproducts, improved pastures, wild grasses and legumes, weeds, etc.) in different seasons, amounts fed and their chemical composition and nutritive value, were collected on a weekly basis between 1990 and 1993. The data lend support to the view that zero-grazing is inherently sustainable as they indicate that diet quality and quantity have been consistently high over time, even in the dry seasons and low rainfall years, and this is confirmed by the observation that mean dry season daily milk yields (8.3 kg) were only about 10% lower than in the rainy season (9.2 kg) (Ulotu, 1994).

3.1.3. Crop yields and manure utilization

Theoretically at least confinement of cattle should lead to increased quantities of manure becoming available for use on fields around the homestead, which in turn should result in increased crop yields. However, there has been no systematic collection of data on manure utilization and crop yields, and it is unclear whether there have been any benefits in terms of improved soil fertility (Rehnström, 1999). Comparisons in one ad hoc study between farms with stall-fed cattle and similar farms outside the project areas with free-grazing cattle, however, indicated that there were benefits in terms of higher crop yields. Over 90% of farmers with zero-grazed cattle utilized the manure, compared to only 21% with free-grazing animals confined at night (Ulotu, 1994).

3.2. Socio-economic indicators

3.2.1. Labor inputs

Although an earlier study (Kerario, 1992) had indicated that labor was considered to be one of the major limiting resources cited by non-adopters of the zero-grazing system, no systematic subsequent monitoring of labor requirements over time was carried out. In his study Ulotu (1994) showed clearly that the confinement system required considerably higher labor inputs than free-grazing, and that the distribution of labor within the family was also changed. In a later study Rehnström (1999) confirmed that around two-third of the 60 farmers interviewed reported that stall-feeding required more labor than free-grazing. One positive result of cattle confinement was that children who had previously been required to spend all day herding grazing cattle could now attend school, and often collected fodder on their way home. Time required for fodder collection was highest in the dry season, but as the opportunity cost of labor at this time is low this was not considered to be a serious problem by the farmers.

3.2.2. Economic indicators

Net profits from the sale of milk, breeding stock and manure were shown to be higher by a factor of 10 for the introduced zero-grazing system compared with traditional free-grazing (Ulotu, 1994). An indirect indicator of total milk production in the HADO area over time is given by the retail milk price, which fell from the equivalent of around US$ 0.60 per liter in 1993 (Ogle et al., 1993) to US$ 0.35 per liter 4 or 5 years later (Bwire, personal communication), indicating that the milk shortages in 1993 had been corrected by the increased supply, which was meeting demand.

3.2.3. Changes in wealth distribution

The situation regarding wealth distribution has probably not changed radically as a result of the zero-grazing project. Although the majority of the free-grazing herds was owned by a small minority of wealthy individuals, the practice of lending cattle to relatives and clan members meant that poorer families also benefited, through access to meat and milk, and in some cases calves. The poorest households did not benefit directly from the introduction of zero-grazing, as the majority did not have the resources to meet

the conditions for being allocated an improved cow (Christiansson and Kikula, 1996); and 92% of the farmers in the zero-grazing scheme were later classified as having a medium or high income (Rehnström, 1999). However, Ulotu (1994) reported that income disparities among farmers in the project villages had decreased, probably as a result of one of the preconditions for joining the project, which was the stipulation that the first female calf should be sold to a neighbor at a heavily subsidized price. Also, the regulations restricting participation to farmers with improved dairy cows were later relaxed, and local Zebu cows and improved crossbred milk goats were made available to families in some of the poorer villages of the area at subsidized prices.

3.2.4. Nutritional status of children

After the closures there were some reports of increased incidence of child malnutrition (Christiansson and Kikula, 1996). However, this has not been monitored directly, and much of the evidence for a deterioration of child health among the poorest households due to lack of protein and trace minerals previously supplied by animal products is largely anecdotal. However, as 50–80% of the milk produced in the zero-grazing scheme is consumed within the family (Eriksson, 1993) it can be assumed that a proportion of this will go to the children of these households. The remainder is mainly sold to neighbors, but the total number of children regularly consuming milk in villages included in the project is still probably less than under the previous free-grazing system, when even relatively poor families still had some access to milk, as wealthy owners of large herds usually loaned their animals to relatives and clan members.

3.2.5. Gender issues

There have been no systematic attempts to monitor the impact of either the original eviction of grazing livestock or the subsequent introduction of confined dairy cows on the situation of the women in the area, and it is possible that this has been a factor in the declining interest in zero-grazing and resurgence of free-grazing, which is once again posing a threat to the local environment. A study carried out in 1993 (Ulotu, 1994), for example, established that while adult males and children were responsible for grazing and watering free-grazing cattle, the situation was reversed for confined cows, with women being responsible for water collection on around 80% of the farms studied. This and increased responsibility for milking, fodder collection and marketing increased the already high workload of the women.

3.3. Composite indicators

3.3.1. Number of participating farmers

Probably the most simple and appropriate single composite indicator of the project's status and progress has been the number of farmers participating at any one time, and also the number that had applied to join and were waiting for improved animals to be allocated to them. By 1996 over 120 farmers were actively participating, and over 600 had requested to join the scheme, which represents about a half of the eligible farmers in the project villages. The main factor restricting expansion of the project at the time was an acute lack of crossbred dairy cows in central Tanzania, and the lack of funding for purchasing and transporting them from the coastal region, where availability was higher.

4. The outcome

SIDA withdrew financial support in 1996, and since then the number of free-grazing cattle in the closed area has increased rapidly, reportedly due to the fact that extension officers, whose responsibility was to report offenders to the police, cannot afford to travel around the district, as they have no travel and fuel allowances (Rehnström, 1999). Another contributory factor to the increase in illegally grazed cattle is probably the process of democratization, which has made local politicians less enthusiastic in punishing offenders for fear of alienating powerful backers and potential voters (Rehnström, 1999).

The number of stall-fed dairy animals has decreased steadily, from a maximum of around 120 in 1996 to less than 80 today (Bwire, personal communication), due to increasing disease problems and decreased availability of feed. Mortality and tick-born disease incidence (particularly East Coast Fever) in confined cows have increased as a result of the withdrawal of veterinary extension officers and increased contact with grazing animals (Bwire, personal communication). Fodder availability for the confined animals

is becoming a problem, due to competition with the free-grazing cattle, and overgrazing and erosion are increasing again as vegetation is being removed by grazing animals.

The attempt to convert a degraded ecosystem to sustainable use is on the point of collapse. It is difficult to quantify the different contributing factors in what is an extremely complex situation. However, if regular meetings between all the stakeholders had been arranged from the beginning it is likely that channels for discussing major issues and problems could have been established from the outset. As it is, the lines of communication between farmers, village leaders, researchers, extension officers, donors and politicians at local and ministerial level have been tenuous. Another important contributory factor may have been the failure to put into place and monitor appropriate indicators from the outset. Even though fairly detailed scientific data concerning the biophysical aspects of the confined dairy animals were collected, they were not made available on a regular basis to the ministry officials and donors.

The most suitable institution that could have been made responsible for the collection of data on key indicators, and their collation and dissemination would have been the Mpwapwa Livestock Research Institute, whose researchers were responsible for the collection of data on milk yields and reproductive performance, and for advising farmers on feeding, management and disease control. Regular meetings between researchers, farmers and extension officers would have led to a local participatory decision-making process. The responsible ministry officials and donor representatives could have been provided with regular data on the progress of the project and potential problem areas, which may have led to its long-term sustainability. Despite the benefits determined from biophysical data it is likely that the failure to systematically collect, collate and distribute data, in particular on socio-economic and environmental issues, may also have been a contributory factor in allowing the ecosystem to continually degrade.

5. A proposed scheme for participatory collection of socio-economic and environmental indicators

If indicators to monitor the socio-economic and environmental effects of the livestock evictions and the subsequent reintroduction of zero-grazed dairy cows had been selected initially together with the farmers they may have been more willing to support the project activities.

Thus, an initial discussion workshop should be arranged with all involved stakeholders — farmers, extension staff, scientists, economists, government officials — to determine major issues relating to a new project and its likely impact upon change in the community and corresponding indicators to monitor these issues. It is likely that government staff and economists will choose indicators relating to environmental and economic issues affecting the country more broadly, i.e. at a high scale level. Scientists will be interested in technical issues, both quantitative and qualitative, whereas farmers will suggest social, economic and environmental data on a local scale, pertaining to their own farms and households and presented in a more descriptive, qualitative form. The important factor is to ensure that farmers suggest issues and indicators, both so that they feel part of the whole process and so that they can continue monitoring the scheme after funding has been withdrawn. This will provide not only a mechanism to detect degradation, but will also support a local decision process whereby the farmers and extension agents can together decide how to reverse the degradation.

Simple proformas could be designed to collect this information by the farmers within their communities. These proformas could be pictorial, simple records of counts or weights and should be in the local language. Examples of socio-economic data that might be suggested for regular collection both before and after the evictions and the introduction of zero-grazing on parameters are frequency of school attendance, children's milk and meat consumption patterns and weight-for-age data, together with qualitative farmer-generated information on changes in their children's health. Data could also be collected regularly on labor inputs with respect to free-grazing compared to confinement systems, and attitudes of family members towards changes in the immediate physical environment as a result of the project activities.

Quantitative environmental data could also be collected on changes in crop yields as a result of increased availability of manure, and time spent collecting fodder. The latter would give an indication of the

probable decrease in availability of wild grasses, weeds and shrubs as a result of competition from increasing number of free-grazing cattle, and which became a serious problem after the project was terminated. This data in turn should give warning signals with respect to the increasing dangers of overgrazing and land degradation.

Other environmental indicators can be decided initially, by the scientists together with the farmers, such as assessments of changes in vegetative cover in sensitive areas, the extent and depth of gulleys, damage to terraces and bunds and siltation of waterways. Threshold levels of some of these indicators could be set, and appropriate action taken if and when they are exceeded.

Interaction at all stages of the project between the farmers, extension staff, scientists and government officials is essential to ensure that the interest of all stakeholders is maintained. Information exchange on progress both positive and negative will ensure that decisions are taken at appropriate times with regard to technical and social actions and also with regard to funding and its continuity.

6. Conclusions

It is concluded that a scheme should have been put in place for measuring socio-economic and environmental indicators, suggested in collaboration with local farmers, that would take stock of the perceptions of the affected community with regard to the project and its benefits. This would have encouraged renewed local interest and created a feeling of ownership of information which would have influenced both local and governmental decision-making processes and possibly avoided what appears to be the imminent collapse of a productive and potentially sustainable system.

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