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Participatory action

Identifying an appropriate methodological approach for considering social, economic and environmental problems caused by development in Sénégal

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Social and environmental problems go hand-in-hand, yet assessment of developments tends to consider them in isolation if at all. This study highlights the environmental and social problems in a small community in northern Senegal, and seeks ways ofproviding sustainable solutions. In this agricultural project, environmental problems are relatively simple to identify; social issues are more difficult. The problems highlighted relate to land tenure issues and irrigation mismanagement: a solution can only be sustainable, if identified and implemented by the local community. A Geographical Information System is suggested as a tool for facilitating community-led improvements.

Keywords: sustainable dcvclopmcnt; social impact assessment; Sénégal

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THERE IS NO DOUBT THAT development has the potential to affect the environment. This fact has been recognised world-wide and has led directly to the adoption of environmental impact assessment legislation in many countries (at least 57 as at January 1997 according to Haklay (1997)). In the developed world, much of the progress in producing legislation to take account of environmental issues occurred in the 1970s and 1980s. Since the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, the emphasis is very much on sustainable development which can be defined as (World Commission on Environment and Development, 1987):

> "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The emphasis in this definition is certainly on human beings and does not emphasise the environment expressly. For traditional communities, or in developing countries in particular, the interrelationship between the environment and socio-economic factors is clear to see (Thanh and Tam, 1992). The key to achieving sustainable development, therefore, which encompasses development as being necessary, is to take full account of the potential effects on the socio-economic

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and natural environments as a result of proposed developments.

Much attention is currently being focused on the appropriate methods to use to assess fully the potential social, economic and environmental implications of development activities. However, to date, there is no agreed way forward; many researchers are calling for an integrated assessment process incorporating elements of social impact assessment (SIA), environmental impact assessment (EIA) and economic appraisal (see, for example, Scholten and Post, 1998; Akpofure and Ojile, 1998). The nature of such a process is not clear and is likely to be highly dependent on the specific case.

Against this background the focus of this paper can be introduced. In the north of Senegal, West Africa, there exist communities which have, effectively, been created by government programmes to promote riziculture. Whilst successful under government management, the transferral of the programme into private ownership has not always been successful and has led directly or indirectly to a current situation in which the major issues are:

- land degradation
- poor rice yields and
- poor health within the population.

To address these problems in a sustainable way requires the participation of local people both to scope the problem and to identify solutions.

This paper begins by introducing a case study, including a description of the major environmental and social problems which are perceived to exist. This description is placed into the context of a Government policy for technological advancement in the study area. The paper continues by suggesting remedies which would take account of environmental and socio-economic problems and thus present a sustainable solution.

Case study: Boundoum, Sénégal

The river Senegal marks the northern boundary of Senegal and separates the country from Mauritania. Much of this part of Africa, known as the Sahel, is a transition zone between the Sahara and the wetter regions to the south. It has a characteristically barren landscape dominated by the infrequent occurrence of trees such as the baobab.

Traditionally, Senegal's major export is peanuts with an annual production of 800,000 tonnes, although in more recent times phosphate production (annual production 3.5 million tonnes) has become a major source of foreign income (British Council Senegal, 1999). The river Senegal itself and its floodplain represent an opportunity for agricultural development in the area and, indeed, this has occurred with both sugar cane production and riziculture being the preferred large-scale enterprises.

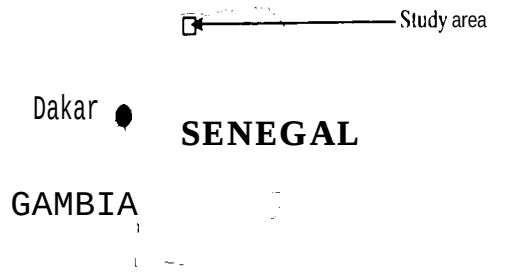

Figure 1. Study area centred on Boundoum, Sénégal

Collaboration with colleagues at the Université Cheikh Anta Diop in Dakar focused this study on an 11km² area centred on a village called Boundoum. Initial inquiries suggested that social, health and environmental problems resulted from mismanagement of irrigation by smallholders in the area, specifically related to the lack of drainage of irrigation waters. In the process of describing this case study, it will be shown that riziculture can be successfully managed, but, where it is not, management changes are needed if the soil is to retain its viability.

The location of the study area is shown in Figure 1. There are a few, small communities of around 1,000 people living close to an anastomosed branch (the Gorom) of the Senegal river. The area is extremely flat, is 44km from the sea, and yet is only 2m above sea level.

Historically, the area was inundated by the sea and the strata contain high levels of salt. As a result, the groundwater is up to three times as saline as sea water (Wopereis, 1996).

The legislative and administrative history of the area is an important factor in explaining its current problems. In 1964, law 64-46 was passed which created a national domain and four land-use zones as illustrated in Figure 2; they arc:

- Classified zones, which are equivalent to National Parks and are managed by the Forestry Service.
- Urban zones, which represent land under the jurisdiction of a town or city.
- Village lands, making up most of the land in the country, which are lands under the jurisdiction of rural communities and usually comprise smallholdings.

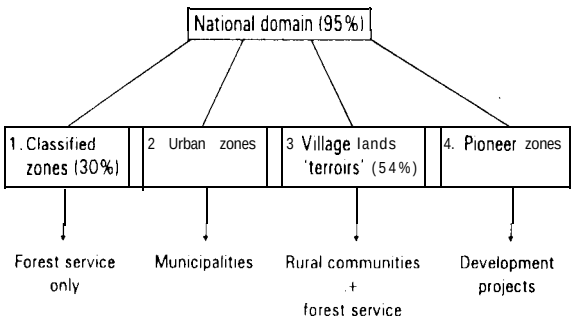

Figure 2. Land classification in Sénégal

The study area had previously been a pioneer zone, in which a Government organisation had developed rice culture increasing yields to 4-5 tonnes per hectare: once successful, the land was reclassified and passed over to the local people to farm

- Pioneer zones, which is land zoned for development, which usually refers to some form of agriculture, for example, riziculture: once the development has taken place, the land is reclassified as village land.

Pioneer *zone*

The study area had been a pioneer zone in the past (from 1965 to 1984), and a Government organisation, Societé Nationale d'amenagement et d'exploitation des terres du delta du fleuve Senegal (SAED), had developed rice culture in the area. Under the control of this organisation, crop yields of 4-5 tonnes per hectare were achieved.

Once successful, the land was reclassified (in 1984) and passed over to the local people to farm. Riziculture has thus developed over the years through a series of improvements in agricultural practice and through a large project downstream to construct a barrage across the river, thereby preventing salt water inundation up the river in the dry season. The following description details the progress made to intensify rice production in the area.

From 1945 until 1960, irrigation followed a traditional pattern developed as local people observed that low-lying land filled naturally with water (cuvettes). Use was made of these, and new ones were excavated. A dyke protected the cuvette from the stream and an opening was constructed for irrigation purposes (Niane, 1992). Typically, the drop from the rim of the cuvette to the centre was 2m (Figure 3).

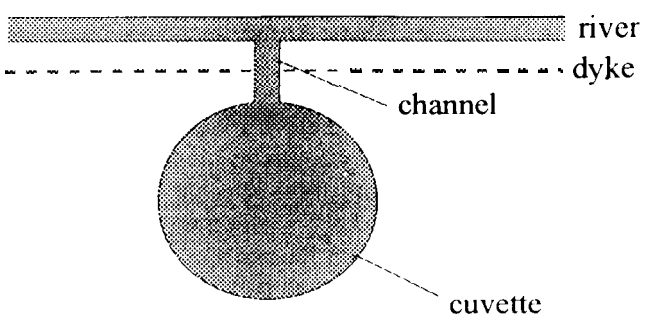

Figure 3. Rice irrigation from 1946 to 1960

Source: Adapted from Niane (1992)

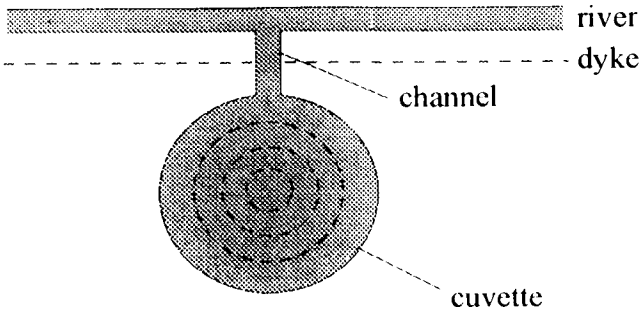

Figure 4. Rice irrigation from 1960 to 1968

Source: Adapted from Niane (1992)

From 1960 to 1968, slight improvements involved terracing inside the cuvettes to allow 0.5m steps down to the centre, with a total drop of 2m as depicted in Figure 4.

Further improvements between 1968 and 1972 involved increasing the size of the cuvette, making it more ellipsoid in shape, and increasing the number of terraces whilst reducing the drop between their levels to 25cms. In addition, an electric pump was used to transfer water from the channel to the cuvette: Figure 5 illustrates this. Yields improved up to 2 tonnes per hectare using this system.

In 1972, separate irrigation and drainage were introduced, every plot was from one to three hectares in size, with one irrigation channel and one drainage channel; the differences between terraces was now down to 10cms. The new system, illustrated in Figure 6, increased yields up to 4 tonnes per hectare.

Since this time, further improvements to yields have occurred followmg the construction of the Diama barrage downstream of the site. During the rainy season, sufficient fresh water flows down the River Senegal to prevent any salt water reaching the study area: during the dry season, however, salt water can migrate 200km inland. The barrage (working since 1986) now prevents this from happening, with the result that water extracted for irrigation in the

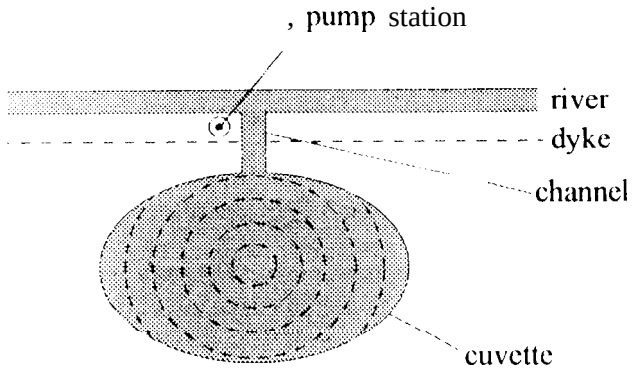

Figure 5. Rice irrigation from 1968 to 1972

Source: Adapted from Niane (1992)

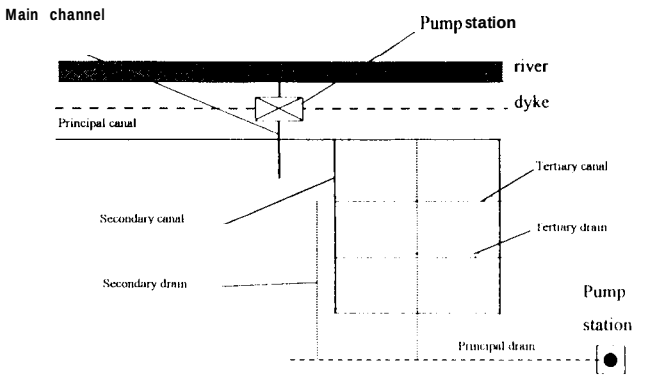

Figure 6. Rice irrigation from 1972

Source: Adapted from Niane (1992)

study area is fresh ail year round: this allows two crops of rice to be taken per year instead of just one in the rainy season.

Adverse effects of development

The progress in riziculture occurred simply because an increase in rice yields is inherently considered to be a good thing. Certainly no impact assessments were carried out to look at the implications of the development, or importantly, of the land-use designation decisions of the Government. As a result, adverse effects are being experienced. For example, the major health problems in the area, prioritised by Ndiawar Diop, the manager of the Boundoum Union (a farming co-operative), are lack of maternal care, malaria and schistosomiasis. The perception of the first of these as the major issue is almost certainly related to the cultural norms in the area for having very large families (Niang, 1994):

> "As in other African societies, Senegalese cultures strongly link women's social status and value to the number of their offspring. Being infertile is one of the worst things that can happen to women, who are under heavy social pressure to have as many children as possible."

The specific mention of lack of maternal care can be explained by reference to national statistics for Senegal, which indicate that the infant mortality rate (in 1994) was 64 per 1,000, and the under-five mortality rate (in 1992) was 106 per 1,000 (British Council of Senegal, 1999). These two health problems are directly related to the increase in rice cultivation in the area, partly because of the increase in standing water.

Historically, schistosomiasis was not a problem in the district until the Diama barrage was built. This is because the snail vector of the disease could not migrate into the area while it was inundated with salt water for part of the year. Now that the area is supplied with fresh water all the time, there has been no barrier to the arrival of the disease.

There is strong evidence that the problems suffered by the smallholders and the degradation in the quality of the soil is related to irrigation practices and is not simply a result of over-intensification

Concern over the potential health implications of rice development in West Africa in general, where production is expected to increase at a rate of 5% per year for the foreseeable future (West African Rice Development Association, 1995), has led to the establishment of a research project supervised by the Panel of Experts on Environmental Management for Vector Control (part of the World Health Organisation). This project will examine the health risks associated with lowland rice cultivation.

In addition, the children in the study area have suffered from stomach problems since 1986. The most likely reason for this is that a proliferation of vegetation has occurred in the river Gorom, which is now freshwater all the time. The water tastes foul because of the putrefaction of this vegetation. Another cause of the stomach problems is likely to be related to poorly managed irrigation drainage (see Woodhouse, 1998), as a result of which waste irrigation water goes back into the river Gorom complete with all the added pesticides.

Even without irrigation mismanagement induced health problems, access to clean water and sanitation is still rare in Senegal's rural communities. Statistics (from 1990 the most recent available) indicate that the percentage of the total rural population with access to safe water, is only 26% (compared to a national average of 44%) and the percentage of the total rural population with access to sanitation facilities is only 38% (compared to a national average of 47%) (British Council of Senegal,, 1999).

There is strong evidence that the problems suffered by the smallholders and the degradation in the quality of the soil is related to irrigation practices and is not simply a result ofover-intensification. Not all the land around Boundoum is privately farmed; a large area is under the control of Grand Aménagements. These are co-operatives (there is, in fact, such a co-operative running out of Boundoum itself, called the Boundoum Union) within which farmers work the land together. They have sufficient resources to be able to manage the riziculture well, and they achieve yields of 4-5 tonnes per hectare regularly since they can afford all the pesticides needed at the appropriate times, and have the human resources to be able to irrigate and drain appropriately.

On the other hand, the crops on land managed by individual farmers, with one or two fields each, suffer because the farmers cannot obtain credit to be able to

buy the pesticides they need; they can irrigate their land, but have nowhere to drain the water to -except other farmers' lands. For this reason, the irrigation water can become contaminated with salt from the saline groundwater via capillary rise as it is very close to the surface (Wopereis and Samba, 1995).

In addition, the water evaporates in the arid conditions and becomes very saline to a point where it is toxic even to rice (which is relatively tolerant to salt). Evapotranspiration rates from rice plots in the Sahel during the dry season have been measured at 10–13 mm/day (Dingkuhn *et al*, 1993). The yields from these areas are thus much reduced. In some cases, fields are being abandoned because of soil degradation, particularly salinisation, alkalinisation and sodification (Wopereis, 1996).

Salinity survey

To confirm that irrigation is the cause of soil degradation problems, a salinity survey of the study area was carried out. Apparent soil conductivity was estimated in the field at over 150 points, accurately located by global positioning satellite (GPS), using an electromagnetic conductivity meter (Geonics EM38). At each point, conductivity was recorded in both horizontal and vertical modes. Measurements were taken along transects within private, co-operative and abandoned areas of rice cropping during the dry season in January 1997.

In all three areas the soil was a heavy clay fluvisol. Soil pH (soil:water ratio 1:2.5) and electrical conductivity (soil:water ratio 1:5) were measured for samples taken at 19 points, to provide data on soil pH and a laboratory control for field conductivity readings. Electrical conductivity and pH readings were also measured in samples of irrigation water for the private (0.10 mS cm^{-1} and 6.3) and co-operative (0.12 mS cm^{-1} and 7.5) cropping areas.

Analysis of soil samples (0–10cm depth) indicated mean pH values of 5.8, 6.3 and 4.7 respectively for private, co-operative and abandoned areas. Electrical conductivity (EC) measurements in the laboratory indicated mean values of 2.51, 0.52 and 7.74 mS cm^{-1} for these same areas. Ceuppens *et al* (1997) considered that topsoil EC values in excess of 0.6–0.8 mS cm^{-1} were likely to limit rice yields in these soils.

Apparent conductivity measurements indicated a similar trend for different areas from those suggested by the limited number of laboratory measurements. Almost 50% of points sampled in the private cropping area had field conductivity readings indicative of moderate (EC 0.6–0.8 mS cm^{-1}) to severe (EC > 0.8 mS cm^{-1}) crop growth limitations. In contrast, no reading taken in the co-operative area had conductivity in either category. Around 20% of the readings taken in the private area had conductivity readings similar to those of the co-operative area.

The conclusion to be drawn from this evidence is that co-operatively managed irrigation schemes are working effectively without jeopardising future production. For private schemes, a few are managing to irrigate in a sustainable way, but the majority are not, with yields on the decrease and soil degradation on the increase. It is clear that some privately owned fields have reached the point at which rice will not grow and they have thus been abandoned.

Solving the problem'?

This study considers a possible approach to take in solving a problem which has already occurred, by facilitating worthwhile participation of affected individuals within the community. Implicit in this is that changes will have to be made to improve the quality of life of the community in the study area. Any successful approach has to integrate consideration of the socio-economic and environmental problems at the same time in order to provide a more sustainable solution.

In choosing an appropriate methodology, whether it be some form ofparticipatory rural appraisal (PRA) or other form of social appraisal, the particular nature of the rural population has to be considered. Many approaches for determining effects and their solutions are either not integrated or contain at least a degree of formal data gathering, often using questionnaires. Parlin and van Achthoven (1998) use a participatory approach for combating land degradation often associated with irrigation-induced salinity in India.

Such an approach can be applied to this case, although the real question is how to facilitate effective discussion of irrigation practices to identify solutions. A particular feature of the case study area stems from the fact that the native language in Senegal is Wolof (this is the English spelling, the French spelling is Oulof); this is a spoken not a written language. The implications of this are that questionnaires, as one example of a means of obtaining information on the social impacts, are inappropriate.

French is taught in schools, but in communities such as these, the ability to speak French is not universal or even common, thus local interpreters are needed at all times. Although colleagues from the Université Cheikh Anta Diop speak Wolof, it does put a number of barriers in the way of gathering information, primary among them being the fact that there is less written information than there would otherwise be.

Another key issue which should never be overlooked by those wishing to undertake PRA or SIA as a means of identifying solutions for socio-economic problems, is that environmental scientists, without additional training, do not have the background to undertake SIA. Rurdge and Vanclay (1995) state as a problem confronting SIA:

> "SIAs are often done by consultants who do not know relevant social and economic theory, and who may not be trained in either SIA or social science methodology."

They go on to say:

> "The need for professionally qualified, competent people with social science training and experience cannot be overemphasised."

The project team comprises an environmental scientist, a sociologist and two soil scientists, which, given the identified issues, seems an acceptable mix of personnel; two members of the team speak Wolof. A further key point to consider in relation to implementing identified solutions is that there is no institutional organisation which can oversee or help implement effective remedies; like many other African countries, capacity building is necessary. The question this point raises is: if an analysis came to conclusions and proposed changes in practices to improve social and environmental matters, how are these transmitted to the affected community and who authorises the necessary changes?

Whilst the approach we suggest for this case also requires that some of the facilitators speak Wolof, beyond this, there is no formal data gathering exercise concentrating on the social issues, and, as the ultimate aim is to facilitate self-help, there is no requirement for a decision-making body. A specific methodology, however, requires that evidence of the technical problems which are leading to the loss of yield and to the soil degradation problems are presented to the community in a manner which enables constructive discussion and action. The information requirements for community discussion can, for convenience, be broken down into two main components:

- Data on the salinity of soils in the study area: this provides evidence of the cumulative effects of poor irrigation management. It is imperative that this data covers some of the Grand Aménagement schemes to allow direct comparison (this was collected in 1997).
- Data on land tenure so that individual fields can be linked with the farmer.

Once this information is gathered, it is necessary to facilitate discussion within the community of appropriate irrigation management, with some farmers perhaps acknowledging that it is necessary to allow waste water from an adjacent field to drain via theirs (the evidence for this comes from the fact that the Grand Aménagements are successful in terms of yield, and in terms of preserving the soil structure). There will be, however, a lot of technical information all of which is map based.

The benefit of the Geographical Information System in this context is that full extent can be made of its strengths to provide understandable information to the community which can then, through focused discussion, agree solutions

The proposal for this scheme is to utilise a Geographical Information System (GIS) as a presentational device. Whilst the use of GIS in EIA is not new (see, for example. Eedy (1995) and João and Fonseca (1996) for basic mformation about GIS), the specific intention in this case is to relate soil degradation problems to land tenure, assuming that tenure and land management can be linked closely. Although this does not provide a predictive tool, it does allow presentation of information in a visual format. The benefit of GIS in this context is that full extent can be made of its strengths to provide understandable information to the community which can then, through focused discussion, agree solutions.

At present, the project has reached the stage where soil salinity has been mapped across the study area. The next step is to collate information on land tenure with the assistance of colleagues from the Université Cheik Anta Diop. The final step will be to present the information to the community, using a GIS. Output from the GIS can be both screen-based and map-based. The outcome is by no means certain, but a lasting solution to irrigation management can only be obtained with the agreement of the farmers themselves.

Conclusions

The particular situation described in this paper is a clear example of social, economic and environmental impacts being very closely related poor irrigation practices damaging the soil and having a direct economic and health impact on the communities.

This is not a situation in which a single development is being considered. or evidence could be submitted to decision-makers. The development of the area for riziculture occurred many years ago and has been proven to be viable. Good management will overcome many of the problems faced by the local people and should be sustainable, but outside of cooperative schemes, no institutional structures exist for implementmg good management.

The aim is thus to facilitate good management. Essential requirements for this to be successful arc:

- an understanding of the problems, both environmental and socio-economic. of the study area;
- knowledge of possible solutions to the problems;
- co-operation of the affected community.

In the developing world, a non-particpatory approach to social impact assessment is unlikely to be viable without significant changes in cultures and practices. There are practical reasons why it is not possible to obtain the required data to fit into the structured and

formal process. A participatory approach, on the other hand, does not have such barriers and needs only a suitable vehicle for enabling participation of communities. It is proposed that, for a small community, a simple Geographical Information System can accomplish this task by virtue of its ability to present information graphically and to respond to suggestions in real time.

A participatory approach to making beneficial changes to existing impacts, or for the planning stages of development, may not be favoured by developers in many countries, because they may be concerned that they effectively lose control of their own developments in the process. However, it seems to offer the best chances of success in the study discussed.

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