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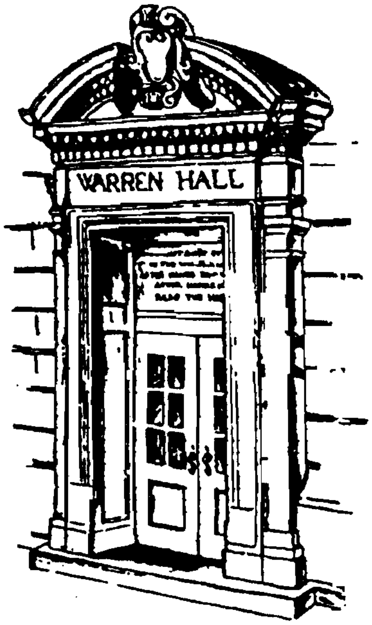

Staff Paper

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Documenting the Status of Dairy Manure Management in New York: Current Practices and Willingness to Participate in Voluntary Programs

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Abstract: Despite intense policy interest in livestock operations and water quality, only anecdotal evidence exists regarding actual manure management practices on dairy farms. This paper discuss the results of a unique mail survey of 470 New York dairy farms that links manure management practices and farmer willingness to participate in voluntary environmental programs. Analysis of this data set indicates a wide divergence between actual and recommended manure management practices on individual dairy farms (high), the apparent ability of farms to divert financial resources to environmental practices (mixed), and the willingness to participate in voluntary programs at various annual costs per cow (low). These findings have policy implications for the USDA/USEPA National Strategy for Animal Feeding Operations and New York's Agricultural Environmental Management program.

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Documenting the Status of Dairy Manure Management in New York: Current Practices and Willingness to Participate in Voluntary Programs

Animal agriculture is presently at the forefront of agricultural environmental policy. According to United States Environmental Protection Agency (USEPA) documents, agriculture is the leading source of impaired river miles in New York and the United States, with animal operations recognized as a leading agricultural source of water contamination (USEPA, 1996; Cook, 1998). High profile spills from animal operations and the presumed linkage of animal waste practices to *Cryptosporidium* and *Pfiesteria piscicida* outbreaks have further elevated public concern about agriculture and water quality (Copeland and Zinn, 1999).

Responding to highly visible lawsuits against animal agriculture (e.g., *Concerned Area Residents for the Environment v. Southview Farm*, CA 2, No. 93-9229, 9/2/94) and the 1990 Coastal Zone Management Act Reauthrorization Amendments (CZARA), New York established an Agricultural Environmental Management program in the mid-1990s to help farmers voluntarily meet environmental goals (Moore, 1997). At the national level the recent United States Department of Agriculture (USDA)/USEPA Unified National Strategy for Animal Feeding Operations (AFOs) calls for all AFOs to implement Comprehensive Nutrient Management Plans (CNMP) by 2009, relying a blend of regulatory and voluntary programs (USDA/USEPA, 1999). In recent years Congress has also demonstrated interest in livestock operations (e.g., the 'Farm Sustainability and Animal Feedlot Enforcement Act' (HR 3232) and the 'Animal Agriculture Reform Act' (S 1323)) while voters in individual states (e.g., Colorado) have passed referenda mandating greater regulations on large livestock operations.

Despite the elevated policy interest, little is known about actual manure management practices on dairy farms. To quote the Unified National Strategy, "there is insufficient data on which to base an estimate of the number of AFOs that have unacceptable conditions" (USDA/USEPA, 1999, p. 16). Even less is known about farmers' attitudes and their willingness to participate in voluntary programs, a component that is critical to the success of national and state policy efforts. To address these information gaps, and to develop a reference point for future policy analysis, we conducted a statewide mail survey of New York dairy farms that focused on documenting manure management practices and investigating farmer willingness to participate in agricultural environmental programs. This paper summarizes the results from this survey and discusses the policy implications of this research.

Survey of Manure Management on New York Dairy Farms

The survey consisted of a 16 page booklet, containing 41 questions, with sections on farm characteristics, manure management, handling manure, spreading manure, neighbor relations and land-use issues. The survey was developed with input from agricultural economists, agricultural engineers, dairy specialists, and soil scientists at Cornell University, and water quality specialists, extension personnel, and Federal and State agency staff throughout New York state. A pre-test/focus group with 14 central New York farmers indicated only slight modifications to the pre-test instrument. Drawing a random sample from a data base of milk shipments in June 1995, 1,115 surveys were mailed to dairy farmers in upstate New York in Summer and Fall 1997[1]. Following widely used mail survey procedures, with an advance mailing, an initial survey mailing, a thank you reminder postcard and two subsequent mailings, 470 completed surveys were returned. After

[1] For the purposes of this research, "upstate" excludes then south-eastern New York State counties of Nassau, Putnam, Orange, Suffolk, and Westchester and the five boroughs of New York City.

accounting for *no longer in dairy farming* (83 obs.), *bad addresses* (37 obs.), *deceased* (2 obs.) this represents a 47.5% adjusted response rate. Such a response rate is lower than the 50 to 70 % standards widely adopted in contingent valuation research, but is higher than might be expected for such a controversial topic.

Comparison of the returned surveys with data from New York Agricultural Statistics Service (NYASS), indicates that the regional distribution of the returned surveys corresponds closely with the actual distribution of New York dairy herds. However, the sample distribution across herd size exhibits a slight upward bias. That is, relative to NYASS statistics, smaller herds with less that 100 cows are under represented in our survey responses relative to larger herds: the survey (and NYASS, 1997) distribution for 99 cows or less, 100 to 199 cows, and 200 plus cows was 71% (81%), 19% (14%), and 10% (5%), respectively. This apparent bias may reflect the age of our mailing list at the time of the survey. This list consisted of farms shipping milk in mid-1995, two years before the mail survey. If one assumes that the "no longer in dairy farming" group was largely composed of farms with smaller herd sizes this could directly affect the size distribution of survey responses The relatively low representation of smaller farms may also reflect a potential non-response bias by this group of farms. Unfortunately, we do not have the data to identify the probable source of this disparity. Consistent with the tendency towards larger herds, the average milk production per cow reported in the survey was a relatively high 17,927 lbs., which compares with the 1996 NYASS statewide average of 16,423 lbs[2].

Data in the survey were grouped according to actual and proposed federal water quality regulations affecting New York dairy farms. While the USDA/USEPA National Strategy regulates

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[2] 1996 data was used for milk production comparisons because the survey asked farmers to report their annual production for the previous year.

Concentrated Animal Feeding Operations (CAFOs) with more than 1000 animal units (AU) through permitting requirements (and relegates all other herds sizes to voluntary performance standards), New York agricultural and environmental agencies are operating on the assumption that all dairy farms with more than 300 AU could be subject to CAFO permitting regulations (CAFO Information Package, http://www.dec.state.ny.us/website/dow). This recognition is based on the general proximity of New York dairy farms to surface water as well as the *Concerned Area Residents for the Environment v. Southview Farm* ruling that left open the interpretation that spread manure is a point source of pollution (CA 2, No. 93-9229, 9/2/94). Correspondingly, for the purposes of this paper, "Large" farms are classified as those with 300 or more AU.[3] A second group of "Medium" sized farms with 100 to 299 AU will generally be exempt from CAFO requirements unless an individual farm is identified as a "significant contributor of pollution to the waters of the United States...[and] pollutants are discharged from a man-made device or are discharged directly into waters passing over, across, or through the facility or otherwise come into direct contact with the confined animals." (USDA/USEPA, 1999). However, farms with 100 to 299 AU will still need to conform with the 1990 CZARA addressing storage facilities and nutrient management. The remaining "Small" farms with less that 100 AU are presently exempt from Federal regulations, with the exception of the "significant contributor" clause indicated previously. Farms of all sizes are encouraged by New York State agencies and the USDA/USEPA to voluntarily follow a comprehensive nutrient management plan, with the USDA/USEPA national strategy identifying such adoption as a performance standard by all farms by 2009. Using this classification, Small, Medium,

[3] Consistent with Federal water quality legislation, the AU data used here accounts for all animals on the farm, including those beyond the main milking herd (e.g., calves, heifers, other livestock). The 300 and 100 AU thresholds correspond to 210 and 70 milking cows, respectively.

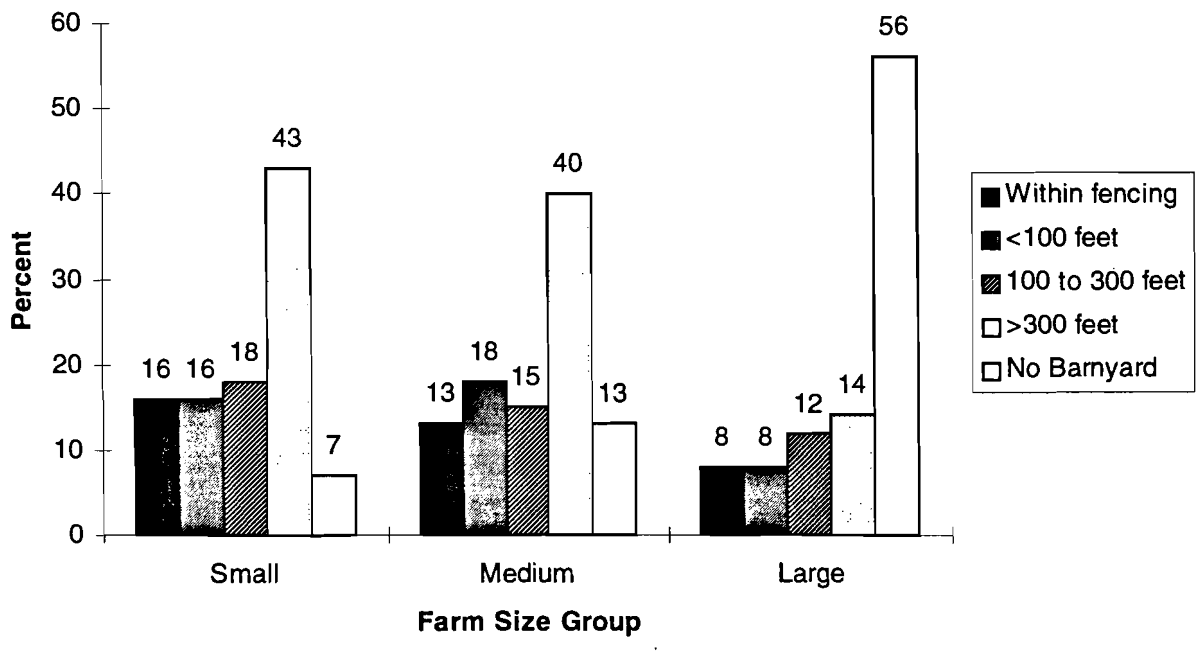
and Large farms comprise 39 %, 49 %, and 12 % of the completed surveys, respectively.

Components of the Comprehensive Nutrient Management Plan (CNMP)

While the specific practices will need to be determined at the individual farm level, the USDA/USEPA National Strategy has identified several components that should be accounted for in a CNMP. Here we investigate four central components of such plans across herd sizes: manure handling, storage, land application of manure, and record keeping.

Manure handling: The siting and barnyard management practices are a central feature of CNMP. Figure 1 demonstrates that the use of barnyards, and barnyard location relative to surface water does

Figure 1: Percent of Farms in Proximity to Downhill Surface by Farm Size



vary substantially and significantly across herd sizes ($p < 0.001$)[4], with 14 % of farms having surface water within the "fencing of the barnyard" and an additional 32 % with barnyards within 300 feet of the nearest downhill surface water. While specific on-farm practices to control runoff from barnyards may vary, those farms with surface water running through their barnyards clearly have a fundamental problem. And those barnyards within 300 feet are likely be scrutinized by environmental agencies, as their proximity to surface water makes it difficult to use less expensive filter areas to reduce their pollution potential. Figure 1 also demonstrates an observation that carries through the remainder of this subsection, that large farms tend to have lower reliance on barnyards, and thus are less subject to run on and runoff concerns.

Figures 2 and 3 similarly demonstrate that large farms are performing better in the management of barnyards. Smaller farms tend to have adopted fewer run-on control practices (e.g. roof gutters and surface water diversions, $p< 0.001$). They also tend to have less investment in controlling runoff ($p <0.001$), with only 15% providing some sort of desirable runoff control. Again, a large component of this disparity in distributions across groups is attributed to the relatively limited use of barnyards on larger farms.

In addition to barnyard location, animals can have direct access to surface water while pasturing or in transit. This form of direct contact also varies by herd size ($p=0.052$) with 60 %, 51 % , and 43 % of Small, Medium, and Large farms, indicating the their "*livestock have direct access to surface water or cross a stream to get to pasture*".

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[4] Throughout, chi square statistics of independence associated with contingency table analyses are used for discrete variables and f-test statistics from ANOVA analyses are used for continuous variables unless otherwise indicated. A p level of less that 0.10 indicates that the responses patterns across herd size groups are significantly different at the 10% level, and so on.

Figure 2: Percent of Farms Controlling Water Entering Barnyard by Farm Size

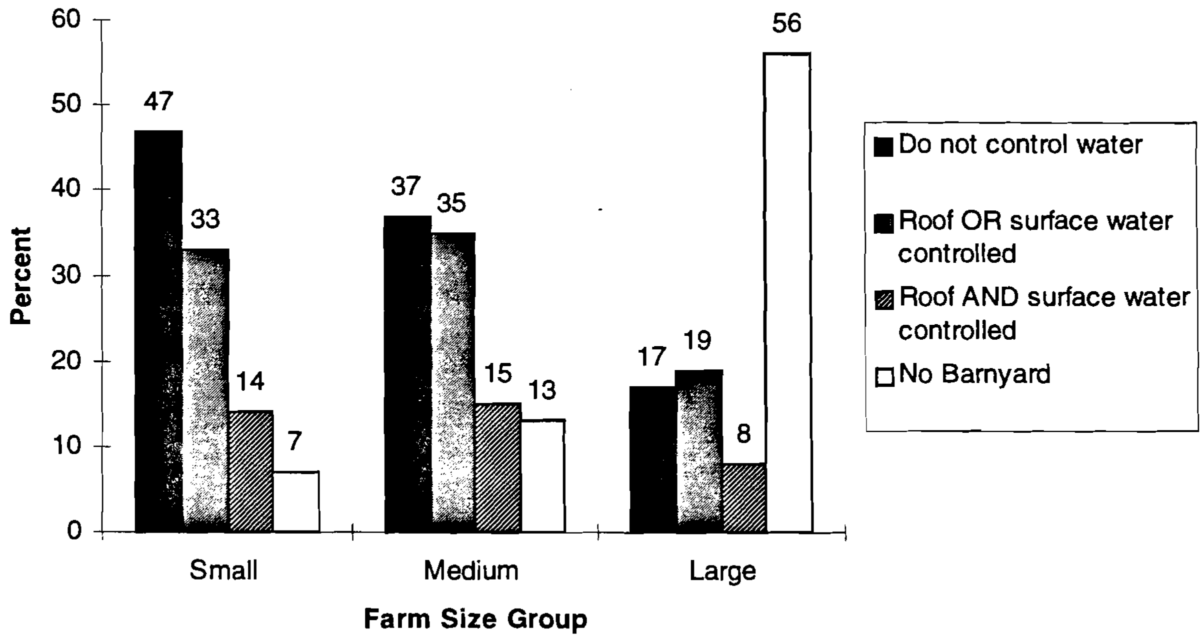
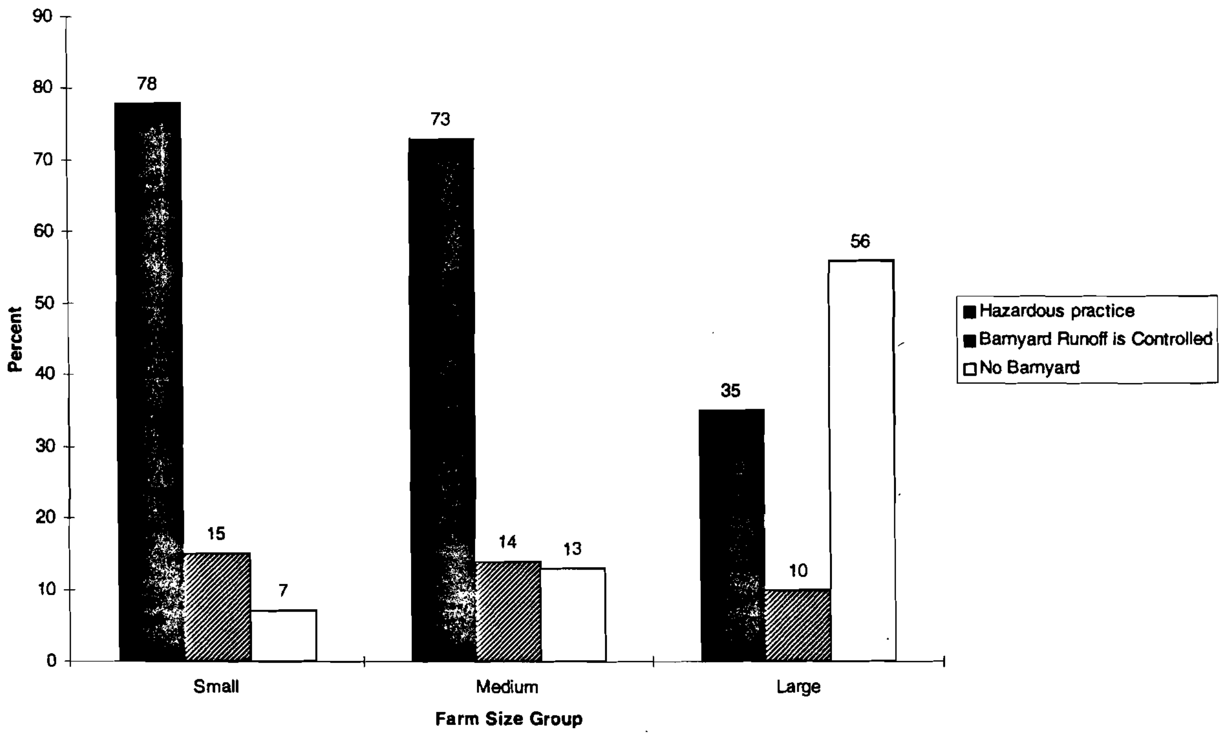


Figure 3: Percent of Farms Controlling Barnyard Runoff by Farm Size



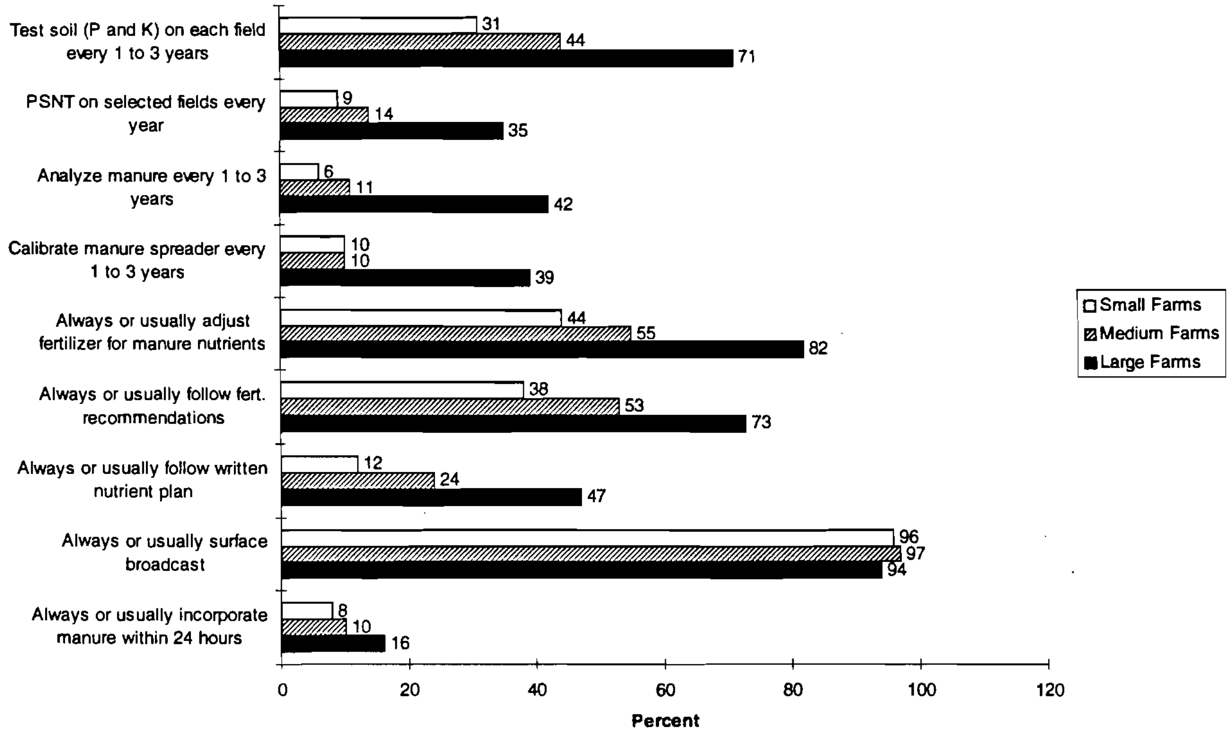
Storage: Adequate manure storage is a critical issue in northern states such as New York, where avoiding saturated and frozen ground is difficult without 180 day storage capacity. As demonstrated in Table 1, average storage capacity is higher on large farms ($p=0.011$) and the average number of days in a year in which manure is spread is lower ($p < 0.001$). Yet, only 21 % of large farms have storage capacity exceeding 180 days. And, reliance on daily spreading prevails on all size groups, with a mean of 263 days per year across all farm sizes. The observed deviation in the amount of storage and the frequency of spreading across herd sizes is related to the greater reliance of large farms on liquid manure handling systems than small farms ($p < 0.001$).

Land Application of manure: According to the USDA/USEPA National Strategy, "land application is the most common, and usually the most desirable method of utilizing manure" (USDA/USEPA, 1999, p. 8) From the perspective of potential land use, the average New York dairy farm in this

Table 1: Manure Handling and Storage

	Small	Medium	Large
Percent of farms that handle manure as a solid	94	74	14
Percent of farms by maximum days of manure storage			
No storage	58	46	39
Less than 60 days	87	77	58
Less than 180 days	93	91	78
Average number of days manure is spread per year	274	271	185

Figure 4: Percent of Dairy Farms Implementing Select Nutrient Managment Practices by Farm Size



survey has more than adequate amount of land for applying manure. Cornell Cooperative Extension uses 1.0 to 2.5 AU/manurable acre as a guideline for manure management, with the range determined by the mixture of crops. Pennsylvania's 1993 legislation identified 2.0 AU/acre as a threshold for requiring nutrient management plans. These thresholds greatly exceed average ratios on all farms size, with Small, Medium, and Large farms having 0.36, 0.42, and 0.54 AU/manurable crop acre ($p < 0.001$).

In spite of this potential, New York dairy farms as a whole do not appear to have adopted recommended practices in terms of soil and manure testing, calibration, accounting for manure in nutrient management planning, and application practices. As demonstrated in Figure 4, a greater proportion of Large farms have implemented recommended nutrient management practices, with significance levels across farm sizes of generally less than 0.1 %. The exceptions to this trend are the proportion of respondents who always or usually "surface broadcast manure with a spreader" ($p = 0.676$) and the proportion who always or usually "incorporate manure within 24 hours of application" ($p = 0.206$). While a greater proportion of large farms have adopted recommended practices, it is evident that there is still a wide gap between existing practices and practices likely to be required by a CNMP for all size groups.

Record Keeping: Livestock operators should "keep records that indicate the quantity of manure produced and how the manure was utilized, including when, where, and amount of nutrients applied (USDA/USEPA, 1999, p. 9). However, only 38 % of Small farms, 53 % of Medium farms and 73 % of Large farms indicated that they maintain records ($p < 0.001$).

Taken together, the above findings suggest that New York dairy industry will be substantially challenged by existing and proposed water quality legislation in the sense that actual practices tend to deviate from those associated with recommended components of CNMP. Interestingly, the one group that will be subject to regulations tends to have adopted practices that are in greater conformity with water quality legislation. Nevertheless, although better, adoption of recommended practices is certainly not universal even on large farms.

Land Use Issues and Neighbor Relations

In addition to actual practices, a number of questions were posed pertaining to land use issues and neighbor relations. With respect to neighbor relations, anecdotal reports and the attendant conventional wisdom suggests that the typical New York dairy operation is under siege from lawsuits and neighbor complaints. This does not appear to be the case: over 63 % of the farms surveyed had NOT received any "complaints from neighbors or local public officials in the last five years", with significant variation across herd size: 76 %, 58 %, and 39 % for Small, Medium, and

Large farms, respectively. For dairy farms that experienced complaints, the following were categories of complaints and associated percentages of total complaints: odors (42 %), roadway spills (26%), water pollution (17%), farm traffic (14 %), chemical use (11 %), flies/insects (10 %), noise (7 %), dust (7 %). Only odor complaints were significantly different across farm size: 25 %, 42 %, and 66 % for Small, Medium, and Large farms. ($p < 0.001$). This external focus on odors rather than water quality is consistent with "sound agricultural practices" complaints from citizens about farms to the New York State Department of Agriculture and Markets (Rudgers, 1998; Bills and Cosgrove, 1998) but deviates from the regulatory focus on water quality.

Likert scale responses (with response options ranging from "Strongly Disagree" to "Strongly Agree") to a series of opinion questions indicate that, in contrast with popular beliefs about agriculture's role in water quality and the implied property rights regime associated with a regulatory approach to controlling agricultural pollution, farmers generally do not believe that they cause water quality problems or that they should have to pay for installing water pollution control practices on current operations (See Table 2). Response patterns to these questions tend not to differ by herd size, with consistent response patterns for individual farms being a source of water pollution (Q27A: $p = 0.412$) and whether they would be able to stay in business if they had to incur substantial environmental costs (Q27B: $p = 0.134$). However a greater proportion of small farm operators felt that they should not have to pay for installing water pollution practices on current operations (Q27C: $p = 0.042$). Irrespective of property right beliefs, a proportion of farmers indicated that they would be "able to pay" substantial environmental costs, with 27% indicating that they would, in fact, "stay in the dairy business" if such costs were imposed by a new regulatory regime. Participants in a 1999 New York State Bankers Association seminar speculated that at least half of the "neutral" respondents would also be able to stay in the business. In part, the conjectured additional participation reflects the realization that this survey was conducted in late summer 1997 when milk prices were extremely low.

To a large extent these results correspond with the "There is no problem, we don't cause the problem, we shouldn't have to pay to address the problem, we can't afford to address the problem" sequence of producer denial that has characterized much agricultural environmental conflicts in the past (Daily, 1999). Yet, in contrast, there does seem to be a tendency to agree that farmers should shoulder the environmental costs on expanding operations (Q27D). This latter result is consistent with past Clean Water Act 319 non-point source pollution control funding in New York, which has given priority to controlling pollution on existing, rather than expanding farm operations.

Table 2: Distribution (%) of Responses to Agricultural Environmental Opinion Questions

	Farm Size	Strongly Disagree		Neutral		Strongly Agree
Q27A. In a typical year, manure and barnyard runoff is not a water pollution problem from my farm	All Farms	7	6	24	31	32
Q27B. If my net returns declined by $50 per cow per year, I would not stay in the dairy business	All Farms	21	23	30	11	16
Q27C. Farmers should not have to pay for installing water pollution control practices on current operations	Small	6	6	34	13	41
	Medium	8	13	31	15	34
	Large	4	15	35	25	21
Q27D. Farmers should not have to pay for installing water pollution control practices when they expand their operation	All Farms	15	12	34	13	26

Willingness to Participate in Environmental Programs at Varying Costs

It is clear from the above that the manure management practices on many New York Dairy farms deviate substantially from what will be expected under CNMPs. The cost of meeting these CNMPs are expected to vary widely across farms, and may be quite substantial in some instances. For example, based on extensive field experience Cornell Cooperative Extension estimates that, in addition to per farm preparation costs, controlling barnyard runoff will cost $1,000 to $500,000 per farm with a similar range of costs for storage. Nutrient management plans will be expected to break even or better. In recent years the New York Agricultural Non-Point Source Grant Program has provided funds to individual farms to address manure management issues, with grants ranging from $2,155 to $419,050 for farms with over 300 AU (Wildeman, 1998). The USDA estimated average cost per cow per year to meet 1990 Coastal Zone Management requirements $17.01 - $34.63 (Heimlich and Barnard, 1995).

New York's efforts to pursue a voluntary program in an effort to preempt agricultural environmental regulations and the voluntary/regulatory mix proposed in the USDA/USEPA National Strategy raises the critical question of how many farmers would actually participate in voluntary programs. Here we use a "contingent valuation" survey method to estimate participation levels at different costs to the farmer. This technique has been widely used in the last three decades to place economic values on environmental goods (Mitchell and Carson, 1989). Several studies have also applied this technique to valuing positive (open-space) and negative (water contamination) agricultural externalities (see Poe, 1999 for a review). Recently economists have adapted this survey method to estimate the likelihood of participation in conservation programs at various prices (e.g. Cooper and Osborn, 1998; Cooper and Keim, 1996; Lohr and Park, 1994, 1995; Purvis *et al.*, 1989).

Figure 5 provides the text and the response format for the contingent participation question.

Figure 5: The Contingent Valuation Question

Farmers are increasingly the target of environmental policies to protect water quality. Federal laws such as the Coastal Zone Management Act and the Clean Water Act may require specific best management practices to be implemented on all dairy farms in New York. At the same time other Federal and State programs may provide some cost-sharing assistance to farmers adopting best management practices.

New York is introducing an agricultural environmental management program that would involve:

1) Individual assessments of farm pollution risk, and
2) Voluntary management plans tailored to the needs and pollution risks of each individual farm.

The implementation of improved manure management practices may increase the returns on some farms, but on others they may decrease the returns.

In order for the voluntary program to be successful, enough farms have to participate in this or similar local voluntary programs. If participation levels are not high enough, then it is likely that a regulatory program requiring specific management practices on all farms will be adopted.

30. If you determined that the cost to implement improved manure management practices on your farm would be one of the following amounts each year, would you participate in the voluntary program? Please bear in mind that we are talking about milking and dry cows in this question. *(Please circle ONE letter for each dollar value)*

	I WOULD DEFINITELY PARTICIPATE	I WOULD PROBABLY PARTICIPATE	NOT SURE	I WOULD PROBABLY NOT PARTICIPATE	I WOULD DEFINITELY NOT PARTICIPATE
0 CENTS PER COW PER YEAR	1	2	3	4	5
10 CENTS PER COW PER YEAR	1	2	3	4	5
25 CENTS PER COW PER YEAR	1	2	3	4	5
50 CENTS PER COW PER YEAR	1	2	3	4	5
$ 1.00 PER COW PER YEAR	1	2	3	4	5
$ 2.00 PER COW PER YEAR	1	2	3	4	5
$ 5.00 PER COW PER YEAR	1	2	3	4	5
$ 10.00 PER COW PER YEAR	1	2	3	4	5
$ 25.00 PER COW PER YEAR	1	2	3	4	5
$ 50.00 PER COW PER YEAR	1	2	3	4	5
$ 100.00 PER COW PER YEAR	1	2	3	4	5
$ 200.00 PER COW PER YEAR	1	2	3	4	5

In creating this question, effort was taken to develop a concise half-page scenario that closely resembles New York's voluntary Agricultural Environmental Management (AEM) program. Two central features of the AEM program, individual assessments of farm pollution risk and voluntary management plans tailored to the needs and pollution risks of each individual farm, were explicitly mentioned. Corresponding to policy expectations that some minimum level of participation would be required for the program to be classified as a success, the need for "high" participation levels was emphasized.

Given this scenario, farmers were asked to indicate the likelihood that they would participate in such a voluntary program at different costs to the producer. The range of "cost per cow" dollar values was determined by first estimating an upper bound of $100 on possible costs[5] and then doubling this value to avoid any truncation effects on willingness to participate (WTP). A lower bound of zero was used to capture "no net loss in farm returns" programs like that used in the New York city watershed.

Based on previous contingent valuation validity research our analysis focuses on the "Probably Participate" (or higher) responses (Poe, Ethier, Welsh and Schulze) As indicated in Table 3 responses at this level or higher are approximately 78 % at $0 This proportion approaches the 80 to 90 % participation rates in the education intensive/complete cost sharing programs in the New York City and Skeneateles (Syracuse) watershed programs associated with the Safe Drinking Water Act Surface Water Filtration Avoidance requirements. However, the "Probably Participate" responses fall below the median by $5 per cow, and approximates 3% at $50 and above. This latter

[5] The upper bound of $100 comes from early estimated costs associated with sequencing batch reactors designed to treat manure (personal communication with Carlo Montamagno, Agricultural and Biological Engineering Department)

Table 3: Distribution of Participation Responses Across Selected Dollar Values -- Percent and (Cumulative Percent)

	Definitely Participate	Probably Participate	Not Sure	Probably Not Participate	Definitely Not Participate
$0.00	58	20 (78)	14 (92)	4 (96)	4 (100)
$0.10	44	23 (67)	15 (82)	6 (87)	13 (100)
$0.50	37	18 (55)	18 (73)	10 (83)	17 (100)
$5.00	12	12 (25)	24 (49)	16 (65)	35 (100)
$50.00	2	2 (3)	12 (16)	16 (32)	68 (100)

figure contrasts substantially with the 27 % of the respondents who indicated that they would be likely to stay in business if they had to pay $50 per cow per year: thus there appears to be a broad discrepancy between "ability to pay" and "willingness to participate".

WTP is likely to be associated with many factors, including the cost of participation, herd size, farmer attitudes, and socio-economic characteristics. Due to the large dimensions of the response matrix (12*5) and the need to control for various factors simultaneously, contingency table analyses, as used in the rest of this article, are neither appropriate nor informative. Instead, a multiple bounded statistical technique described in Welsh and Poe (1998) was used to model the "Probably Yes" response function. These estimates were then converted to WTP functions following methods detailed in Cameron (1988, 1991). Combined, these statistical analyses allow us to estimate a "regression" function relating WTP to other variables reported in the questionnaire.

In estimating these WTP regressions, the $ per cow value was multiplied by the number of milking and dry cows reported in the survey in order to directly estimate WTP as a function of total, as opposed to per cow, farm costs. As such, each respondent faces a unique set of dollar values in considering their WTP. In the simplest case, we estimated WTP as a function of the dollar value and the herd size. The resulting regression coefficients were:[6]

$$WTP = -96.46 + 222.97*(\text{Medium Herd Size}) + 968.83*(\text{Large Herd Size}) \quad (1)$$

in which the intercept was not significantly different from zero but both the herd size slope shifters were significant at the 5% level or higher (see Model 1 in Table 4). Holding everything else constant this estimated function indicates that the average Small farm would not be willing to participate in this type of voluntary program if it had zero or negative effects on net returns. In contrast, the average Medium sized farm would "probably participate" at a cost of $126.51 (=-96.46 + 222.97) per annum. Similarly, these estimates indicate that the average Large dairy farm would participate at a cost of $872.39 (=-96.46 + 968.83) per annum. Accounting for the size distribution across farms, the overall average willingness to participate is $133.

Other covariates were introduced into the model in an effort to account for farmer and farm characteristics that are correlated with WTP and to examine the construct validity of farmer responses. These additional variables are evaluated in Models 2 to 4 in Table 4, which hold the number of observations constant across models at the level associated with Model 3, the most complete model: Model 2 uses the limited set of covariates in Model 1, indicating that the restricted number of observations provides similar results; Model 3 includes the most complete set of

[6] Because of the Cameron 1988 transformation, the bid value does not appear in the final regression. An indicator of the responsiveness of WTP to changes in this variable is provided in the coefficient on the 'k' variable in Table 4. In all cases, this coefficient was found to be highly significant, and thus, there is statistical evidence that farmers were responding to the variations in the costs of participation.

Table 4. Estimated Coefficients, Willingness to Participate Models "Probably Yes" Responses

Variable	Description	Mean Value [n]	Sign Exp.	Model 1	Model 2	Model 3	Model 4
Constant	1	1	n.a.	- 96.46 (78.41)	- 42.12 (83.11)	-78.00 (424.23)	-45.92 (385.68)
D100299	Binary: 100 to 299 AU = 1	0.51 [357]	?	222.97 (100.38)**	196.57 (405.80)**	89.34 (103.33)	
D300 Plus	Binary: more than 300 AU = 1	0.12 [357]	?	968.63 (186.15)***	942.75 (192.82)***	596.29 (182.45)***	551.83 (166.35)***
Q27A	1-5 scale: Farm is not a water pollution problem	3.77 [357]	-			-99.29 (42.27)**	-99.98 (42.11)**
Q27B	1-5 scale: No able to pay $50 per cow	3.16 [325]	-			-80.88 (37.02)**	-95.09 (35.24)***
Q27C	1-5 scale: Farmers should not have to pay for installing practices, current operations	3.61 [325]	-			-21.01 (40.72)	
NoComplain	Binary: no complaints from neighbors or local officials in last five years = 0.	0.38 [325]	+			160.56 (98.19)	170.21 (98.27)*
Inoper10	Binary: farmer, family or partner expects to be in operation in 10 years =1	0.62 [325]	+			98.04 (103.57)	
Age	Age in years	48.07 [325]	-			-6.79 (4.38)	-7.33 (4.25)*
Milk	Lbs milk per cow per year, actual or estimated from daily milk production	17,949 [325]	?			0.06 (0.02)***	0.06 (0.02)***
k	Scale parameter as defined in Cameron (1988)	n.a.	0	516.32 (45.36)***	522.15 (47.49)***	479.53 (36.01)***	481.53 (36.03)***
n				357	325	325	325
log likelihood				1875.49	1715.20	1675.98	1677.98

Notes: Numbers in () are asymptotic standard errors, and *,**,*** denote 10, 5 and 1 percent significance levels, respectively.

covariates; and Model 4 excludes those Model 3 covariates (D100299, Q27c, and Inoper10) that were not significant at the 20% levels. While these excluded variables were not individually significant, the estimated coefficients demonstrate the expected sign: whether or not farmers believed that they should have to pay for installing water pollution control practices on current operations (Q27c) was not statistically significant, which seems to contradict the widespread "property rights" belief that farms should not have to pay to install environmental practices on their farms; farmer expectations about whether they would be in business in the next 10 years was positively correlated with WTP but was not statistically significant. Because of correlation in responses between these and other covariates, the exclusion of these non-significant covariates raises the significance of the remaining covariates in the "short" Model 4.

Notably, as expected, WTP is negatively correlated with the belief that their farm is not a water pollution problem. This finding is important, because it suggests some potential for an educational role in agricultural environmental policy in the sense that WTP would be expected to rise if farm operators could be convinced that their farm contributes to water pollution problems. In addition, it was found that the ability to pay, as measured by the response to Q27B concerning the farmer's assessment of staying in business if additional environmental costs were $50 per cow, was positively correlated with WTP. Such a report supports the intuitive argument that those farms which are more economically viable will have a higher WTP. WTP was also significantly and positively correlated with production per cow, suggesting that more intense milk production management may carry over to willingness to invest in manure management. Community pressures further appear to exert an influence of WTP, as farms that had received complaints from neighbors of local officials in the last five years had a significantly higher WTP. And, the age of the farmer was negatively correlated with participation. Overall, the models strongly conform with prior expectations, indicating that WTP does vary systematically across farmers.

In summary, stated WTP behaves in a manner consistent with prior expectations and estimated participation rates in a voluntary pollution control program at various costs to farmers is much lower than the expected costs of meeting CNMPs facing many farms. This latter finding should not be interpreted as implying that farmers have a low environmental ethic. Many farmers may simply have reached their own environmental equilibrium, in which they are undertaking practices as they seem fit. As such, they may be reluctant to contribute additional funds simply to meet the demands of the broader population. Such a conclusion may be supported by the observation that a relatively small proportion of farmers believe that they are presently contributing to water pollution in a typical year. Nevertheless, under present conditions, these WTP results do suggest that a voluntary AEM style program will face substantial challenges in meeting environmental objectives if the additional costs to farmers exceed even nominal amounts.

Summary and Discussion

This research provides key insights into the degree of non-conformance with recommended CNMP best management practices, and the likelihood of voluntary participation to meet stated agricultural environmental objectives. Such research is critical because the great majority of livestock operations in New York, and the rest of the country, fall below the regulatory AU threshold associated with the Clean Water Act. Compliance with recommended practices on those farms that do not exceed this threshold will rely on educational activities and voluntary programs.

The data from this survey indicates that there is a substantial gap between actual and recommended nutrient management practices for all dairy farm size groups. Many of these gaps are fundamental. For example, 14% of farms surveyed have surface water running through their barnyards and less than 10 % of farms have 180 days storage. It is clear from these data that farms will have to incur a range of costs to meet performance objectives stated in the USDA/USEPA National Strategy. On some farms, these added costs will be negligible. But on others, particularly those which will need to relocate their barnyards or install storage facilities, these costs could be substantial.

A notable finding of this research is that Large farms (i.e., those with more than 300 AU) seem to be doing better in terms of manure handling, storage, land application, and record keeping -- all central elements of CNMPs. This group of farms also indicated a higher willingness to participate in voluntary programs. To some extent, this finding suggests that the federal water quality focus is much like the proverbial drunk looking for his keys under the light post. That is, for New York dairy farms at least, the USDA/USEPA National Strategy appears to be regulating the least egregious violators on a per-practice basis, simply because existing permitting laws limit agencies to regulating point sources. Yet the ubiquitousness of water quality degradation associated with animal agriculture may be associated with those who are not regulated under present Federal water quality laws[7]. This necessitates the question, Can we expect these farms outside the current regulatory scope to voluntarily comply with CNMPs?

The findings of this research correspond with the economics notion of "cheap riding" in the provision of voluntary goods. Consistent with altruistic behavior, a sense of community, and a feeling of stewardship, etc., farmers do demonstrate some willingness to participate in programs that

[7] A second application of this metaphor might be found in odors v. water quality. Odors seem to be the motivating complaint against livestock operations, but we presently have no regulatory structure to control odors at least to the extent that odor control is not positively correlated with water quality practices. As a result, lawsuits and regulations are directed to the one thing that we do have existing legislation — water quality.

support environmentally friendly practices. Indeed, 78% indicate that they would participate in a program if it was 100 % cost shared, a result that is consistent with participation rates in well financed watershed protection programs in selected watersheds in New York State. However, since the majority believe that they are not causing a water quality problem, and that they should not be responsible for paying for additional environmental expenses on their farm in any case, the contributions by these farmers might be classified in the realm of voluntary contributions for environmental goods. Viewed in this manner, the farmers' willingness to participate found in this study, at an average of $133 per farm per year, could be regarded as a relatively substantial contribution to environmental good causes[8].

However, regardless of the motivations for participation, the estimated willingness to participate is low relative to the range of anticipated compliance costs on many farms. This suggests that the New York dairy industry, at least, will be challenged by water quality legislation, and that agricultural environmental policy in New York and elsewhere will need to extend or move beyond present voluntary program approach to meet water quality objectives.

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[8] Indeed, this average value compares relatively well with Vice President Gore's 1997 declared contributions to charitable groups of $353 (from an income exceeding $200,000). Of course, no one is claiming that the Vice President is a leading source of water pollution.

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