A SURVEY OF DAIRY FARMS OF PIKE AND AMITE COUNTIES OF MISSISSIPPI IMPACT OF DAIRY WASTE ON WATER QUALITY

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INTRODUCTION

Wastes from animal production are a significant component of agricultural Non-Point Pollution Source (NPS), for example, a 100 cow dairy herd produces as much fecal matter as a community with a population of 15,000 (Myers 1985). Thus a dairy facility with a herd of 100 cows would generate waste equivalent to waste produced by five towns of the size of Port Gibson, MS (population 3,000). The availability of these estimates associated with their reports related with nutrient over-enrichment in the bays, estuaries, and margin of the Gulf of Mexico has focused attention on the significance of agricultural Non-Source Pollution (NPS) in the Tangipahoa River basin of Southwest Mississippi. A number of state and federal agencies are actively involved in providing assistance for on farm nutrient management and development of best management practices (Myers 1985).

There are problems associated with the disposal and/or use of dairy cattle waste. One problem is the concentration of large scale feeding operations typically in a different geographical area. A second problem is that the nutrient in the content of manure vary considerably. The reasons for variations are not well documented.

Most agricultural producers tend to over apply animal manures to the land primarily for two reasons: 1) the producer often does not control enough agricultural land to dispose of the animal waste at the rates approximating the agromonic need of the crops being produced; and 2) nutrient content of the manure is so variable the agricultural producer may treat the manure as a waste to be disposed of rather than as a valuable nutrient source to be utilized and managed for profit. Every dairy farm has a unique combination of variables in addition to soil type and management practices. Very little specific data is currently available on nutrient content of dairy wastes, in lagoon, holding ponds, or litter; considerable variation also occurs with waste handling, dilution, bedding used, feeding ratio, pasture grazing, etc, (SCS 1992). It has been recommended by U.S. Soil Conservation Service that laboratory analysts be provided for the best utilization of this resource (SCS 1992). The testing of manure and lagoon water is not a service which is commonly utilized by dairy farmers. The cost of this kind of analysis is expensive as compared to soil test, and the source is not readily available. The objective of this study was to evaluate the on farm condition of dairies in Pike and Amite counties of Mississippi and the status of dairy wastes and lagoon waters to enable the agricultural professional to become more effective as they work with live stock producers in managing animal waste.

MATERIALS AND METHODS

Field data was collected directly from the dairy farmers and/or farm owners of the Amite and Pike Counties of Mississippi which included: site of farm, size of farm in acres, number of dairy cattle on farm, and kind of rations used during summer of 1992. Manure and wastewater samples were transported within 24 hours of collection to the Biological Science Research Laboratory of Alcorn State University, about 100 miles away, where samples were either stored in a freezer (solid samples only) or analyzed as soon as the samples were received for the following parameters: potassium, calcium, magnesium, zinc, copper, total nitrogen, nitrogen oxidized, nitrogen reduced, total phosphorus, and sulfate. These analyses were performed according to the methods described in EPA Methods for Chemical Analysis of Water and Wastes (1983). Metals: potassium, calcium, magnesium, zinc and copper were determined by an atomic absorption spectrophotometer (direct aspiration as per procedures described by EPA (1983). Total Kjeldahl Nitrogen was determined by EPA Method #351.4 (1983) with the use of ion selective electrode for ammonium ion. Nitrogen (Reduced) or ammonium was determined by EPA method #350.3 (1983) with an ion selective electrode. Nitrogen (oxidized) or nitrate was determined by EPA Method #352.1 (1983). Total phosphorus was determined by ascorbic acid method (EPA Method #365.3) and sulfate by turbidimetric

method #375.4 of EPA (1983). The manure samples were air dried at 60+ 1°C. The dried manure samples were ground in agate until the entire quantity passed through 250 mesh screen (Jackson 1958). Four sub-samples were used, one sub-sample each for metals, nitrogen (total, oxidized, and reduced) total phosphorus and sulfate analyses. Sub-samples for metal was digested by hydrofluoric and perchloric acid method (Jackson 1958). After digestion potassium, calcium, magnesium, zinc, and copper present in the content of manure were determined by atomic absorption spectrophotometer (direct aspiration method) as per procedure described by EPA (1983). Sub-samples for the determination of total phosphorus was digested by fusion with sodium carbonate method (Harwood et al. 1969). After digestion, total phosphorus was determined by colorimetric method with the use of ammonium molybdate and ascorbic acid (Harwood et al. 1969; EPA 1983). Sub-samples for the determination of sulfate was first oxidized by acid digestion method and sulfate was determined by barium chloride method (Tabatabai 1982; EPA 1983). Total nitrogen was determined by the Kjeldahl method (Bremmer and Mulvaney 1982). Nitrate and ammonium nitrogen were determined by the ion selective electrode method (Keeney and Nelson 1982). Chemical analyses data was tabulated in two sets: mineral contents in manure and mineral contents in lagoon water.

RESULTS AND DISCUSSION

Data presented in this paper were collected from 74 dairy facilities located in Pike and Amite Counties of Mississippi during the summer and a part of fall 1992. Their area of land in use for dairy farming was 7,343 ha with over 11,500 dairy heads. According to an estimate, the litter generated by dairy farms of Pike and Amite Counties of Mississippi should be equivalent to feces generated by a community with a population of 1.7 million. Thus 74 operational dairy farms of Pike and Amite Counties of Mississippi, with an average of 155.7 dairy heads/farm, generate as much animal waste as that produced by almost half of the human population of the State of Mississippi.

The dairy facilities ranged in size from 30 to 425 cows on farm size ranged from 40 ha (800 acres). Average population density of dairy cattle was 1.6 cattle/ha. The largest farm had only 247 cows on 320 ha farm which is equivalent to 0.80 cow/ha. Out of 74 farms, 37 were dry and 37 had holding ponds and lagoons. The most common breed on all the farms of Pike and Amite Counties was Holstein. Out of 74 farms, only four farms had Jersey cows, and 18 farm facilities had two (Holstein and Jersey) or more breeds of cows. The maximum number of breeds on a farm was not more than four breeds (Holstein, Jersey, Ayrshire, and Guernsey). A wide variety of pastures, feed, and rations were used. The most common summer pasture was Bahaia grass mixed with Crab grass and Bermuda grass. The least commonly used grass was Alicia. No pasture was used on one farm, and Signal grass was used on one farm. As a source of carbohydrate, corn was the most commonly used grain. In most cases, corn was associated with soybean meal and minerals. Thirty seven farms used corn, and 11 farms did not use any grain. Millet was used on 7 farms. Among concentrated feeds, pellets were most commonly used. Other rations included silage, peas, cotton seed, syrup, hay, and corn silage.

Physical characteristics of the manures collected from 37 farms of Pike and Amite Counties of Mississippi were: color: pale brown, brown, and dark brown; moisture content: ranged from 65 to 79%; and gravel and rocks: content ranged from 0 to 27%. The colors of lagoon samples ranged from pale yellow to dark brown.

A wide variation in minerals present in the contents of manure and lagoon waters was recorded. Such variations were expected because of the variables present on the farm. Every farm had a unique set of variables present on the farm. Every farm had a unique set of variables in addition to differences in management practices. Average nitrogen, phosphorus, and potassium present in the content of manure, was 4.5, 0.32, and 2.5 percent of dry weight of manure respectively. Thus the ration of N:P:K was 45:3:25. The highest TKN was in two samples (6.7%), and the lowest TKN was also in two samples (3.3%). The highest level of total phosphorus was recorded in one sample (0.68%) and the lowest was 0.075%. The variation of potassium in the content of manure ranged from 1% to 3.8%. The variation in calcium and magnesium ranged from 0.09 to 2.9% and 0.3 to 1.8%, respectively. This might not be due only to the kind of feed or breed of animal, but also due to gravel and rocks found in manure samples. Nitrate and ammonium in the content of manure sample had wide variations ranging from 0.08 to 0.9% for nitrate and 0.11 to 0.67% for ammonium. In lagoon water, phosphorus had a wide variation ranged from 14.0 to 206.0 mg/L. The variation in phosphorus might be due to the age of the lagoon. (Table I)

Almost every dairy farm of Pike and Amite Counties of Mississippi was a unique combination of variables which included breed or blood line and age of fairy

cattle, kinds of feed and pasture, and waste management practices. In the data presented for minerals present in the content of lagoon, not only the breed and feed factor were reflected, but also variation in the management of waste. Manure samples were collected from dry farms, and lagoon samples were collected from wet farms. The comparative figures of manure and lagoon were from two different locations, thus they could only give a general view of the status of two states of wastes: solid and liquid. The unit of measurement was also different. It was mg/g for manure and mg/L for lagoon water. Thus, the data was reduced in NPK ration which is a familiar set of number for agricultural professionals and farmers. The NPK ratios for manure and lagoon samples were 15:1:8 and 5:16:22, respectively. Nitrogen registered a substantial loss while phosphorus and potassium seemed to be in accumulating mode. It is interesting to note that the data presented in this paper are for lagoon waters of dissolved phosphorus only. It should be several times higher if considerations are made for suspended solids and precipitated solid in the sediment. Loss of nitrogen in the content of lagoon was expected because of mineralization and escape of ammonium nitrogen in the atmosphere. P and S ration was 3:2 in manure, and in lagoon water it was 13:1. This ration also suggested that phosphorus was accumulating in the content of lagoon water. Calcium and magnesium rations remained fairly constant in manure as well as in lagoon waters. (Table I)

CONCLUSION

The data presented in this paper is a part of ongoing research. At the present stage of study, the data is unable to provide any solution or make the study conclusive. The data which is currently being published are generating more questions than answers. One major problem is the variability of factors both in quality and quantity. No two dairy farms have identical or similar conditions. Every dairy facility has a unique combination of variable which includes all aspects of farming: breed and age of cattle, pastures, grains, concentrated feed and several other factors. Waste management practices must be able to cope with these variabilities, requiring the understanding of the dynamics of the process. In spite of the handicaps of variables, this data identifies two major areas of concern: phosphorus and potassium accumulation and loss of nitrogen in lagoon waters.

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TABLE I

Variation of Minerals in the Content of Manure and Lagoon Waters Collected from 74 Dairy Farms of Pike and Amite Counties of Mississippi.

Mineral	Range of Variation	
	Manure (mg/g)	Lagoon (mg/L)
TKN	33-67	3.5-58.2
NH	1.1-6.7	1.2-20.2
NO	0.8-9.5	1.2-8.7
Total P	0.75-6.8	21.7-
K	10-38	22-210.0]
Ca	0.9-29	4.3-19.6
Mg	3.0-18	5.7-24.2
SO	1-3.2	1.9-11.7
Zn	0.00-0.3	0.03-0.2
Cu	0.00-0.04	0.01-0.1