Modernizing Agriculture in Africa to improve Environment

Peter Katongole, and Catherine Wambui

Until about four decades ago, crop yield in agricultural systems depended on internal resources, recycling organic matter, built in biological control mechanism and rainfall patterns production was safeguarded by :

 Growing more than one or a variety in space and at time in a field as insurance against pest outbreaks or severe weather. Import of nitrogen

I. was gained by rotating majors field crops with legumes. In turn rotation suppressed insects, weeds and diseases by effectively breaking the life cycle of the pests.

II. A typical corn large farm grew corn related with several crops including soybeans and small grain production was intrinsic to maintain livestock.

In these types of farming systems the link between agriculture and ecology was quite strong and signs of environmental degradation were seldom evident

But as agricultural modernization progressed, the ecology farming linkage was often broken as ecological principles were ignored and/or overridden. In fact several agricultural scientists have arrived at a general consensus that modern agriculture confronts an environmental crisis. A growing number of people have become concerned at the long term sustainability of existing food products systems. Evidence have accumulated showing that whereas the present capital and technology competitive , they also bring a variety of economic , environment and social problems.

Evidence also show that the very nature of the agricultural structure and prevailing policies hence led to this environmental crisis by favoring large farms sizes specialized productions , crops monocultures and mechanization. Today as more and more imperatives to diversify disappear and monoculture are rewarded by economies of scale. In turn lack of rotation and diversification take away key self regulating mechanism turning monocultures into highly vulnerable agro ecosystems dependant on high chemical inputs.

Peter Katongole is with the Water For All –East Africa ,Nairobi P O box. 923-00600, KENYA (Phone: +256 752 855 097, +254 735 618 561; e-mail: katongolepeter493@yahoo.com).

Catherine Wambui is with the Water For All –East Africa ,Nairobi Po box. 923-00600,Nairobi, KENYA (Phone: +254 712 837 242 (e-mail: catherinewambui@hotmail.com).

EXPANSION OF MONOCULTURES

Today monocultures have increased dramatically worldwide mainly through the geographical expansion of land devoted to single crops and year-to –year production of the same crop species on the same land. Availability data indicate that different amount of crop diversity per unit of arable land has decreased and that cropland have shown tendency toward concentration to devote large area to monoculture, and infact such systems are rewarded economies of scales and contribute significantly to the ability of national agricultures to serve regional markets in east Africa.

The technologies allowing the shift toward monoculture were mechanization, the improvement of crops varieties, the development of agrochemicals to fertilize crops and control weeds and pests . government commodities policies these past several decades encouraged the acceptance and utilization of these technologies. As a result , farms today are fewer, larger, more specialized and more capital intensive. At the regional level, increase in monocultures farming meant that the whole agricultural support infracstructure (ie research) extension, suppliers, storage, transport, markets etc) has become more specialized.

CONSEQUENSES OF MONOCULTURE

Most large scale agricultural systems exhibit a poorly structural assemblage of farm components, with almost no linkages or complementary relationships between crops enterprises and among soils, crops and animals.

 Cycles of iminents, energy, water and wastes have become more open, rather than closed as in a natural ecosystem.

 Part of the instability and susceptibility to pest of agro ecosystems can be linked to the adoption of crop monocultures

 As specific crops are expanded beyond their “natural ranges or favourable regions” to areas of high pest potential, or with limited water, or low fertility soils, intensified chemical controls are required to overcome such limiting factors.

 Commercial farmers witness a constant parade of new crops varieties as varietals replacement due to biotic stresses and market changes has accelerated to unprecedented levels .

 The need to subsidize monoculture requires increase in the use of pesticides and fertilizers, but the efficiency of use of applied input is decreasing and crops yield in most key crops in most keys crops are leveling off. In some places, yields are actually in decline.

However as long as transgenic crops follow closely the pesticide paradigm, such a biotechnological products will do nothing reinforce pesticide treadmill in agri-ecosystems, thus legitimizing the concerns that many scientists have expressed regarding the possible environmental risks of genetically engineered organisms. So far , field research as well as predictions based on ecological theory, indicate that among the environmental risks associated with the release of genetically engineered crops can be summarized as follows:

 The trends set forth by corporations is to create local, regional (East Africa) market for a single product, thus creating the conditions for genetic uniformity in rural landscapes.

 The spread of transgenic crops threteans crop genetic diversity by simplifying cropping systems and promoting genetic erosion.

 There is potential for the unified transfer to plant relatives of the "transgenes" and the predictable ecological effects. The transfer of gene from herbicides resistant crops (HRCs) to wild or semi domesticated relatives can lead to the creation of super weeds.

 Most probably insects pests will quickly develop resistance to crops with Bt toxin.

 Massive use of BT toxin in crops can unleash potential negative interactions affecting ecological processes and non target organism.

 Another important environment concern associated with the large scale cultivation of virus resistant transgenic crops relates to the possible transfer of virus derived transgenes into wild relatives through pollen flow.

With the agriculture modenisation in the rural arid areas of eas Africa with case studies of Garissa and Wajir north of Kenya and Karamoja in the nort eastern Uganda and the arid pastoral belts of Sembabule in the central part of Uganda; irrigation in the mentioned areas as one of agriculture modernization, has proved a great deal in improving the environment degradation of the respective regions.

Irrigation, together with organic manures and artificial fertilizers, land in these areas has dramatically improved and rain seasons have been realized in the long run . and below are the different ways trough which farm lands of the arid are reached with water.

GROUND WATER AND SURFACE WATER MANAGEMENT

Ground water .

It is a natural resource that is found under the ground. Its origin is precipitation or in simpler terms rain. The process for the occurrence of ground water is ; when there are rains and part of the water runs over the surface or forms pools of water on the ground. This type of waters are called surface Run-off or in simpler terms floods, and pans or dams, lakes or seas. In technical terms they are surface water bodies.

THE METHODS OF WATER ABSTRACTION

Abstraction is the means of pumping water to the ground surface or to the storage reservoir. In the groundwater the simplest methods apply to shallow boreholes and hand dug wells, while the complex ones apply to medium deep and deep boreholes.

The simple methods range from mechanical levers to wind-driven and hand pump.

 Home-made levers refer to rope and winch with a bucket tied on one end. This method is crude and can pollute the well.

 Windmill is a mechanical pump with wind vanes that are rotated by the wind. The mechanism for drawing the water is similar to the hand pump.

 Hand pump is a hand operated mechanical pumps they are well represented by the india mark II.

Other more complex pumps

Other pumps exist which are more efficient than the simple mentioned above. They include:

i. Surface centrifugal pumps

ii. Surface centrifugal electric pumps

iii. Electrical submersible pumps.

Electrical submersible pump is the most is the most suitable for deep boreholes. The major similarity in all above mentioned pumps is that they exist in two units:

1. The prime mover
2. The pump.

The prime mover is the part that supplies power to the pump, while the other part is the pump.

Centrifugal pumps are pumps with central circular intake vanes that have suckling effect. The preferable prime movers for this kind of pump could be a diesel or petrol engine or an electrical motor.

THE SUBMERSIBLE PUMP

Its one long thin pump that comprises a motor attached to a multistage impeller unit.

Management aspects of ground water.

Having learnt all the processes for attaining ground water it then becomes easier to visualize all the aspects of the ground water system that need to be managed for an efficient water supply system.

Right from the feasibility, design, implementation and maintenance stages, the aspects of sustainability must be identified.

Management is a factor of productivity while productivity is a relative to demand for services. We therefore manage

systems to deliver services created by demand.

Water is essential for life, yet its existence naturally affects its availability as well as quality. In water management we consider;

- Domestic need
- Livestock need
- Agricultural need
- Industrial need
- Recreation need

The need in all the above is related to level of demand. The first thing is to visualize the level of demand.

1) What is our primary demand
2) What quantity for the primary demand
3) Which are the available sources
4) What is the availability of each source
5) Which one offers the best option for quality, quantity, delivery and sustainability
6) What constitutes our primary demand

Statistics; Are mathematical facts about any particular matter of interest at any given time? Statistics are formed by data derived from assessments purposefully carried out to help make decisions about a particular matter.

In water management human population with their livestock data is essential, the prevailing increment is also essential in the determination of future developments of water utilities.

All service utility projects are supposed to be designed to meet the following criteria;

- Design stage
- Initial stage
- Future stage
- Ultimate stage

- Design stage – This is the stage of the project initiation which should take into consideration the current water demand for the current population.
- Initial stage – This is the commissioning stage of the project, where it is fully implemented and considers the prevailing water demand for the prevailing population
- Future stage – This is a projection of increment in water demand for a period into the future in accordance t expected population growth
- Ultimate stage – This marks the end of usefulness of the project to meet the prevailing demand. Augmentation measures must be put to meet the water demand or urgent management measures like rationing to cope with over whelming water demand must be put in place.

Note:

The interval between the different stages can be calculated using the national census data and national projected population growth. If national census is constantly carried out for example after five years, the projected growth rate within that period should be used consequently if it is done after a long interval then the design criteria should use the prevailing population growth rate.

PLANNING AND DESIGN

Population project

1. Assume that the current population in Karamoja is 2 million people and the projected population growth rate is 6% per annum. The population in one of the counties is 100940 people.

So a population projection for a water project to be designed to have its ultimate stage 30 years from the year 2014.

P= Xni/100 + n

Where P= projected population

X= annual growth rate

i= interval between design stages

n= current population.

Design stage	Annual growth	Initial stage	Annual growth	Future stage	Annual growth
2014	6%	2024	6%	2034	6%
100940	6056	161500	9690	258400	15504

Design stage	Ultimate stage
2014	2044
100940	413440

Where we do not have any pumping we have gravity mains. In order to make our calculated demands, intakes must be designed to meet the water supply criteria of delivering enough water.

In ground water, where it is not easy to get one borehole that meets all the required water demand, it becomes inperative to know how many boreholes should be drilled to contribute to the demand. It is also important to know what area in square kilometers that need to be set aside for this purpose.

Surface water management.

We need to know how much water we are taking to meet our water demand. The structures used to measure water from a primary source include

- Water master meters
- The rectangular notch
- The V notch
- The current meter
- The rain gauge
- The evaporation pan

The V notch

This is used mostly in treatment plants to measure the volume of water entering the treatment process. This is important for the purpose of knowing the treatment capacity of the plant.

Rectangular notch

It is useful in measuring the quantity of water flowing in the river. A river is not an indefinite quantity. Development and increase in population increase demand for the river

water such that it is not well managed and gets finished.

Current water.

The current meter is an instrument calibrated to take the surface water velocity across a river bend. The average velocity is used to calculate the water flow across the section.

Master meter

These are device used to measure the water passing through a conduit. They can be used to measure water in a rising main of a borehole or river intake.

Rain gauge

This device is used to measure amount of rain received in a particular area in a specified time mostly 24 hours.

Evaporation pane

It is used to hold water during observation for the determination of the quantity of evaporation at a given location. Such pan are of varying sizes and shapes, the most commonly used being circular or square. Often the evaporation pane are automated with water level sensors and a small weather station is located nearby. It has been noted that over the past 50 years, the amount of evaporation has gradually decreased. Researchers have found strong ties to global dimming and climate changes.

ACKNOWLEDGMENT

A special thank you goes to Doctor Gichane K John; Director Water For All –East Africa who contributed in the mentoring and guiding during the research work while under the organization umbrella.

REFERENCES

[1] GROUNDWATER AND SURFACE WATER MANAGEMENT TRAINING FOR BENTIU ACF STAFF, GOVERNMENT STAFF, AND WATER FOR ALL.