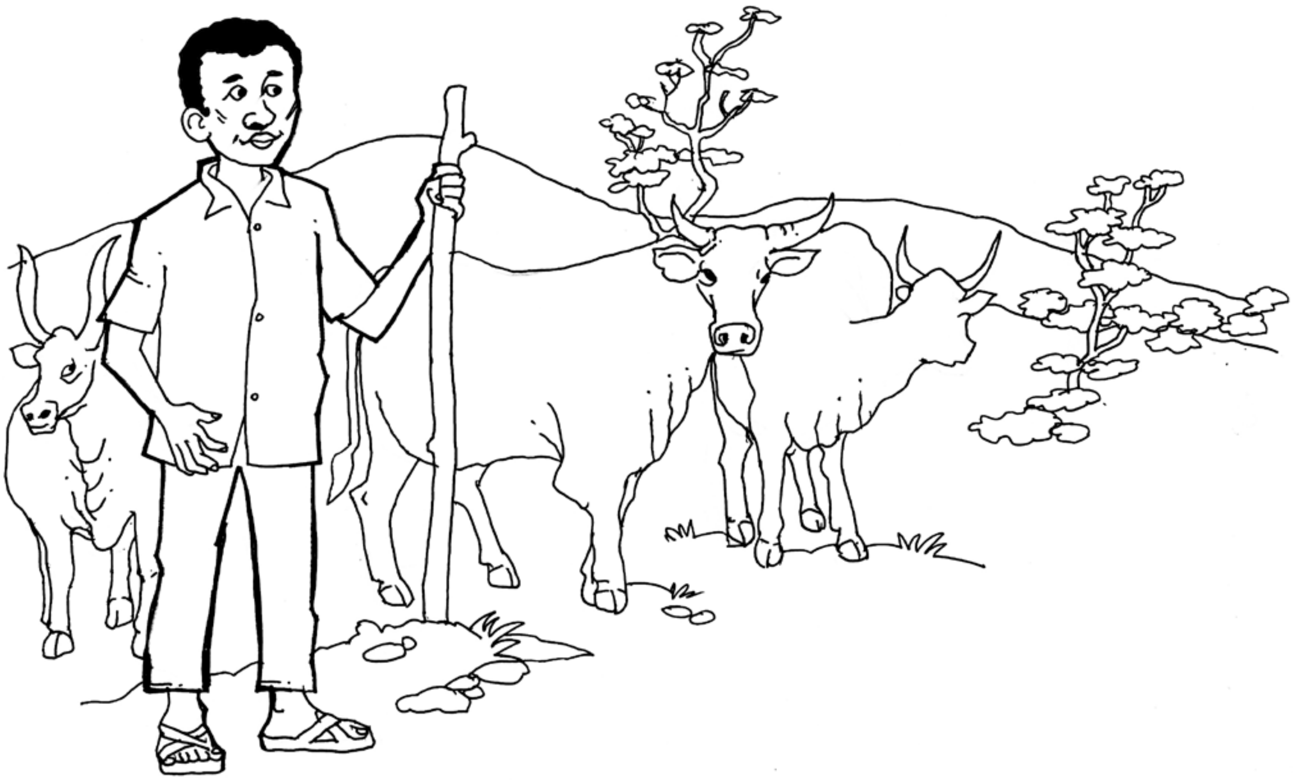
Identifying Strategies for Increasing Livestock Water Productivity in the Blue Nile Basin



The livestock sector is socially and politically very significant in developing countries because it provides food and income for one billion of the world's poor, especially in dry areas, where livestock keeping is often the only source of livelihoods. Livestock keeping is a major component of agricultural gross domestic product (GDP), providing meat, milk, income, farm power, manure (for fuel, soil fertility replenishment and house construction), insurance, and wealth savings to hundreds of millions of people worldwide. However, livestock raising is a major consumer of water. In regions such as the Nile where water is a scarce commodity, the CGIAR Challenge Program on Water and Food (CPWF)through the Nile Basin Livestock Water Productivity project led by the International Livestock Research Institute (ILRI) saw the need to develop strategies to improve livestock water productivity (LWP). LWP is a ratio of the total net beneficial livestock-related products and services to the water depleted in producing them (Bekele Awulachew *et al* 2012). A water accounting approach was used to develop a livestock water productivity (LWP) assessment framework. This framework was then used to identify strategies for increasing LWP, assessing LWP in the Blue Nile Basin, and suggesting opportunities to improve LWP more broadly.

Livestock water productivity assessment framework

Livestock provides people, especially the poor in developing countries, with multiple benefits derived from diverse animal species and breeds. Estimating LWP requires estimates of the total value of these goods and services. Monetary units are used for benefits and LWP is expressed in units such as US$/km^3 of water. As a tool, the LWP helps stakeholders to systematically understand the livestock-water interactions in a variety of systems in the Nile basin. Beneficial outputs refer to milk, meat, hides, farm power, etc. produced from livestock. To produce these outputs, the animals, particularly cattle, need water for drinking and for producing their feed/forage. Depleted water, on the other hand, refers to the water that is lost through evaporation, transpiration (evaporation of water from the plants), and downstream discharge. Once depleted, water is no longer available and has no further value within the system. Water contamination is a depletion process that makes water less valuable to future users even though it may remain within the system.

Estimating livestock-related water inflow, depletion, and storage is a primary requirement for assessing LWP.

$$LWP = \frac{\Sigma \text{ beneficial outputs}}{\Sigma \text{ depleted water}}$$

Water Demand of Livestock

Generally, livestock production competes heavily with both humans and plants for the world's water supply. In particular, livestock in the Nile consume about 600 million cubic meters of water per year (Table 1).

Table 1. Water resources availability, loss, and use.

Crop-Livestock Production	Water Availability (est.)	Water Loss	Water Use
6 rainfed livestock-dominated and mixed crop-livestock production system	1.68 trillion m^3/year	1.27 trillion m^3/ year through evapotranspiration	
Livestock use of water for feed			0.06 trillion m^3/year or 4.7% of evapotranspiration
Livestock use of water for drinking			<600 million m^3/year

Water contamination is a depletion process that makes water less valuable to future users even though it may remain within the system. Once depleted, water is no longer available and has no further value within the system.

In assessing LWP, a basic requirement is estimating livestock-related water inflow, depletion, and storage.

Based on the assessment framework, there are four basic livestock keeping strategies that can help improve LWP. These are optimal feed sourcing, enhancing animal productivity, conserving water resources, and providing drinking water to livestock, especially cattle. These strategies involve supply-side and demand-side management of both water resources and animal products (Figure 1). The four strategies, along with the LWP assessment framework, underpin the research undertaken on a basin-wide and country-specific basis in Uganda, Sudan and Ethiopia.

The framework identified the following four strategies to increase LWP:

1. selection of feeds that require relatively little water and produce enough quality dry matter and nutrients;
2. integration of animal science knowledge (e.g. veterinary science) into water development;
3. water conservation associated with livestock keeping; and
4. optimally distributing livestock: feed and drinking water resources over large areas to maximize animal production through access tp underutilized pasture far from water while preventing overgrazing and water degradation near watering points.

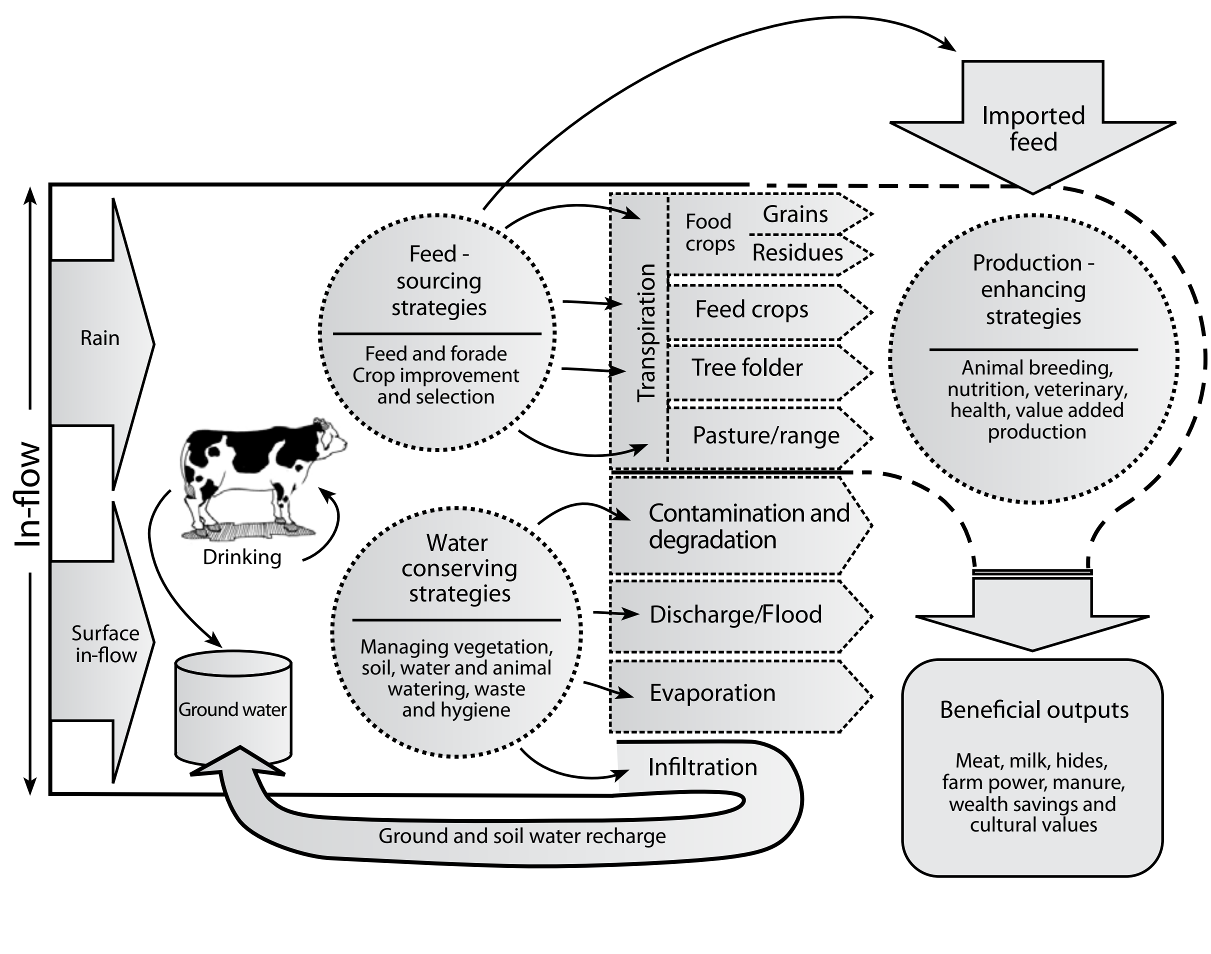


Figure 1. LWP Assessment Framework

Four basic strategies of LWP

1. Feed sourcing

One key strategy for increasing LWP lies in selecting the most water-productive feed sources that produce enough feed to meet the animals' needs. Feed water productivity estimates vary 80-fold from the most to the least efficient, due in part to biology and inconsistent methodologies.

High LWP does not necessarily mean high levels of production and livestock keepers need to maintain profitable enterprises. Thus, the approach to increase LWP through feed sourcing demands must be carefully planned.

a. Feed must meet the nutritional requirements of the animal. This includes estimating the water productivity of the feed with the ratio of metabolizable energy or protein content to actual water depleted.

b. Manure management can also have a major influence on the net benefits derived from livestock and thus on LWP. In extensive production systems, around 50% of the feeds ingested by animals are excreted as manure. Approximately, half of the depleted water supports animal maintenance and production. The other half of the depleted water supports manure production and, in well-managed rangelands, directly supports ecosystem services. Manure is highly valued and widely used for replenishing soil fertility, domestic fuel and construction of houses. However, manure can also be a major cause of environmental degradation, such as water contamination.

c. Water used to feed animals for traction is an

Best practices

In areas where livestock depend partly or entirely on crop residues and by-products, maintaining vegetative ground cover is vital.

When land is traditionally cultivated much of the year, it becomes devoid of vegetative cover. It is then made vulnerable to water loss through runoff and evaporation. The productive land often suffers from declining soil organic matter and water-holding capacity.

Since livestock keeping is highly integrated into rainfed agriculture in developing countries and feed scarcity is widespread, excessive use of crop residues for livestock and household energy aggravates the land and water resource degradation associated with cultivation.

In some cases, water harvesting and groundwater recharge techniques can capture surplus water, which is then kept in storage for dry seasons, increasing water productivity annually. Interventions, aimed at producing animal feeds utilizing crop residues and by-products, also maintain vegetative cover and soil moisture.

input into crop production. Oxen, equines, and buffaloes have traditionally provided farm power for crop production and marketing in many basins, including the communities along the Blue Nile. When the primary use of an animal is for farm power, beef production then becomes a by-product of animal production and is only "produced" when an animal is no longer capable of cultivating land.

2. Enhancing animal productivity

Increasing the ratio of feed energy for production to maintenance has high potential for increasing LWP. In Africa, feed scarcity limits intake, implying that most consumed feed is used to support maintenance, leaving little for production.

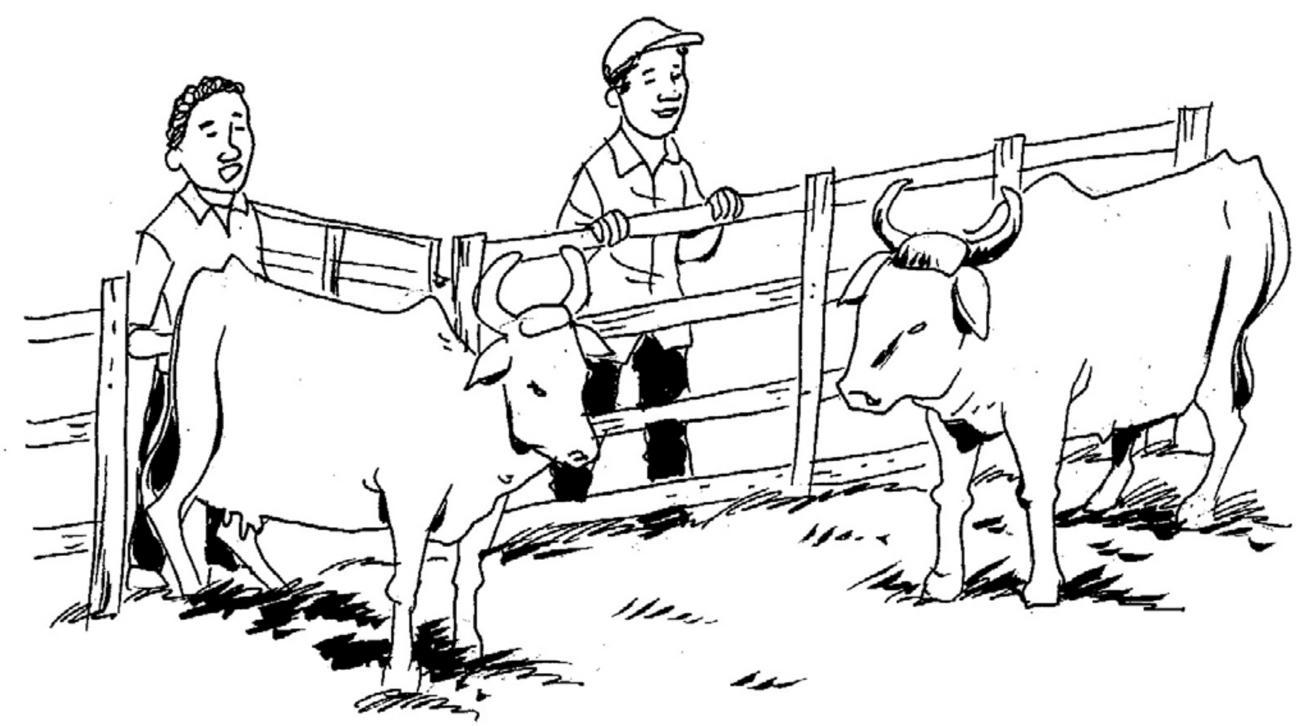
Relying only on aggregate monetary valuation of LWP does not include the disaggregation of animal products into diverse nutrients required for human nutrition. Animal food sources provide essential nutrients such as Vitamin B12 and micronutrients that are often not readily available to poor farmers producing crops on nutrient-depleted soils.

3. Conserving water resources

The primary challenge to conserving agricultural water is maintaining high levels of vegetative ground cover to promote increased transpiration, infiltration and soil water holding capacity and decreased evaporation and discharge.

GRAZING PRACTICES: We suggest limiting animal stocking rates to levels that allow moderate production and to avoid overgrazing. Overgrazing often removes excessive ground cover or shifts plant species composition from palatable to unpalatable types.

GRASSLAND: When well-managed grassland is often the best land use for capturing rainfall, encouraging storage in soil and promoting transpiration and plant production, particularly in drylands and on steep slopes.



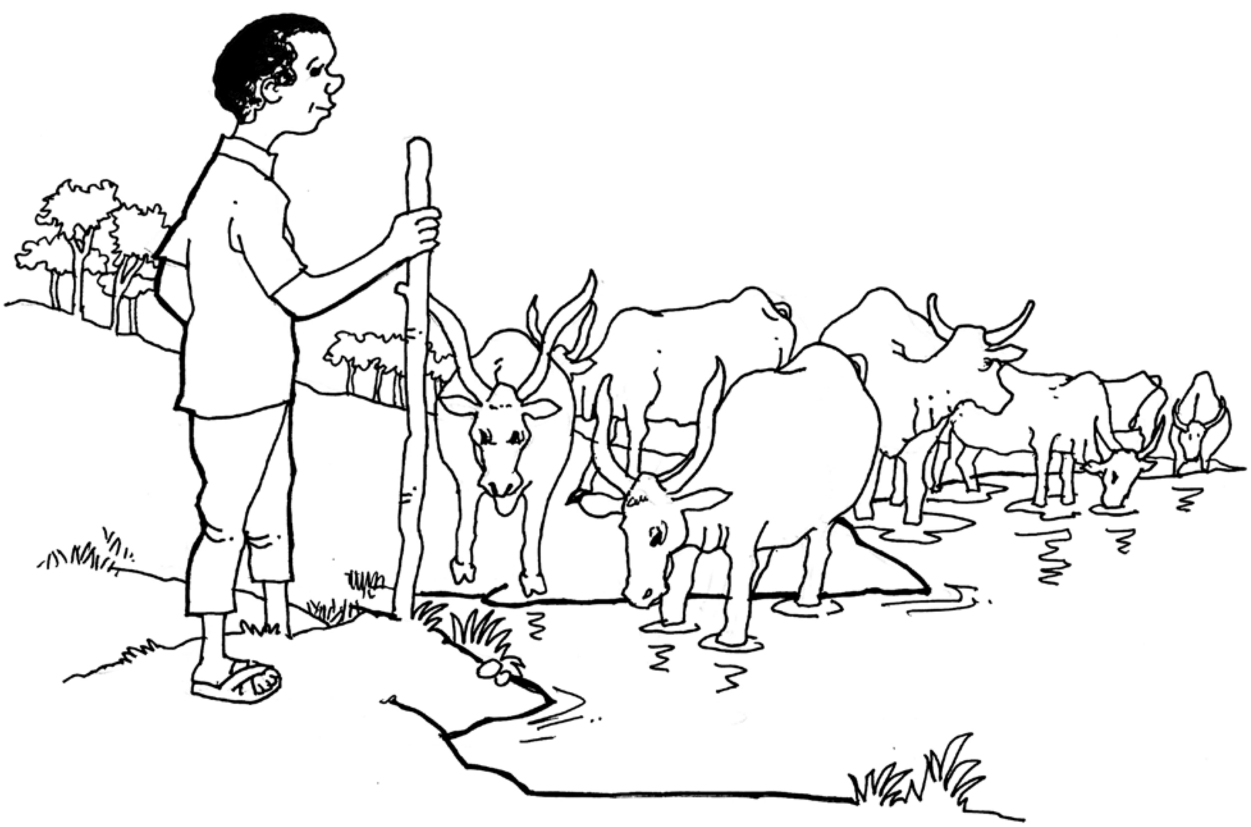
4. Providing drinking water

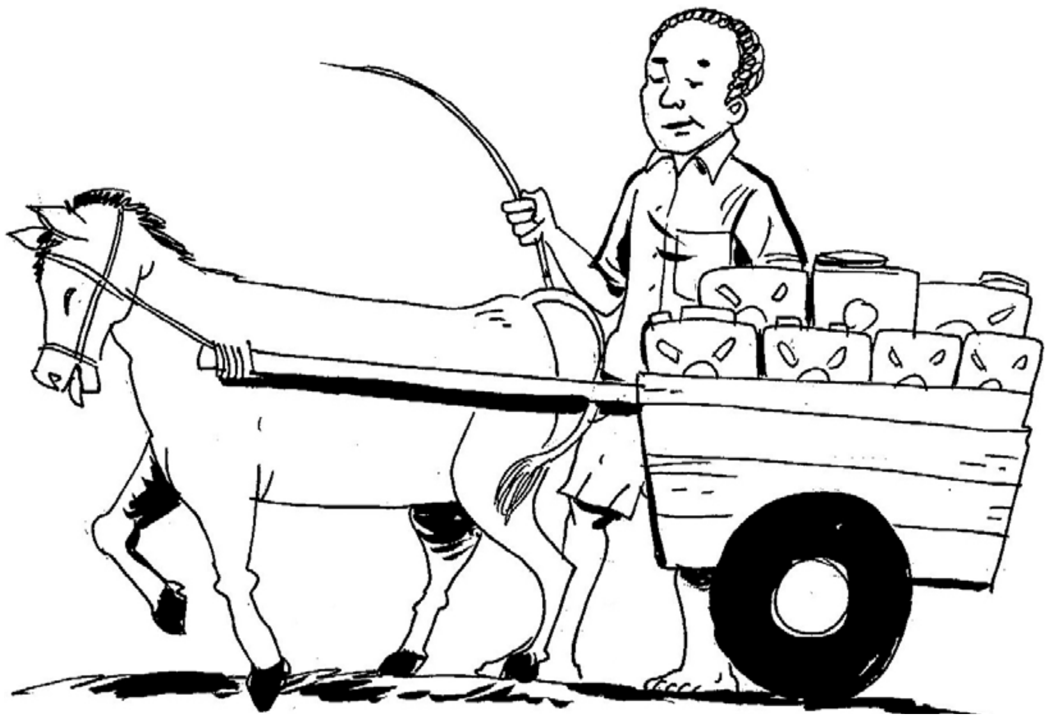
Drinking water must be of high quality and available in small but adequate quantities. Although the cost of providing a unit of drinking water may also be high, the amount of water drunk is less than 2% of that needed to produce feed. Livestock drink about 25 to 50 liters/TLU/day, with variation dependent on many factors, such as species, breed, ambient temperature, water quality, feed intake and water content of feed. More importantly, strategically allocating drinking water opportunities over time and space (seasons and landscapes) optimally distributes livestock, especially cattle, to make more effective use of forages without overgrazing the land. In Africa, livestock watering points are often inadequate in number and sub-optimally distributed and managed. During dry seasons in some areas, livestock travel for hours to reach watering points, resulting in significant loss of energy. In Sudan, achieving an optimal spatial distribution of livestock and drinking water sites can greatly increase LWP and reduce land and water degradation in large parts of the Nile Basin.

Other key issues

- The hotspots and issues identified at the Blue Nile Basin level were livestock production systems, livestock population, livestock water demand for animal feed production, LWP and livestock-induced soil erosion.

- Men tended to dominate in terms of having greater access and control over benefits from financial, social, human and natural capital as compared with women. An exception can be found in Uganda where women are actively involved in the country's cattle corridor, where they seem to have equal engagement as men in crops, goats and poultry, also having access to credit.





- Animal movement occasionally involves crossing state borders in the southern part of the country, such as the northern part of the Upper Nile, as well as with bordering countries, especially Chad and the Central African Republic. Livestock access to the Nile system in dry periods allows better utilization of the vast grazing lands that are accessible during more favorable periods in the rainy season.

Hotspots were defined as "development domains" where intervention options could improve LWP through better management of livestock and water and pasture resources and through improved marketing of livestock products. The development domains were defined on the basis of livestock distributions and densities, access to markets and human population densities.
- Peden et al. 2009

Conclusion

Where livestock are important components of farming systems, there is a need to integrate livestock management, crop management, land and water use practices and resource degradation into one integrated framework. The LWP framework is a starting point. When tested in diverse production systems, the generic framework was robust in handling conditions ranging from extensive grazing systems to intensive mixed crop-livestock systems at local, watershed and basin scales.

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Partner Organizations

Addis Ababa University, Ethiopia
Agricultural Economics and Policy Research Center, Sudan
ASARECA Animal Agriculture Research Network, Kenya
Animal Resources Research Corporation, Sudan
CARE, Ethiopia
Ethiopian Institute of Agricultural Research
Ethiopian Rainwater Harvesting Association
International Livestock Research Institute
International Water Management Institute
Livestock, Environment and Development Initiative
Makerere University, Uganda
Sudan Academy of Science
Swiss College of Agriculture, Switzerland

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Tags: PN37; Nile Livestock Water Productivity

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