Comprehensive assessment of water management in agriculture

water for food, water for life issuebrief#8

Integrating livestock and water management to maximize benefits

Incorporating the needs of livestock into water planning and management could bring big benefits—benefits not achievable by either sector alone. Such integration would enable poor livestock keepers to get more from their animals, while using less water and reducing degradation of land and water resources. The Comprehensive Assessment (CA) has identified this as a high-potential opportunity to reduce poverty, increase water productivity, boost investment returns on agricultural water development, and improve environmental sustainability.

Livestock require a great deal of water, not for drinking, but for their feed. The CA estimates that growing animal feed in developing countries currently depletes upwards of one trillion m_3 of water per year—which is approximately one seventh of global water depletion for agriculture. Given that demand for meat and animal products is increasing by 2.5 to 4% per year in developing countries (see Fig. 1), increasing "livestock water productivity" is a pressing issue—but one that is receiving little attention in the water and livestock sectors.

The CA, along with the Challenge Program on Water and Food, has identified four basic strategies to reduce the amount of water used in livestock production and to increase the benefits from livestock per unit of water used (see Box 1). By taking a balanced site-specific approach that combines all four strategies, it should be possible to at least double livestock water productivity (see Box 2).

Photo: ILRI

Box 1: Strategies for improving livestock water productivity

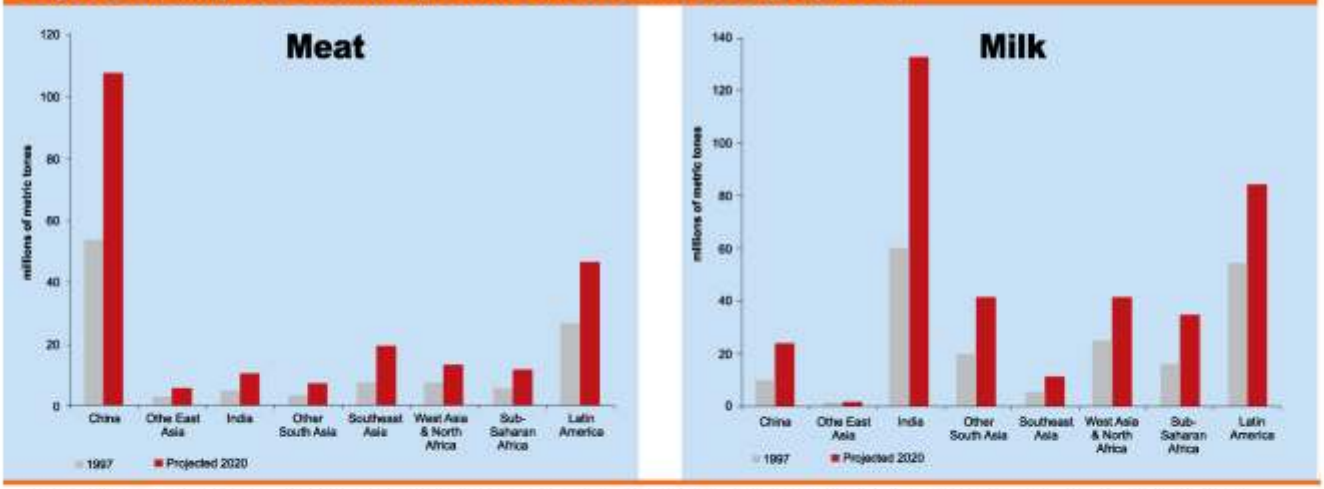
Strategic sourcing of animal feeds – Promoting: non-grain food sources with high water productivity, use of crop residues and by-products as feed, and practices that encourage more uniform grazing.

Enhancing animal productivity & reducing herd sizes – Promoting better health, genetics, nutrition, and animal husbandry practices—thereby enabling livestock keepers to get more from fewer animals.

Reducing negative environmental impacts – Managing animals in ways that reduce land and water degradation (e.g. overgrazing).

Strategic provision of drinking water – Providing adequate quality drinking water—strategically placed—enables animals to reach otherwise inaccessible grazing areas, keeps them from contaminating domestic water sources,: enables animals to reach otherwise inaccessible grazing areas, keeps them from contaminating domestic water sources, and enhances the production of meat and milk.

Fig. 1. Consumption of animal products in 1997 and 2020 (projected)



Demand for meat in China and milk products in India are projected to increase rapidly in the next 15 years. This will increase competition for water in these countries, where groundwater and many rivers are already overexploited.

Box 2: What is livestock water productivity?

Livestock water productivity is the ratio of net beneficial livestock-related products and services to the water depleted as a result of livestock keeping. It is a function of several factors, all of which need to be taken into consideration in decision-making:

- Values of all economic and social benefits from livestock—including food, fuel, fertilizer, and labor.
- Opportunity costs of alternate water uses.
- Water productivity of diverse animal feeds.
- Animal productivity.
- Watering and grazing practices that affect water depletion and degradation.

Livestock & livelihoods

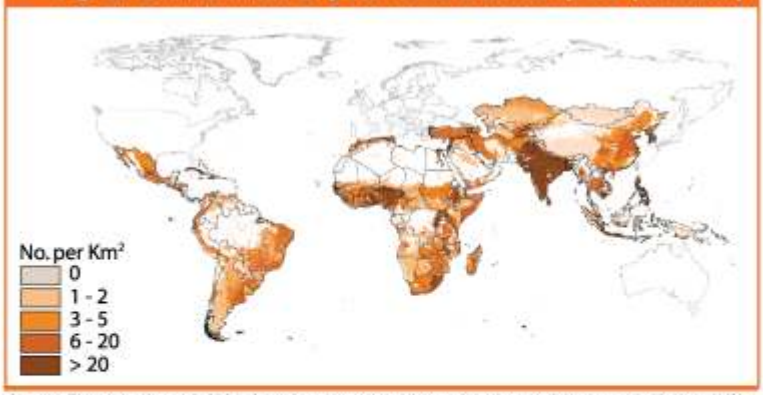
Livestock contribute to the livelihoods of at least 70% of the world's rural poor. And, in addition to enhancing income and food security, livestock play a unique role in livelihood strategies—enabling families to survive crop failure, cope with income shocks, and meet unexpected or major family expenses through the sale of an animal. In many cultures, investing in livestock is the preferred means of building wealth security—serving as a kind of high-interest savings account for rural people who do not have access to formal financial institutions.

Livestock provide many benefits—food, fuel, fertilizer, transportation, labor for cultivation, and materials for other enterprises. And they also play important roles in religious and cultural practices and community life.

While health experts and environmentalists in developed countries may call for people to reduce their consumption of meat and dairy products, in the developing world, nutritionally-deprived people could benefit from consumption of more animal products. For them, meat, milk and eggs are vital sources of protein, minerals, and micronutrients—sources that cannot easily be replaced by other locally available, affordable foods.

The rapidly increasing demand for meat and dairy products in urban areas of developing countries can benefit the rural poor or it can drive them deeper into poverty. Which of these outcomes prevails will depend to a large extent on how and how well water is managed. If current trends continue, the additional pressure on agricultural water resources, especially for feed production, will increase competition—generating conflict over increasingly scarce water resources and marginalizing some farmers and herders (most likely the poorest). On the other hand, if water is better managed for crops and livestock, this can mean an opportunity for rural farmers and herders to greatly increase their income. To help the greatest number of livestock-dependant rural poor, South Asia and sub-Saharan Africa should be the priority regions for integrating livestock and water development (see Fig. 2), although poor and non-poor livestock keepers in many other regions could also benefit.

Fig. 2: Distribution of poor livestock keepers (No./km²)



Source: Thornton, P., et al. 2002. *Mapping poverty and livestock in the developing world.* Nairobi: ILRI.

The convergence of high livestock densities and poverty occurs mostly in South Asia and in a band stretching from Senegal across the Sahel to Ethiopia and southward through East Africa and into South Africa. High animal densities also exist in the cone of South America, Turkey and the eastern Mediterranean, and East Asia, but poverty in these areas is less severe.

Reducing the amount of water livestock "eat"

Livestock "eat" up to 100 times more water than they drink. Reducing the amount of water depleted to produce animal feed may be one of the most effective ways to improve water productivity globally. There are three basic ways of accomplishing this, which are described below:

Switching to feed sources with a higher water productivity: In this context, water productivity is a function of how much water is consumed (through plant transpiration and surface evaporation) to produce a unit of feed. Of the three options, this could have the biggest impact on water productivity in agriculture, but it may also be the most challenging to implement.

A large part of the challenge is a lack of knowledge. Existing estimates of water used to produce forages vary from a low of 0.1 to 7.0 kg/m3—a seventyfold difference. But there is much we don't know—for example, how animal preferences and nutritional value factor into water productivity calculations. As a first step, there is an urgent need for a systematic global evaluation of water productivity of existing forage plants and other feeds. The next step will be identifying high water-productivity feed sources suitable for different climates, landscapes, and types of production systems and, finally, finding ways to encourage farmers and livestock keepers to adopt them.

Using crop residues and by-products as feed: This is a promising option from the point of view of poverty reduction and reducing the water consumed to produce feed, and it has the added advantage of increasing returns on investments in irrigated and rainfed agriculture. For example, in Sudan's Gezira irrigation scheme, livestock provides 37% of farmer's income. Theoretically, if livestock production were based solely on use of crop residues and by-products, water for feed production would be nil. However, livestock often cannot thrive on such a diet. They also need some high-quality feed to provide essential nutrients and to enable them to digest lower quality feeds.

Photo: ILRI

In the Ethiopian highlands, millions of poor grain farmers who also keep livestock harvest residues to use as feed for oxen, horses, and donkeys. Combined with strategies to improve animal productivity, this has enabled them to increase their income and produce more animal benefit with less water.

Encourage more efficient grazing: Almost 50 million km^2 of agricultural land in developing countries support livestock, but animal production is not optimally distributed to take advantage of many feed resources. Some areas are overgrazed and some have untouched surplus vegetation. A large part of implementing this option involves providing drinking water to enable livestock to access surplus forages and crop residues. But this must be done with care because areas adjacent to watering sites are vulnerable to overgrazing and land degradation.

Photo: IRC

Any interventions to improve livestock water productivity need to take into account the different roles men and women play in livestock production systems. In India, women are responsible for 71% of the labor, including feeding and watering.

More animal benefit per drop?

Increasing animal productivity—through better nutrition, health, and genetic resources—and benefits for livestock keepers—through access to markets and value-added processing—will also contribute to water productivity and poverty reduction.

In much of the developing world, livestock productivity is less than 50% of genetic potential. Milk production is low—often less than two liters per cow per day (as opposed to 15 or more). Animals have high mortality and morbidity rates and low reproductive rates, and they often do not meet the animal health and food safety standards necessary to access international markets.

Some examples of possible interventions to increase the benefits from livestock per unit of water used include:

- Provision of continuous access to quality drinking water to maintain high yields of milk, for example, through water harvesting or adaptation of irrigation or domestic supply systems.
- Selection and breeding of cattle to improve the efficiency with which they convert feed to productive use.
- Provision of veterinary health services as part of investments in irrigation development where livestock production potentially contributes to farmers' incomes.
- Enabling value-added household processing of animal products, for example, butter-making.

Reducing negative impacts on the environment

Loss of vegetation due to overgrazing results in increased soil erosion, downslope sedimentation, and reduced water infiltration—all of which can have an impact on overall water productivity. Research indicates that low to moderate grazing pressure has little negative impact on hydrology. The threshold level of grazing intensity above which water and land degradation becomes problematic and animal production declines is site-specific, and in most areas is not known or factored into livestock management.

In addition, animals can aggravate runoff and sedimentation by trampling and trekking on paths. And they can cause damage to irrigation infrastructure and to riparian and aquatic habitats.

Some examples of interventions include:

- Restricting animal access to certain water sources to avoid: sedimentation, water-quality loss, risk to human health, loss of riparian and aquatic habitats.
- When planning or upgrading irrigation systems, making specific provision for animal drinking areas (including water storage to ensure animals have a reliable year around supply).
- Better, more integrated management of grazing land, for example by establishing community-based range and water management, creating riparian buffer zones, and limiting stocking rates and grazing pressure.
- Preventing overgrazing and maintaining some vegetative cover or crop residues to reduce runoff and evaporation from soil surface.

Drinking water for animals: Big returns from a little water

Livestock drinking water requirements total only about 900 million m^3 per year for all the developing countries. Only a small fraction of this water is actually depleted, since water drunk is not lost from the farming system and much returns to the environment in the form of urine and feces. However, the amount, quality and location of drinking water sources in pastoral, rainfed and irrigated crop-livestock systems can have a big impact on livestock water productivity.

Water deprivation reduces feed intake and can greatly lower milk production. Providing adequate quality drinking water in sufficient quantities greatly increases animal productivity. Given the high value of animals, particularly to poor households, and the relatively small amount of water used, animal drinking water supplies are a good investment.

In addition, since cattle prefer to graze close to drinking water, strategic placement of watering points encourages more complete and uniform grazing and can enable animals to reach otherwise inaccessible feed sources. This means a significant water savings when the plants, and therefore the water consumed in their production, would otherwise remain unutilized.

The way forward

To realize the opportunities described here requires intersectoral development and management of water and livestock resources, and, this, in turn, requires location-specific adjustments in institutional arrangements—for example, at the community level, the integration of pasture management and water user associations. Integrated analyses of costs, benefits, investment returns and optimal use and allocation of land and water also need to be incorporated into natural resources management.

Box 3: Three key areas for action

- **Water development planning processes** should explicitly assess the potential for adding value, sustainability and profitability to investments in agricultural water by assessing the benefits and costs associated with livestock in the area under development.
- **Livestock development and management** should be designed in ways that reduce the amount of water depleted and degraded, and this action needs to include the water sector.
- **Knowledge gaps** related to livestock-water interactions among diverse agro-ecosystems and cultures and among many species and breeds of animals need to be filled to enable better water and livestock decision-making.

CGIAR Challenge Program on WATER & FOOD

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

Comprehensive assessment of water management in agriculture

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The Comprehensive Assessment of Water Management in Agriculture (CA) is a five-year initiative to analyze the benefits, costs, and impacts of the past 50 years of water development and management in agriculture, to identify present and future challenges, and to evaluate possible solutions. The CA's Issue Brief series, published by the International Water Management Institute (IWMI), presents key findings from the main Assessment report *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture* (Earthscan). More on the CA donors, co-sponsors (CBD, CGIAR , FAO, Ramsar), process and publications can be found at: www.iwmi.org/assessment.

The International Livestock Research Institute (ILRI) is a non-profit organization working at the crossroads of livestock and poverty. ILRI brings high-quality science and capacity-building to bear on poverty reduction and sustainable development in Africa, Asia, Latin America and the Caribbean. See www.ilri.org.

The Challenge Program on Water and Food (CPWF) is an international research and capacity-building initiative of the CGIAR to find ways of growing more food with less water—while improving rural livelihoods and protecting the environment. For more information, see www.waterandfood.org.

This Brief is based on the chapter "Water and livestock for human development" by Don Peden, Girma Tadesse and A.K. Misra in *Water for food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, 2007. For the more information on the livestock component of the CA, contact ILRI-Kenya@cgiar.org.

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