REPUBLIC OF KENYA

MINISTRY OF AGRICULTURE

LAND DEVELOPMENT DIVISION

SMALL SCALE IRRIGATION UNIT

Irrigation Extension Bulletin No. 1

General guidelines for the identification and selection of (small) irrigation schemes.

by

P. Hekstra

W. S. Post.

September 1980

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IRRIGATION AND DRAINAGE BRANCH

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CONTENTS

FORWORD

The meaning of this paper is to make policy makers, development planners, local authorities and the staff of the Ministry of Agriculture aware of the fact that irrigation development is far more complicated than usually anticipated.

In general terms the paper deals with the various aspects that play an important role during identification, planning and development. These aspects and other related subjects will be dealt with in more detail in other bulletins as indicated in the annex.

Although the paper cannot be considered an accurate account of investigations, it may well serve as a sort of check list for identification of small irrigation schemes.

1. INTRODUCTION

The kinds of crops and their level of production depend on the environment in which the crops are grown. Apart from a few exceptions, the natural environment permits moderate to fair levels of production only. Fortunately man has at his disposal the means to correct and to improve the environmental factor, so to enhance the quantity and the quality of the production.

One of such means is the application of irrigation in areas where water naturally is deficient. However, the application of irrigation only is not doing the trick by itself, but should be accompanied by a range of measures to increase the quantity and to improve the quality of production, such as salinity control, fertilisation, variety selection, cultivation methods, but also management, marketing and input supply.

This paper is meant as a tool to identify and to assess the potential for irrigation development where water is deficient for shorter or longer periods during the year. In doing such an exercise one has to evaluate the following factors:

- land
- water
- crops
- human factor.

These factors are interrelated and exert interaction one on the other. In the following these factors are briefly discussed.

2. The land

There are two physical aspects to the land:

a) The conditions of the terrain

b) The conditions of the soil.

2.1 The terrain

Depending on the erodability of the soil the slope should not exceed 3% for surface irrigation methods. Even for overhead systems (sprinkler) slopes should not be much steeper. Preferably the slope of the terrain should be less than 1% for surface irrigation.

Another aspect is the roughness or micro (or meso) relief. This is indicative for the magnitude of land levelling required, if surface irrigation is to be adopted. Since land levelling is a costly and sometimes unwanted affair (removing the topsoil often creates a poorer soil), it should be kept to the minimum. Therefore smooth soil surfaces should be selected.

2.2 The soil

The soil is the medium in which the plant grows. Here it finds its anchorage, nutrients, water and air for the roots.
It is obvious that the quality of the soil is of utmost importance. Rather than indulging in the details of the physical and biological processes of water and nutrients absorption by the roots, here it will suffice to know the texture and the salinity and / or the alkalinity levels of the soil.

The texture.(and the structure) of the soil determines the adequacy of water retention and movement in and into the soil. The best range of soil texture is from sandy loam, loams to loamy clay. Light textured soils (such as sands) tend to become dry too quickly, whilst heavy textured soils tend to stay wet too long. The latter therefore, usually is good for wet land rice production.

Salinity and / or alkalinity levels have to be assessed in considering irrigation development. Although these levels are determined in the laboratory, the presence of salts can often be observed in the field, when the soil is dry. The degree of susceptability varies with the kind of crop, but all crops will show depreciations in yield, if grown in saline and / or alkaline soils.

Also, one should realise that irrigation may cause the ground water to raise. This usually results into salts or saline ground water to raise into the rooting none. In order to prevent such an increase of salt and to prevent water logging in the rooting zone, as a general rule, irrigation schemes nearly always must be accommodated with adequate drainage facilities. Often, the latter is neglected as can be seen at the Hola scheme where proper drainage has not been provided.

3. The water

Water is a climatic factor. In areas with low rainfall there will be little water available for irrigation unless the water derives from areas with higher rainfall.

In assesing the water potential for irrigation the following aspects have to be considered:

a) the source and location of the water;
b) the quantity of the water;
c) the quality of the water;

3.1 The source of the water

The source of the water can be direct rainfall, groundwater (= subsurface water) or surface water from rivers or lakes.

In order to estimate how much irrigation water should be supplied and during which time of the year, rainfall data has to be evaluated together with evaporation data. This also will give an indication whether all-time or supplementary irrigation is to be envisaged.

Groundwater resources are little used in Kenya, because of their assumed limited quantities or their high levels of salinity. If groundwater is used, it invariably has to be pumped.

In Kenya the largest resources of water are found in the rivers and lakes. If the water level of these sources is below the field surface the water has to be pumped. This is usually the case with lakes.

If the water is drawn from a river, it is necessary to investigate whether there is a suitable point to abstract the water by gravity. If possible the use of pumps should be avoided, because of the high costs and many troubles to the operations, maintenance and the acquisition of fuel and spare parts. If abstracting water by gravity means a long conveyance canal or pipe, this might still be preferable to using pumps.

3.2 The quantity of water

Usually the amount of water needed for irrigation is underestimated, whilst the amount of water available at the source is overestimated. This always leads to too optimistic projections.

Water requirements for irrigation are of an entirely different magnitude than for domestic water supply. For example, the amount of water needed for 1 ha under a crop is about 60 to 80 m^3 per day. This amount is equivalent to the needs of 1 family of four for the period of one year, including washing.
As a rule of the thumb it can be said that 1 ha requires 1 liter/sec during 24 hours of the day.

After assessing the quantity of water (in liters per second) available at the source, or the capacity of the pump(s), one can easily estimate the size of the land which can be irrigated. If night irrigation or night storage is not feasible, the area to be irrigated is proportionally reduced.

The quantity of water available at the source should be estimated during the dry season, when the water level is lowest (baseflow). This baseflow determines the area that can be irrigated at the time irrigation is needed the most. In many cases it should be considered to cultivate a large area under food crops during the rainy season, with supplementary irrigation, whilst mainly cash crops should be grown on a smaller area under full irrigation during the dry season

3.3 The quality of the water

The quality of irrigation water drawn from rivers, usually presents not a serious problem in Kenya, unless the rivers have been polluted near urban centres. River water is rather fresh in contrast to many lakes, which often have high alkalinity levels. Water with noticeable levels of alkalinity should never be used for irrigation as this will cause deterioration of the soil structure.

Not too saline water can be used, provided that precaution is taken, by leaching the surplus of salts down to lower soil levels, by adding extra water and draining the surplus water (drains). Although each source has its own quality, irrigation water always contains some salt. Therefore drainage facilities are almost always required in irrigation schemes.

4. The Crops

The potential of certain areas for irrigation development is not determined by the availability of good land and water only. Certain soils are suitable for certain crops only

(i.e. rice). Also the climate poses limitations to growing certain crops.
In many cases the physical factors might be suitable to a range of crops but, if a proper crop selection has not been done, schemes are prone to failure.

Apart from the above mentioned soil and climatic aspects, basic criteria in assessing the suitability of irrigated crop production are:-

(a) Are the techniques of growing a crop in harmony with the technological skill / ability of the prospective farmers ?

(b) As operation and maintenance of an irrigation scheme is a costly affair, is the planned acreage under cash crops sufficiently large to generate enough cash. (It should be kept in mind that under the prevailing conditions in Kenya, each farmer still has to produce his own food).

(c) Are the existing outlets in the region capable to market the envisaged crop produce or are the markets flexible enough to absorb an increase of these commodities. (This aspect is of extreme importance for instance if vegetable production is considered)

5. The human factor

Most scheme failures are caused because the human factor has been considered too little in advance. Under this factor a whole range of social, economic, political, organisational and administrative aspects can be considered.

With the exception of a few areas, it can be stated that there is hardly any irrigation tradition in Kenya. Therefore farmers often have no idea about the consequences and difficulties that irrigation development creates. Too often policy makers or development planners think that the

introduction of irrigation will solve the problems in semi-arid and arid lands, while the local population (often pasturalists) might have different ideas and priorities for their own development. Others think that irrigation is a way to get rich quickly.

Infact irrigation development should be seen as a tool:

- to assure crop production in areas with periods of unreliable rainfall,
- to reduce the risk of crop failures,
- to increase farmers' income.

Crucial questions have to be answered prior to development to start.
For example:

- If for social/political reasons foodproduction should be promoted in (semi)-arid areas, are the planners aware that the Government will have to subsidise these efforts for many years to come ?
- Contrary to rainfed agriculture were each farmer can make individual decisions, irrigation is a collective enterprise involving 20-100 farmers. The question therefore arises if these groups of farmers can form a social unity able to organise themselves in the administration and operation (management) of the scheme. This requires discipline by all people concerned.
- Does the wish for an irrigation schmes originates from the farmers or from the technicians ? In the first case the farmers will certainly be more motivated.
- Who owns the land and can the land be made available for development in such a way that the farmer on the plot will be the beneficiary.
- Will there be sufficient labour available for irrigated crop production and will the incentive be sufficient for the farmer to make the effort.

- Are there facilities of input supply and marketing of produce in the region. If marketing cannot be made adequate alternative crops have to be selected.

- Are there facilities for repairing pumps and engines nearby, if pump irrigation is considered. Similarly are there workshops for tractors, if tractors are to be used.

ANNEX

Subjects proposed to be included in subsequent Irrigation Extension Bulletins

- Planning of irrigation schemes.
- How to conduct an agro-economic survey
- Selection criteria for irrigation and drainage schemes or programmes.
- Design criteria for irrigation and drainage schemes.
- Cost of implementation of irrigation and drainage schemes.
- Scheme organisation.
- Pumps
- Windmills.
- Irrigated vegetable production.