DAIRY ECOSYSTEM MANAGEMENT

Rhett H. Johnson

AUTHOR: Grazing Lands Specialist, Soil Conservation Service, South National Technical Center, P.O. Box 6567, Fort Worth, Texas 76115.
REFERENCE: Proceedings of the 1993 Georgia Water Resources Conference, held April 20 and 21, 1993, at The University of Georgia, Kathryn J. Hatcher, Editor, Institute of Natural Resources, The University of Georgia, Athens, Georgia.

INTRODUCTION

The state of Georgia has 602 dairies. Many of these dairies have pasturelands that are not being managed to maximize their potential in aiding water quality achievement.

The objective of this presentation is to establish why dairies with pastureland should be managed using ecological principles to solve water quality problems. Many people think of a dairy as a place where farmers milk cows and animal waste is produced. Seldom are dairies thought of or managed as a unique ecosystem.

DISCUSSION

Dairy as an Ecosystem. Webster defines an ecosystem as "an ecological community with its physical environment, regarded as a unit." Ecological is defined as "the relationship between organisms and their environment." In other words, an ecosystem is a community where a relationship between organisms and their physical environment is considered as a unit.

Let us look at the ecological components of a dairy. First, we have the physical environment that consists of soils, water, air, sunlight, and nutrients. Nutrients are nitrogen, phosphorus and potassium, and other many less prominent elements. Second, the organisms of our dairy ecosystem are cows, plants, wildlife, insects, micro-organisms and man.

In a dairy ecosystem, there is a flow of nutrients. Nutrients are brought into the system as purchased feed and fertilizer. Forages use these nutrients as they grow in the ecosystem. Animals are fed the forage or graze it directly. Animal waste is produced that contains nutrients which are spread on the soil again for plant use.

Plants in the Dairy Ecosystem. Plants are the basic organisms responsible for nutrient and energy flow through ecosystems. Plants are responsible for capturing the energy of the sun and then utilizing the nutrients to produce food for their growth.

Many times plants on a dairy are not managed to insure their health and vigor. They are managed as a resting area for cattle. No consideration is given to their production of quality feed, or as a major link in the nutrient cycle. No consideration is given to their soil binding properties and their ability to act as a giant filter.

Plant growth must be understood by the dairy manager to insure that plants have the opportunity to manufacture sufficient food to maintain their health and vigor. Only healthy plants can maximize nutrient use. Plants with continuously reduced leaf area consume all their manufactured food to regrow leaf area. No food is allocated to the root system when this occurs. The root system uses its stored carbohydrate reserves in respiration, and begins to shrink in size. As it shrinks in size it loses its ability to take in water and nutrients. Without water and nutrients, and reduced leaf area, the plant can no longer efficiently manufacture food. Only limited growth occurs (Briske, 1991). The end result is that nutrients available in the soil cannot be efficiently utilized.

Plants utilize nutrients in direct proportion to production. Production is in direct proportion to optimum plant heights maintained on the area. Tall fescue grazed to a 1 to 3 inch height early in the season and maintained at that height throughout the remainder of the season produced only 2800 pounds total annual production. Tall Fescue grazed initially and for the remainder of the growing season to a 3 to 6 inch height produced 7000 pounds of growth (Norman, 1992). A comparison of nutrient use by these plants with different grazing heights is 63 pounds of nitrogen, 15 pounds of phosphorus and 61 pounds of potassium for the 3 to 6 inch grazing height. For the 1 to 3 inch grazing height, 29 pounds of nitrogen, 6 pounds of phosphorus and 26 pounds of potassium are used (Lemunyon, Cropper, Geter, 4/92).

Management Plan. How can the dairy ecosystem be managed to meet the needs of the plant, maximize nutrient use, produce high quality feed for the dairy cow, reduce nutrient flow in the form of feed into the ecosystem, stop sheet and rill erosion, stop stream bank erosion, reduce nutrient flow to surface water, reduce fecal coliform to an acceptable level in surface water, and maximize economic efficiency?

A grazing management plan designed to utilize a short duration grazing system can be designed to use the dairy

cow as a "tool" in ecosystem management. A pasture of high quality cool season perennial grass and legume species could be subdivided into 21 pastures using one wire electric fence. A 21 day cycle could be used giving cows access to one pasture a day. This would provide 20 days regrowth before regrazing would occur. Through a nine month grazing season, each pasture would receive 13 single day grazing periods, and then be completely rested during the 90 day summer period. A high quality warm season grass could be established and subdivided into 14 pastures. Each pasture could be grazed 2 days and rested 26 for regrowth.

Benefits of Management Plan. By using such a grazing management plan, plants in the dairy ecosystem are allowed to grow at their maximum rate, with periodic short grazing periods of one or two days in length. High quality plant species can be maintained in the pasture. The entire pasture becomes a giant filter. Animal waste is scattered over the pasture naturally instead of deposited at concentration points due to livestock density and limited access to the natural shades along steams, etc. Riparian area vegetation grows to the waters edge and stream bank erosion is no longer a problem because the plants in these natural concentration areas will now have almost continuous rest with brief periods of grazing. Sheet and rill erosion is controlled due to healthy plants providing complete cover of the soil.

A major portion of the feed requirements come from the pasture instead of being purchased as the pasture is now producing to its maximum. Nutrients are no longer forced into the ecosystem as bought feed, but recycled as forage is grown, grazed and passed through the animal, and back to the pasture. Due to the abundance of high quality forage available every day in the short duration grazing system, purchased grain is reduced from one pound of grain for each 2 or 3 pounds of milk produced to one pound of grain for each 4 or 5 pounds of milk produced. Animal waste from barn areas are spread on healthy growing plants that can hold it in place as well as maximize its use. This is in contrast to waste being applied on low vigor or dormant plants and bare soil.

Streams with eroding stream banks, will seldom need to be fenced as cows will have only limited and timed access. Areas along streams can be used as hayland if total elimination of animal contact with water is a must, or the stream can be fenced as an option. Combinations of pasture plant species that provide 12 months of forage production and nutrient use can be selected. Pasture species that grow during periods of the year when high fecal coliform counts occur can be planted in areas away from streams, thus moving livestock away from stream contact during this time. Waste can be applied on these areas without contamination of streams.

Allowing animals to directly harvest (graze) high quality forage from pastures is much more economical than mechanically harvesting the forage and storing or hauling it as green chop to the barn. There is a substantial reduction in equipment cost and labor.

Environmentally, the ecosystem is no longer force fed a high rate of nutrients. Nutrients brought into the system are naturally and mechanically spread on healthy plants. They are held in place and utilized at the maximum rate, and thus maintaining them in the dairy ecosystem. Man becomes a positive influence on the dairy ecosystem through his understanding and management.

SUMMARY

Through the use of a Grazing Management Plan and a Short Duration Grazing System the pastureland dairy ecosystem can be managed to be both ecologically and economically sound. When ecological principles are not used, the dairy ecosystem becomes inefficient, and leads to the application of practices aimed at treating "symptoms" instead of "causes."

RECOMMENDATION

Prior to the establishment of a dairy waste management system or the fencing of streams in a dairy ecosystem, the dairy ecosystem should be evaluated. Plans to maximize plant community health and vigor by using the dairy herd as a tool should be considered. In this way, the needs of the soil, water, air, plants, animals, and man will be met for now and the future.

LITERATURE CITED

Briske, D.D., Developmental Morphology and Physiology of Grasses, Chapter 4 of *Grazing Management an Ecological Perspective*, Edited by Rodney K. Heitschmidt and Jerry W. Stuth, Timber Press, INC. 1991.

Lemunyon, Cropper, Geter, Role of Plants in Waste Management, Chapter 6 of Part 651, *Agricultural Waste Management Field Handbook*, 4/92, Soil Conservation Service.

Norman, Arnold, Pasture Management and Water Quality, South National Technical Center Pastureland Workshop, Jackson, Mississippi, May 19-21, 1992.