A copy of the table (or the graphs) of the maximum energy requirement for a given region ought to be handed over to each District in the region so that tariff scheduling bands based on energy consumption can be worked out.

A standardised form ought to be drawn up for each hydrogeological formation in each province. Each time a request for electrification was made, such a form would have to be filled out by:

(a) the farmer, who would note down all the specifications of the holding and the well;

(b) CRDA personnel, who would add the characteristics of the groundwater reserve and the maximum water requirements in power and energy per hectare.

STEG, for its part, in collaboration with the Administration, would prepare a proposal for new tariffs based on the degree to which power and energy are overused, and also a proposal for power supply timings.

A 'STEG information sheet' ought to be produced for each province and given to any farmer who wants well electrification so that the farmer is aware of procedures.

A case study is now underway to gauge the economic and financial effects of this electrification project, with a view to its being implemented as soon as is best. New laws are now being drawn up in line with this study to determine how electricity is to be used. It is also intended to create farmers' associations for managing the system and implementing the guidelines.

DEVELOPING VILLAGE LIFT IRRIGATION IN MALI

Souleymane Dembeley
Chargé de projets, GUAMINA (ONG/NGO), Bamako, Mali

GUAMINA is an NGO undertaking development actions in response to the needs identified by local people and making use of their full participation. Our actions are strongly focused on food self-sufficiency through small-scale irrigation schemes for rice and market gardening. At the moment GUAMINA is involved in four main irrigation scheme projects. In this paper we discuss the project in Boya, 60 km from Gao in the seventh region of Mali.

From the outset, though, it must be stated that rice or market garden irrigation schemes cannot be undertaken in isolation or they are bound to fail. Other components are necessary, such as small farmer organisation around the scheme and training in rehabilitation and management techniques (which consist of small farmer organisation, literacy training, natural resource management and environmental protection).

Earlier the Boya scheme was under flood recession agriculture. The rising of the River Niger, which flows near the village of Boya, inundated that part of the plain and the local people made use of this to grow rice. With the drought of recent years and the very low level of the rise in the river, the plains were no longer sufficiently inundated to guarantee a good rice harvest. This situation led the local people to develop the plain, seizing upon GUAMINA and another Canadian NGO for this work.

A preliminary study was conducted to discuss the development plan and how the work would be carried out. This was followed by the project document worked out on the basis of the preliminary study and with the full participation of the people concerned. The project outline is as follows:

1. GOAL AND OBJECTIVES

The project is aimed at increasing agricultural production by controlling and using efficiently the river waters in order to meet the needs of the people of Boya in relation to food self-sufficiency (development of a small-scale

irrigation scheme, and traditional fields). For this the project must guarantee the development of infrastructure to increase the capacity of agricultural production:

- securing agricultural production by total water control;
- local consumption of foodstuffs;
- building up reserves;
- sale or exchange of supplies for other foodstuffs;
- training in management techniques of men and women involved in the irrigation scheme;
- training local people to be able successfully to take over the project when the NGOs withdraw.

2. PROJECT SUPPORT STRATEGY

GUAMINA's approach aims at involving as many people as possible in community development. The ground work with local people represents the first step in reaching this goal. Priorities are to be set out by the local people in relation to their needs. The project will proceed in this way in the village of Boya stressing, of course, the other necessary components.

3. PRESENT SITUATION ON THE BOYA PROJECT

(a) What has been learnt from the Project, at the level of small-scale irrigation?

Having been running for four years, the Boya Project is at the moment in its last year of funding. During these first four years much important work has been carried out, with development of a small-scale irrigation scheme covering 50 ha with individual parcels distributed according to criteria established by the local people themselves. This scheme extends over more than 50 ha with two motorpumps and a canal system which allows each user to irrigate their holding at their convenience.

The main thing learnt is that the scheme itself originates with the people, which means that the small farmers already had expertise in rice-growing techiques, in this case setting up the nursery beds, re-planting, respecting fertiliser quantitites, organisation of watering and of seedling densities. Also we can add awareness of the crop calendar, of the over-lapping of mineral

fertilisation as a function of the plant growing cycle and crop diversification on the scheme: sorghum IRAT-204 (or sorghum - Djebock variety, which is very well adapted to the area) and of Gorom-Gorom variety. The development of the scheme has been carried out with a lot of consultation and technical support from the two NGOs.

During high river levels the scheme received river water and motorpumps were used less. During the winter (the recession period of the river), however, the motorpumps were the only means available for irrigating the fields. This is why instead of double-cropping rice, the project adopted growing Djebock sorghum as the winter season crop. Market gardening should be added as well.

Traditional Fields

Rice growing in the bas-fonds (floodplains) is an activity which goes back generations in this area. The small farmers not only are totally expert in the different growing techniques but also have extensive knowledge of all the varieties cultivated locally. The need to conserve local strains must also be stressed. The disappearance of traditional varieties is a danger and a menace for this activity and might in the longer-term give rise to the disappearance of certain varieties if an adequate solution is not found. For the present, however, essentially three main varieties of local rice are grown in the region (Moberi, Tetere, Kossa), each made up of various strains maintained traditionally until the present.

In the traditional fields, growing is done as best as possible since the amount of flooding cannot be determined in advance.

Recently the river rise no longer allowed the traditional fields to be irrigated. The project therefore recommended supplementary irrigation, which is looking after the young shoots through using the motorpump until the river water arrives. At the times when the rise is small there will be recourse to the system of backup irrigation using motorpumps.

Also the project has introduced the system of planting carried out from a rice seedbed collectively maintained, in place of hand sowing in the traditional fields. This planting system will avoid the uncertainties of the floods which are often too strong or too weak.

(b) Problems met with:

- Inability to deal with the essential technical issues, in particular sticking to the crop calendar and the overlapping of mineral fertilisation as a function of the plant growing cycle;
- Lack of rest for the small farmers in the annual double-cropping;
- Overlapping of work times (irrigation scheme and traditional fields);
- Management of infrastructure, mainly the motorpump and irrigation network.

These different points are at present being dealt with in detail and adequate solutions are at present being recommended. These are to make investments profitable and to encourage take-over by the small farmers.

With a view to this, the project is in the process of putting the emphasis on:

- Training the small farmers and follow-up of the scheme;
- Awareness and extension of modern techniques;
- Improving the system of supplementary pumping for the traditional fields;
- Conservation of, and experimentation with, traditional strains with the intention of determining their potential and of improving cultivation methods.

(c) What has been learnt: In all, the project has:

- Carried out studies of development sites (50 ha);
- Set up infrastructure intended to consolidate the scheme and put the tools for working on the scheme at the disposal of the small farmers;
- Trained and introduced the small farmers to canal and masonry techniques;
- Achieved improved crop practices as much on the scheme as on the traditional fields;
- Diversified crops;
- Practised new techniques to produce seedlings in seedbeds of local strains used in the traditional fields;
- Achieved control and good water management from infrastructure created at the scheme level.

GROUNDWATER DEVELOPMENT FOR SMALL SCALE IRRIGATION IN SUB-SAHARAN AFRICA: TECHNOLOGY FOR SMALL SCALE GROUNDWATER IRRIGATION IN NORTHERN NIGERIA[1]

Richard Carter
Senior Lecturer in Water Supply & Management
Silsoe College, Bedford MK45 4DT, UK

INTRODUCTION

In northern Nigeria dry season vegetable cultivation has been practised for generations in the *fadamas* or seasonally wet bottom lands (Carter et al, 1983). These fadamas range from localised depressions to major river flood plains. Water is lifted from perennial rivers, water holes and wells by the locally constructed counterpoised device known as the *shaduf*.

This is a labour intensive, low capital cost device which permits the irrigation of approximately 0.1 ha (Nwa, 1981). The main crops irrigated by the shaduf are tomatoes, onions and peppers. Even in the more extensive flood plain fadamas this sort of lift irrigation is largely restricted to the banks of perennial water courses and to the margins of natural water holes.

The technical intervention in recent years has been the introduction of simple technology for the construction of shallow boreholes, together with handpumps and motorpumps, as alternatives to the shaduf. This has increased the potential area of vegetable cultivation back across the flood plain, to cover virtually the whole of the fadama, or at least those areas where the water table is no deeper than about 3-4 m below ground surface.

The method of borehole construction used is described in detail by the present author in BSADP (1984). A 50 mm steel pipe is jetted into the fadama soil by pumping water or bentonite mud through it and using this fluid to return displaced soil to the surface. Usually a temporary casing of about 100 mm diameter is driven at the same time as jetting proceeds, so

[1] A longer paper on this topic was first presented to the Geological Society of the UK in 1988. Please contact the author if you could like a copy.