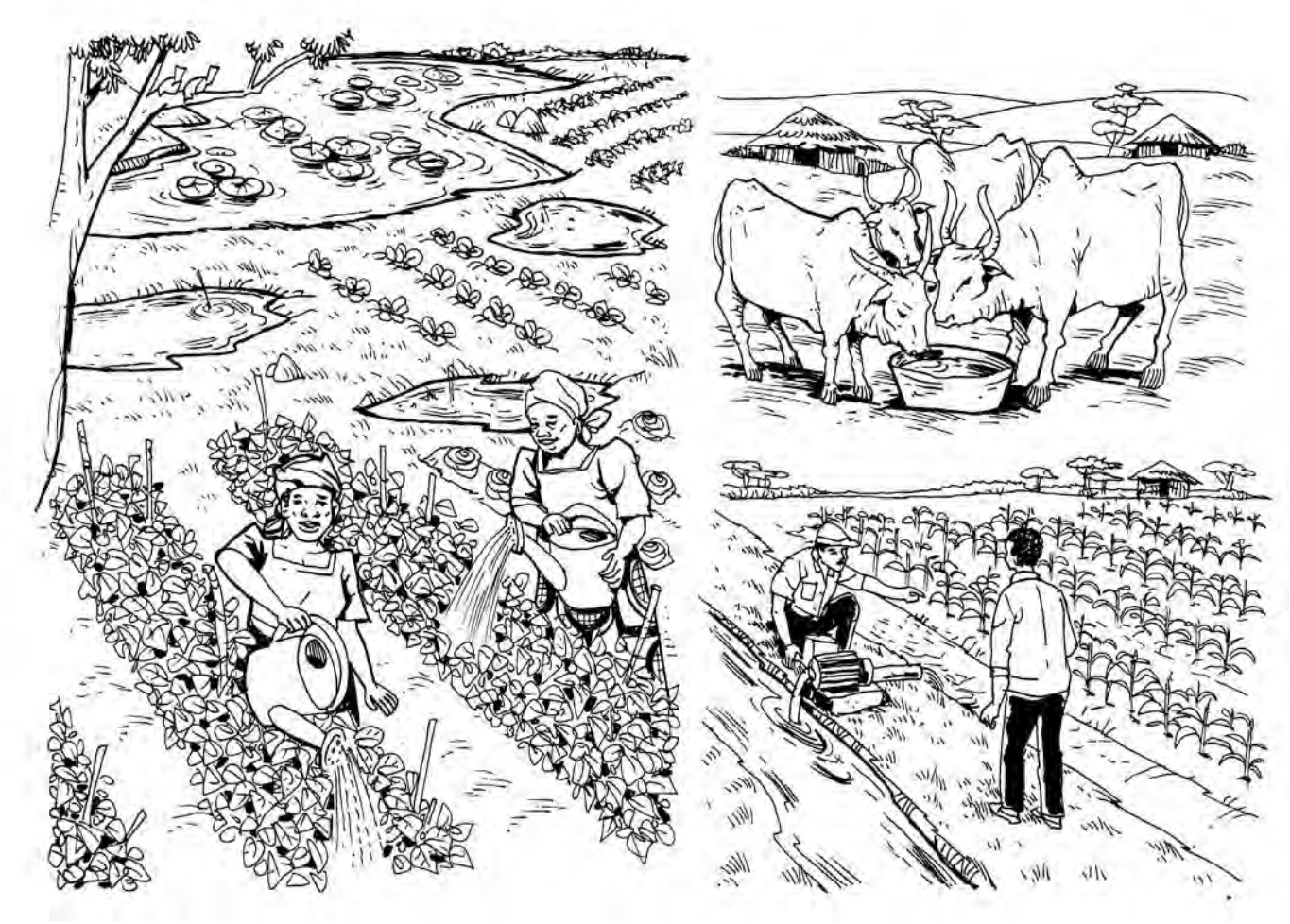
Improving Water Productivity and Efficiency



Rainfall variability has adverse impacts on agricultural production. Rainfall variability experienced in sub-Saharan Africa already has detrimental impacts on crop production. Indeed, too much or too little water due to erratic rainfall and insufficient storage capacity wields adverse impacts on food security. Climate change is widely predicted to increase rainfall variability in sub-Saharan Africa, with the effect of increasing droughts and floods. For many millions of smallholder farmers, reliable access to water is the difference between plenty and famine. It is therefore essential to find ways to cope with existing and increasing variability in rainfall, as well as other effects of climate change like changes in temperature patterns.

Water storage is the basis for ensuring water productivity in the face of climate change. Water storage spurs economic growth and helps alleviate poverty by making water available when and where it is needed. Today, many developing countries, even those with abundant water, have insufficient water storage capacity. Inadequate storage leaves farmers vulnerable to the vagaries of climate. Ethiopia is one such example. Ethiopian farmers are heavily reliant on rainfed subsistence agriculture. The lack of storage infrastructure means farmers have limited ability to cope with droughts and floods. These limitations are estimated to cost the economy one-third of its growth potential. The Ethiopian case is a good illustration of the urgent need for appropriate

investments in water storage to increase agricultural productivity and to ensure that farmers have options for adjusting to the coming climate changes (IWMI, 2009).

Many technologies are available to enhance water productivity. Improving water productivity constitutes another method to adapt to climate change. Increasing water productivity enables greater crop production per unit of water consumed, thereby decreasing reliance on erratic rainfall. There are numerous ways to increase water productivity, some of which are described below.

Response strategies

Storage as basis of improved water productivity

When most people think about water storage, the first thing that comes to mind is large dams. More than 45,000 large dams (more than 15 m high) have been built throughout the world. However, many effective methods for storing water are also relatively simple and cheap, bearing in mind that in some regions such as Ethiopia, even simple ponds and tanks are beyond the financial means of the poorest. Ponds and tanks built by individual households or communities can store water collected from microcatchments and rooftops. Individual ponds and tanks may be small in volume, but in some places this water is vital to supplement domestic water supplies, household gardens, rainfed crops, and livestock. Many different storage options exist (McCartney and Smakhtin, 2010):

Natural wetlands. Lakes, swamps, and other wetland types have provided water for agriculture for millennia, both directly as sources of surface water and shallow groundwater and indirectly through soil moisture. Consequently, wetlands span the surface/subsurface interface and provide water in many different ways. As a result of their important role in the provision of water, wetlands are increasingly perceived as "natural infrastructure."

Soil moisture. Globally, the total volumes of water stored within the soil are huge, but at any given locality, they are relatively small and quickly depleted through evapotranspiration. Because of this, in recent decades, there has been increased interest in various in situ rainwater management techniques that enhance infiltration and water retention in the soil profile. Widely referred to as soil and water conservation (SWC) measures, examples vary from place to place but the most promising include deep tillage, reduced tillage, zero tillage, and various types of planting basin.

Groundwater. Groundwater is water stored beneath the surface of the Earth in aquifers. A major advantage of groundwater is that there is little or no evaporation and total volumes are often much greater than annual recharge. The amount of water that can be abstracted from a well in an aquifer is a function of the characteristics (particularly the permeability) of the rock. Some aquifers will yield only a few liters per day, while others can yield as much as several million liters. Methods for increasing groundwater recharge include pumping surface water directly into an aquifer and/or enhancing infiltration by spreading water in infiltration basins.

Ponds and tanks. Ponds and tanks are cisterns or cavities (covered or uncovered, lined or unlined) built by individuals or communities to store water. They are often linked with rainwater harvesting and store relatively small (but often vitally important) volumes of water. Ponds and tanks fill either by surface runoff or through groundwater and differ from reservoirs by the absence of a dam. A common limitation is that they are usually shallow, with a relatively large surface area, so that often a significant proportion of the water is "lost" through evaporation.

Reservoirs. Reservoirs consist of water impounded behind small and large dams constructed across streams and rivers. Small dams (often built simply by mounding earth) store relatively small amounts of water (a few hundred to a few thousand cubic meters) and often empty every year. Many small dams do not have outlets and water is simply removed by livestock drinking, pumping, and as a consequence of spilling and evaporation. They tend to be shallow with relatively large surface areas so that, in common with many ponds/tanks, a significant proportion (sometimes more than 90%) of the water may be lost through evaporation.

Direct improvements in water productivity

The selection of a particular technology for a given set of conditions is not always evident. As

Different technologies for improving water productivity.

Technology	Description	Advantages	Disadvantages	Typical cost (US$)
Large schemes	Typically river diversion with or without storage reservoir	Potentially large acreage, high potential for improving food security	Management problems, high cost of maintenance	3750–4000/ha
Small schemes	Typically up to 200 ha, may or may not involve storage	May be farmer–managed	Typically less secure water source	450–540/ha
Drip kits	20–L bucket with lengths of drip kit and larger sizes	Versatile, may be used for kitchen garden with excess production marketed	Limited in size, requires nearby water source	20–200 per kit
Drip irrigation systems	Commercially made drip tape, filter, water source	Water-efficient, delivers measured amount of water to root zone	Drip tape generally has a life less than 5 years	High cost
Greenhouses	Plastic or glass enclosure for intensive, controlled agriculture	Water efficient, good potential control of diseases and pests	Plastic may have life less than 5 years, subject to hail damage	High cost
Rainfall harvesting	Constructed reservoir for capture of rainfall for irrigation purposes	Provides supplemental irrigation to rainfed crops or allow production of irrigated crops	May be water–short during drought	Can be constructed by local labor
Treadle or other manual pumps	Lifts water from shallow well, capable of irrigating up to 0.5 ha	Provides a low-cost water source	Requires shallow aquifer within 9 m of surface	35–120
Power pumps	Provides pressurized water from surface or groundwater source	Provides a reliable water supply	Requires electric, gas or diesel power and maintenance	Dependent on power source, lift, and volume
Photo-voltaic pumps	Provides pressurized water from surface or groundwater source	Provides a reliable water supply, no operating costs	May require maintenance, typically small-scale application	High investment cost

can be seen in the table, there is a wide range of technologies available. Some will be more appropriate than others, according to local farmer preferences and local conditions. Farmers would benefit from technical assistance to evaluate and recommend technologies for their particular situations. For irrigation schemes, as opposed to individual enterprises, assistance may be needed in establishing farmer organizations and assuring that they can effectively manage and maintain irrigation systems. The table provides information on some of the major approaches and technologies, along with some of their advantages, disadvantages, and costs.

Source

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References

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