

# AGRICULTURAL WATER USE ASSOCIATED WITH ANIMAL PRODUCTION SYSTEMS IN GEORGIA

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**Abstract.** Agricultural waters use normally centers on the large cross-section of irrigation withdrawals by cropping systems. However, animal production systems are also a significant component of water use in the state of Georgia. These production systems are therefore directly affected by the continuing drought and limited availability of water. Many animal production facilities, such as dairies, poultry houses, processing plants, and related operations use water continuously throughout the year. Some of these facilities could be prime candidates for improvements in water use efficiency and water conservation. The main emphasis of this paper will be to present an overview of water use associated with animal production systems in the state of Georgia.

## INTRODUCTION

Water user by animals is composed of the water actually consumed by animals plus the water used in management, and in the case of aquaculture, water used essentially to house the animals. Water intake of mammals and birds is relatively well understood and is known to be influenced by feed intake, temperature, productive stage of the animal, and some factors related directly to the water, such as salinity or components contributing to its palatability. Equations for predicting the water consumption of beef and dairy cattle have been published by the National Research Council (NRC, 1989, 1996). Other factors, such as the waste management system used, washing and sanitation practices (including cleaning of watering devices), and how the water is presented to the animals (amount spilled or otherwise bypassing consumption) likely have much greater impacts on total water use from farm to farm for a given species than does the actual amount of water consumed by the animals. Much unpublished data concerning auxiliary

water use are outdated and deal with issues such as the effect of water pressure on the amount of water needed to hose off concrete floors, etc., or the amount of water used for various flushing arrangements, which were common before the widespread adoption of the practice of using lagoon liquid for manure flushing. However, there is still a need to document and compare auxiliary use of water associated with various types and management systems.

Additional water is used in the processing of animal products. For example, it has been estimated that it requires 50 liters (13 gallons) of water to produce 0.45 kg (1 pound) of beef on the farm, ranch and/or feedlot plus about this same amount to convert it to a consumer ready product (Ross, 2000). Most of this processing now occurs at central locations where meat, milk, and eggs from entire regions are processed. The few remaining small processing facilities in operation are most often connected to public water supplies. Thus, most of the processing should be covered under present industrial and commercial uses and it is unlikely that small processing plants will proliferate in the future. This paper will therefore only discuss on-farm use of water by animal enterprises.

## Beef cattle

The National Research Council (1981) discusses water intake and factors which influence it. In general, beef cattle at thermoneutral temperatures need about 0.45 liters (one gallon) of water for each one kg (2.33 lbs.) of feed dry matter intake (feed plus water - 20 to 22% dry matter). Water intake will likely be near this amount when cattle are receiving a dry diet, such as hay, but can drop to one-half this amount when fed moist forage such as silage, and can be only a small fraction of this amount when consuming lush, high water content, pastures. In

theory, cattle that are grazing high water content winter annual forages, for example, will obtain nearly all of their water needs from the plants consumed and deposit a large percentage of this water back on the soil surface, with evaporation as the only consumptive use. Other factors which affect water intake are environmental temperatures, which if high enough to invoke heat stress, can increase water uptake up to five fold (the temperature of the water at both high and low temperatures also affects intake); reproductive status, as water intake increases during lactation; rainfall, which reduces voluntary water intake of exposed cattle; and cattle breeds. Since other metabolic products are also lost through the skin along with perspiration, urine production can be lower such that zebu cattle consume about 35% less water than other breeds under the same feed intake and temperature conditions. There have been attempts to predict cumulative water intake of beef cattle based on “growing degree days”. The values of such schemes may depend upon the data used in their development, as beef cattle maintained in close confinement may consume considerably more water than similar cattle in more extensive conditions.

### **Dairy cattle**

Water use by dairy enterprises can be attributed to animal intake, including amounts added to feed during mixing, equipment and facility cleaning, manure handling, and evaporative cooling. In general, the water intake of dairy cattle is similar to that of beef cattle, taking into account the feed intake needed to support milk production together with their much larger requirements for lactation, i.e. greater milk production, added on (NRC, 1981). At the same milk production level, Jersey cattle will generally consume about 10% less water than Holstein cattle (NRC, 1989). In addition, since dairy cattle are usually at a higher metabolic state, environmental changes often invoke larger responses than observed for beef cattle. Many dairy herds in Georgia are maintained in confinement or partial confinement which usually necessitates the use of water for purposes other than cattle intake, and even where dairy cattle are maintained on pasture, additional water is used in the milking area to clean facilities and equipment. Evaporative cooling of dairy cattle in confinement is also becoming more widely practiced. The greatest variation in water use on dairy farms is expected to be due to housing and manure management systems, type of milking facility, and the extent of water reuse.

### **Swine**

Pigs, from weaning to market, consume about 3.7 liters (one gallon) of water for each 1.5 kg (3.3 lbs.) of feed eaten (Almond, 1995; Brooks and Carpenter, 1993; NRC, 1998). The total amount then varies from less than 3.7 liters (one gallon) per pig per day during the period just after weaning to 19 liters (five gallons) or more per day immediately prior to marketing. Actual water intake will be affected by temperature, feed composition, and water quality (NRC, 1981). Water intake by the breeding herd is influenced by reproductive status and lactation, but is generally greater per unit of feed intake than for market pigs (Friend, 1971). Almost all pigs are currently maintained in confined housing for at least a portion of their life cycle. Therefore, as with dairy, much of the farm to farm variation in water use will likely be due to auxiliary uses, such as for washing, manure management, and evaporative cooling.

### **Poultry (Chickens)**

Chickens can be divided into broiler chickens, layer hens, and breeder flocks. While housing and management of broilers, layers, and breeders is different, in most modern facilities for either, water use is a combination of water consumption and water used for evaporative cooling. As with most other animals, the environmental temperature has a profound effect on water intake by chickens (NRC, 1981). The primary differences are expected to be those related to age and egg production for layers and breeders, and rate of feed intake and growth for broilers (Bramwell, 1997; NRC, 1994; Vest, 1997). Although most liquid manures systems for layers and flow-through watering systems for poultry have been phased out, they still offer some degree of facility design and management variation which may need to be verified.

### **Aquaculture**

Several aquaculture species are represented in the state of Georgia, but catfish production predominates. This production ranges from food fish production to fee fishing ponds. The major water uses for catfish production are pond filling initially and after draw down, during harvest, evaporation, and seepage. Total water use can also be affected by management options that allow pond levels to fluctuate so that rainwater is collected rather than overflowing, reusing tail water from draw down operations, and other practices. In addition, stocking rate and fish production per acre will affect water use per unit of fish produced. Water use per unit of pond area

may be as high as 1.2 m (48 inches), or considerably lower when water conservation measures are practiced.

## MATERIALS and METHODS

Water use for beef cattle was collected from water meters installed on individual water tanks and drinkers, located in pastures where cattle did not have access to streams or ponds. The pastures that were selected included four fields at the Redbud Farm in Calhoun, two fields at Alapaha, one field at the Bull Test Station in Irwinville, and four fields at the Coastal Plain Experiment Station in Tifton. Data collection occurred during 2002. Animals were divided into three weight classes, ranging from < 400 lbs., 400 to 800 lbs., and > 800 lbs.

Data collection for swines was limited to the Boar Test site at the Coastal Plain Experiment Station for 2002 only. It included both an early wean nursery as well as grown pigs.

No data were collected for poultry. Instead an analysis was conducted based on outcomes of a long-term study on water intake conducted by S. Savage (personal communication). For aquaculture the appropriate methods for determining water use are currently still being evaluated.

## RESULTS AND DISCUSSION

### Beef cattle

Water use for heifers located at the Bull Test Station in Irwinville ranged from 3.8 to 9.5 gallons/animal/day. One observation in February included an example of water use during overflow, which was 32.3 versus 6.8 gallons/animal/day during normal use. This large difference between normal and spillage water use could be a potential area for water conservation.

Water use for cattle located at the Alapaha farm varied between 3.0 and 10.3 gallons/animal/day, with the highest water use occurring in May. There was an equal split between small (< 400 lbs.) and large (> 800 lbs.) size animals for this location.

Water use for cattle located at the Coastal Plain Experiment Station in Tifton was much higher than the other two locations, mainly due to larger animals. For instance for a pasture that only included large animals (> 800 lbs.), water use varied between 6.5 and 23.2 gallons/animal/day. For a second pasture that included a

mixture of large and small animals, water use varied between 3.8 and 21.5 gallons/animal/day. Overflow measurements varied from 29.6 to 71.0 gallons/animal/day, again demonstrating a potential for water conservation.

Water use for the Red Bud Farm in Calhoun was very consistent among the four fields, varying between 4.3 and 15.1 gallons/animal/day. The herd sizes varied between 33 and 39 animals and consisted of an equal number of small (< 400 lbs.) and large animals (> 800 lbs.), except during the month of July, when some animals were removed and approximately half of the small animals were changed to the intermediate weight class (400 - 800 lbs.).

### Swine

Water use data for swines was very limited and only presents preliminary results. For grown swine water use varied from 5.4 to 10.04 gallons/animal/day, while water flush varied from 47.0 to 64.8 gallons/animal/day. Water use for the nursery varied from 1.0 to 1.1 gallons/animal/day.

### Poultry

Based on the outcomes of 15 years of long-term water use data collected in Georgia by poultry extension specialists, broilers consume approximately 1.4 pounds of water for each pound of feed (S. Savage, personal communication). Broilers, e.g. table eggs and broiler breeders, consume 1.8 pounds of water per pound of feed. The 2001 agricultural statistical report for Georgia (National Agricultural Statistics Service, 2003) showed that in 2001 1,247.3 M broilers were produced for a total of 6,236.5 M lb. With a feed efficiency of 1.9, total feed usage was 11,849.35 M lb. That would project a water usage of 16,590 M lb or 1.989 M gallons. In 2001, there were 11.696 M hens for layers, with a total feed intake of 1,766.6 M lb and water usage of 212 M gallons, and 9.298 M hens for breeders, with a total water usage of 234 M gallon. The estimated total water usage for poultry for 2001 was 2,435 M gallon/year, not accounting for layers and breeding pullets, other types of poultry, and water used for evaporative cooling of chicken houses and other management procedures.

The results reported so far are still preliminary. Data will continue to be collected during the Spring and Summer of 2003. Hopefully an improved set of estimates can be developed at the end of this study that will show water use by animal production systems in Georgia. It is

important to keep in mind that the key to the survival of any mammal is access to adequate water on a daily basis for optimum functioning of all its physiological processes.

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