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AGRICULTURAL ENGINEERING

SUMMARY OF AGRICULTURAL WATER MANAGEMENT PROGRAM ACCOMPLISHMENTS 1976 THROUGH 1982

Larry D. Geohring

Agronomy Mimeo 82-18

Agricultural Economics Staff Paper 82-30

An interdisciplinary program of the New York State College of Agriculture and Life Sciences

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SUMMARY OF AGRICULTURAL WATER MANAGEMENT PROGRAM ACCOMPLISHMENTS 1976 THROUGH 1982

by Larry D. Geohring*

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AGRICULTURAL WATER MANAGEMENT PROGRAM

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EXECUTIVE SUMMARY

The Agricultural Water Management Program (AWMP) is a coordinated inter-disciplinary approach to improving the agricultural water management capabilities of individual and organized groups of farmers. Viable solutions to important water management problems are investigated and implemented through joined efforts of research, extension, and "action" oriented projects and activities.

The AWMP's significant accomplishments of the past several years include:

- facilitating (both technically and financially) the completion of a drainage outlet improvement project in the Deer Creek Watershed in Franklin County and the Squeak Brook Watershed in St. Lawrence County;

- initiating an inter-agency personnel agreement with the Soil Conservation Service to employ a drainage specialist for the Northern New York region;

- conducting several field demonstrations of drainage installation techniques exhibiting the latest technology;

- supporting the construction of a pump drainage plant on mineral soils as an alternative to major drainage outlet improvement;

- characterizing and measuring water movement parameters, particularly with respect to shallow, sloping, heterogeneous and also hardpan soils;

- research investigations (both laboratory and in the field) essential to establishing and improving subsurface drainage design parameters;

- developing and validating water movement prediction models;

- determining the amount of stretch occurring in corrugated plastic tubing when installed with a drain plow which effects the quality of subsurface drainage installations;

- developing conceptual models for evaluating economic benefits of drainage;

- collecting data to evaluate the impact improved drainage will have on farms and adjacent communities;

- compiling and summarizing information on legal aspects of organizing drainage districts and disposal of drainage waters;

- assembling data on the environmental impacts of constructing drainage outlet facilities and encouraging further support of this activity by NYS Department of Environmental Conservation;

- providing support to the surface drainage program conducted by Jefferson County Extension and their Conservation District;

- producing a 25 minute color film titled, "Land Drainage" which reviews the state-of-the-art of drainage technology in New York;

- initiating training sessions on drainage design for contractors and conservationists;

- and, developing and disseminating informational materials such as newsletters, fact sheets, maps and extension bulletins.

This report discusses each of these accomplishments in more detail and also includes many other lesser activities which furthered the impact the AWMP has had on improving the water management capabilities of farmers.

PREFACE

The Agricultural Water Management Program at the New York State College of Agriculture and Life Sciences was initially established with a goal to improve the quality of life of rural dwellers in New York State through improved water management capabilities. The program was initially funded in the late fall of 1976. Since that time the Agricultural Water Management Program (AWMP) has funded research and provided assistance to a wide variety of clientele ranging from individual farmers to county governments. The AWMP has assisted in the implementation of outlet development projects in Franklin and St. Lawrence Counties; has developed methodologies for assigning priorities to outlet development projects; has organized demonstrations of the drain plow and other drainage installation equipment; has conducted farmer demonstrations and tours for local leaders; has produced a 16 mm film and several publications concerned with water management; has conducted drainage design workshops for drainage contractors and conservationists; and has conducted research on agronomic, economic, engineering, environmental, legal and sociologic aspects of improved water management.

The program has been largely, but not exclusively, focused on the water management challenges in Northern New York because of the common and widespread water management problems in that six-county region. The intent of the AWMP, however, is to provide a statewide water management program. The initial focus of the AWMP was to concentrate on existing and persistent soil drainage problems that limit crop yields, farm incomes, and community development. Since much of the cropland in New York is seasonally too wet to produce economically acceptable crop yields, the AWMP focus on problems of soil drainage is an attempt to improve these marginal resources by introducing educational programs and improved technologies into the management of the soils and the farming systems.

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INTRODUCTION

The Agricultural Water Management Program evolved out of the mutual concerns of a number of individuals interested in the problems of under-developed areas of New York State, especially Northern New York. Problems of water management were identified as major constraints to development, and a program to remove or reduce these constraints was conceived. This program was to include coordinated efforts of applied research, extension education, and local demonstration projects directed to encourage and to demonstrate to farmers, and especially groups of farmers, viable solutions for important water management problems.

The AWMP established goals to improve agricultural water management capabilities of farmers and to facilitate cooperative water management efforts. These goals encompassed two different levels of managing waters: 1) water management via a larger watershed or subwatershed approach, and 2) water management on individual farms or tracts of land. Managing excess water on a watershed basis implies providing major drainage outlet facilities (as distinguished separately from flood control facilities) to provide improved gravity outlets for subsurface drainage systems and to safely dispose of water accumulated from a large area comprised of several landowners. Managing excess water from an individual farm incorporates many of the traditional on-farm soil and water conservation and drainage practices.

Three of the AWMP objectives were directed at the watershed level management approach: 1) to encourage the establishment of drainage districts and cooperative drainage efforts among landowners and/or units of local government, 2) to demonstrate via watershed development projects the benefits of collective action to achieve water management capabilities, and 3) to assess the impact of improved drainage on agriculture in the community. Three additional objectives were directed at managing water on individual farms. These are: 1) to teach farmers, rural landowners, and contractors the procedures for obtaining improved water management systems, the techniques for installing and using such systems, and the benefits of improved water management; 2) to develop alternative drainage technologies and make operational drainage criteria not presently used for drainage design in New York; and 3) to investigate optimum economic adjustments in farm systems as a result of improved drainage

systems. These objectives were carried out in activities which include research, extension, and "action project" components.

The AWMP has supported several separate concurrent projects to meet these overall program objectives. This report describes the different activities which were undertaken.

ACTION PROJECTS

The concept of "Action Projects" was initiated to implement activities or projects which would facilitate or directly demonstrate new concepts or solutions to water management problems. The action concept provided program flexibility so direct response or financial assistance to specific water management problems could be applied quickly and where they occurred. The action designation implied that real "in-the-ground" projects would be carried out as a means of direct demonstration, and activities would result in prompt solutions to problems. Moreover, a high degree of visibility or awareness of projects and activities would result in widespread adoption of solutions to problems. These action projects have involved a wide variety of activities and are discussed below.

The AWMP action funds were used to facilitate the completion of a drainage outlet project in the Deer Creek Watershed in Franklin County. This project was completed in cooperation with the Franklin County Soil and Water Conservation District and the Black River-St. Lawrence Resource Conservation and Development Project. These funds constituted part of the farmer's cost of the project and were considered crucial to the completion of this project (Gore, Beauvais, and Garrigan, 1978). Project monitoring and follow-up technical assistance was provided to the Deer Creek landowners for installation of the on-farm drainage.

A significant portion of the AWMP action funds went to hiring a "Drainage Specialist" to work in the six county Northern New York region. Support from the Black River-St. Lawrence Resource Conservation and Development Council helped facilitate an inter-agency personnel agreement with the New York State Office of the Soil Conservation Service to help fund this drainage specialist. Along with providing some of the more traditional extension programming efforts in the region (discussed elsewhere in this report), the drainage specialist was instrumental in initiating a county drainage program in St. Lawrence County. This program constructed a drainage outlet project for landowners in the Squeak Brook Watershed, using county funds administered through the St. Lawrence County Soil and Water Conservation District.

Action funds were also earmarked to participate in the Hogansburg Watershed Resource Conservation and Development Project in St. Lawrence and

Franklin Counties. Implementation of the construction phase of the project was not timed appropriately to coincide with the earmarked allocation. Nevertheless, AWMP participation is considered instrumental to the continuing interest of this project and the continuance of seeking methods to implement the project.

The construction of pump drainage outlets was considered to be an option available to landowners who were in areas where major drainage outlet construction was considered impractical (Geohring and Swader, 1981). Consequently, AWMP action funds were used to facilitate the construction of a pump drainage facility. This facility is used to demonstrate the concepts of pump drainage outlets on mineral soils. This facility was the first of its kind in Franklin County and led to other such installations in the area.

The installation of subsurface drainage with a drain plow (trenchless method) was demonstrated at three different farm locations in St. Lawrence and Clinton counties. These demonstrations showed that the trenchless installation technique could be used successfully in the fine textured and stony soils of Northern New York. These sites also provided the location for some of the research activity.

Discussions initiated with faculty members from the State University of New York Agricultural and Technical College at Canton led to a field day of their farm facilities and also a field day centered around drainage installation on their farm. Drainage research activity is now underway at this site. Furthermore, the importance and need for adequate soil drainage was introduced into their field crops course curriculum through joint teaching efforts.

The AWMP provided support for expanding the surface drainage program which is conducted jointly by Jefferson County Cooperative Extension and the Jefferson County Soil and Water Conservation District. The AWMP provides two hydraulic scrapers and levelers for this program. Equipment is loaned directly to farmers so they can construct surface drainage practices. These efforts have increased the interest in surface drainage in Jefferson and surrounding counties and it demonstrates that Extension and the Soil and Water Conservation District can complement each other on soil and water management programs.

The AWMP in conjunction with the Wayne County Soil and Water Conservation District developed a methodology for technically evaluating and establishing priority ratings for implementing drainage outlet improvement projects

(Hoddinott, Swader and Zimmerman, 1978). This complements Wayne County's Water Management Program which uses county funds to improve drainage channels for groups of farmers and for improving highway drainage.

The outlet end of the Black Brook Watershed in Seneca County was plagued with problems of overbank flooding and erosion. The AWMP evaluated runoff volumes in the watershed for various conditions and recommended alternatives to safely dispose of this runoff (Geohring, 1980).

The Bell-Six Mile Creek Landowners Organization in Oswego county received AWMP assistance when the extent, nature, and causes of drainage and flooding problems were evaluated in that watershed (Geohring and Brantner, 1977). Alternative solutions were recommended to these landowners. An assessment and alternatives for improving the drainage in the Beaver Meadow Watershed area in Franklin county was also carried out (Geohring, 1980).

A preliminary study of potential drainage outlet projects in Northern New York was made to define dimensions of a program for developing drainage outlets (Zimmerman and Swader, 1981). This work will assist the planning efforts of the associated county Soil and Water Conservation Districts and the Black River/St. Lawrence Resource Conservation and Development Council.

RESEARCH

A portion of Agricultural Water Management Program dollars were used to fund research projects. These projects were directed towards solving specific problems which were deemed crucial to obtaining a better understanding or solution to agricultural water management problems. Since agricultural water management problems do not follow the basic institutionalized disciplinary (or for that matter political) boundaries, research was conducted in several different discipline areas. The AWMP research projects were divided into the general areas of Agronomy, Economics, Engineering, Environmental, Legal and Sociologic.

Agronomic

The Agronomic (and also Engineering) research was directed at quantifying the effects of drainage on soil temperature. Theoretical (model) evaluations and field data in early spring were collected to basically conclude that although there were small differences in soil temperature, there was no statistically significant increase in soil temperature in early spring as a result of drainage treatments in central New York (Hoddinott, 1980; Walter and Rogers; and Walter and Steenhuis). Soil drainage did not appear to be an effective practice for the sole purpose of raising soil temperatures. Weather fluctuations and different soil surface covers probably mask differences. Furthermore, timely planting on poorly drained soils is more often restricted by inadequate field trafficability rather than too low soil temperatures.

Data were collected to evaluate the apparent water table response to subsurface drainage (which was installed by drain plow) on the heavy Kingsbury and Covington silty clay soils. A 100 ft. spacing of tile laterals was observed to be too wide for effectively lowering the water table on these soils. However, even with the 100 ft. spacing, water tables were lowered substantially (for example 1.3 feet in 5 days) on these soils during wet spring periods (Swader, 1980; Swader, 1981). This site was used as meadow and pasture so responses to drainage on continuously cropped fields (those with more traffic and compaction) may not be as rapid as those measured in this study.

Research on the yield responses achieved with better soil drainage were supported by the program through association with the Miner Institute Drainage

Project. Significant increases in corn silage and grain yields on drained fields were documented (Swader and White, 1978; Swader, White and Geohring, 1980; Swader and Geohring, 1980; Swader and Geohring, 1981; and Geohring, Black and Swader, 1981).

Economics

The research in Agricultural Economics focused on developing conceptual models to evaluate the potential economic benefits of drainage and case study investigations of the impact of tile (subsurface drainage) on different enterprise combinations and their profitability. Several reports consummate this activity (Neenan, Milligan and Swader, 1978; Wackernagel, 1980; and Wackernagel, Milligan and Knoblauch, 1979) with general conclusions that drainage projects can be evaluated and tiling is a profitable investment. The greatest returns were demonstrated where the farmer could increase hay quality by switching from grass to mixed mainly legume and introduce a corn grain enterprise. Tiling added to the farm managers flexibility to produce more of his own feed and forage and/or increase herd size. The increase in returns for the case study farms were roughly 3 times the annual cost of the tiling investment where the manager made adjustments to fully utilize his new opportunities.

Data to assess the impact of improved drainage on agriculture in the community has been and is still being collected in the Deer Creek Watershed. Farm appraisals and production information was collected prior to drainage outlet construction. Production data is being collected now that outlet construction is complete and some farms have installed the on-farm drainage systems. Further efforts are still required to complete this study.

Engineering

The research in Agricultural Engineering was concentrated in the area of measuring and characterizing water movement parameters and evaluating drainage installation procedures. A solid state transducer for continuously recording perched water table movement below the soil surface was designed and tested (MacVicar, 1978; and MacVicar and Walter). This instrumentation is useful for obtaining piezometric data where a suitable power supply and appropriate support instrumentation are available.

Computer model, laboratory and field studies at the Cornell University Turkey Hill Farm were conducted to gain a better understanding of water movement through shallow, sloping, heterogeneous soils. This study provides information on the causes of seepage zones, their size and location, and the mixing effects of subsurface and surface waters. The study also concluded that hydraulic conductivities measured in soil cores in the laboratory have higher mean values than those measured in the field using auger holes (McCarty, 1980; McCarty and Walter, 1979 and 1982; Nieber, 1979; and Nieber and Walter, 1981). Additional work evaluating the spatial variability of hydraulic conductivity as measured in the field is currently near completion.

A model to simulate the effects of drainage on soils underlain by a hardpan was developed and utilized to quantify the effect of drainage rates, soil moisture and surface runoff (Steenhuis, Geohring and Walter, 1979). Surface runoff was highest on the most poorly drained soils and surface runoff decreased gradually as the drainage rates were increased. High drainage rates had little further effect on reducing surface runoff and only marginally decreased the soil moisture content. The basic conclusion to be drawn from this is a certain amount of drainage can be very beneficial to reducing surface runoff and lowering the soil moisture content, while very intensive drainage is not considered to have much additional benefit.

Apparent water table data is being collected for selected soils in Allegany, Clinton, Franklin, Niagara and St. Lawrence counties to observe the response to subsurface drainage. This information is being used to compare drained and undrained areas and also to determine drain spacing effectiveness. This data will help to refine drainage design criteria and promote the benefits of drainage.

Field investigations of soil hydraulic conductivity have been conducted in Clinton, Franklin, Jefferson, Oneida, and St. Lawrence counties and are still currently underway. This information is essential to establishing drainage design parameters. Tests are being made in specific soil series (mostly the heavy silty clays) where information is lacking and questions about drainability are constantly being raised. Specific soils across Northern New York are being studied to establish the statistical spread of hydraulic conductivity of these soils in the region. This information will be useful and made available to engineers, conservation technicians, contractors and landowners for determining appropriate drainage spacings in these soils.

The Cornell Drainage Model has been developed and partially validated (Steenhuis, Geohring and Black, 1980). This model predicts apparent water table levels and the drainage discharge for given climatic regimes and soil types. The model is useful for studying the effect different drain spacings have on water table positions. The water table and conductivity studies mentioned above provide validation data for this model. The model will be used to refine drainage design criteria and eventually to provide a decision-making framework for evaluating possible drainage investments.

Research was conducted on the drain plow installation method and the effect various equipment would have on stretching corrugated plastic tubing (Geohring and Thomas, 1979; and Geohring, Swader and Thomas, 1982). It was concluded that a power feed device located on the drain plow would significantly reduce the amount of stretch occurring in the plastic tubing. This provides a better quality subsurface drainage installation.

Fifteen years of subsurface drainage data that was collected on the Department of Agronomy's Aurora Farm in Central New York was compiled and analyzed. This analysis quantified the effects of long term drainage on the physical properties of soil and also indicated correlations of drain flow with weather parameters (Black, Walter and Swader, 1977; and Walter, Black and Zwerman, 1979).

Environmental

A research project in Natural Resources assembled data on riparian vegetation, bird and small mammal species in a project area where construction of a major drainage outlet channel was planned and later implemented (Malecki and Eckler, 1980). The objective was to gather baseline data which could later be compared with counts after construction to assess the environmental impact of drainage outlet construction activities. Recommendations to minimize impact were also reviewed and suggested. Additional funding from the New York State Department of Environmental Conservation was recently obtained to further enhance this activity.

Legal

Investigations into the various methods of legal organization of drainage districts and the legal aspect of disposal of drainage waters were made to clarify the institutional requirements of drainage projects constructed in New

York State (Geohring and Coward, 1978; Grossman, Bettis and Doyle, 1982; and Swader, Geohring and Milligan, 1978). Landowners have several options when organizing for group outlet projects. However, landowners must look to both statutes and case law to determine their rights and liabilities. New York has adopted the "Common Law" or "Common Enemy Rule" which basically states a landowner is liable for downstream damages caused by disposing drainage waters. An easement is essential to protect oneself from this liability.

Sociologic

Assistance from Rural Sociology included a study which characterized local drainage organization and how landowners arranged to get major drainage works improvements implemented and maintained. Several case studies of organizational options were documented (Coward and Offenheiser, 1976).

An investigation into farmers' attitudes towards drainage installation, the effectiveness of the drainage installed, and how they perceive the importance of drainage was conducted on sample farms in Northern New York (Berardi, 1979). This study provided estimates of previous surface and subsurface drainage installations and projected future drainage activity. Eighty-eight percent of the farmers surveyed indicated problems with poor drainage on their farms, yet 57% classified their drainage as good. Since these farmers did not have well-drained soils, they rated their soil drainage as good. The attitudes toward drainage were very positive and 66% indicated they were planning to install drainage in the future.

A study of landowners in the Corbeau Creek Watershed was conducted to evaluate their current farming practices and their awareness of drainage problems (Kiefert, Malanchuk and Gore, 1978). An interesting component of this study was to determine the landowner's awareness of how his agricultural practices may influence non-point source pollution. One conclusion of this study is that expanded educational programs are needed to inform farmers of more efficient and environmentally sound methods of farming.

EXTENSION IMPACT

In order to have the broadest educational impact, the Agricultural Water Management Program had to deal with several audiences. These audiences included: 1) extension agents and specialists, 2) farmers who have soils which are limited by excess soil water, 3) local leaders who are in decision making roles in local agency advisory boards, and 4) persons who provide services to farmers to overcome the problems of excess soil water (i.e., drainage contractors, technical farm advisors, and agency personnel who facilitate such services). With these diverse audiences in mind, the general objectives of the AWMP were initiated in three specific areas to: 1) create awareness of drainage problems and technology, 2) improve local capabilities for drainage installation, and 3) provide educational programs for the general public. The associated extension activities and the impact are described below.

Creation of Awareness of Drainage Problems and Technology

A 25-minute color film titled "Land Drainage" was produced. This film reviews the state-of-the-art in drainage technology. How this technology is being implemented on New York farms is described through interviews with three farmers. This film has been shown to many audiences both within New York State, in other states, and in provinces of Canada.

The installation of subsurface drainage with the drain plow was demonstrated at three locations in St. Lawrence and Clinton Counties. The demonstrations were viewed by large audiences and had a very desirable and widespread impact. Two farmers have since purchased a drain plow to install their own on-farm drainage. A former conservation district manager began a drainage contracting business. One demonstration site was approved for drainage cost-sharing, the first time this installation technique received such approval in N.Y. One of the demonstration sites was used for additional studies of the effectiveness of the drainage installation. Another served as a local demonstration of recommended cropping practices. Corn silage yields were significantly improved when recommendations were followed.

The subsurface drainage installation at the SUNY-ATC Canton facility will increase the awareness and importance for drainage in St. Lawrence County. The research activity at the site will document the benefits of drainage and

Many ATC students enter farming careers; therefore, future adoption of drainage practices is anticipated.

Surface and subsurface drainage techniques were demonstrated in Niagara County in cooperation with extension, the local district, local contractors and tubing suppliers. The demonstration provided another site for the research activity of quantifying the effects of subsurface drainage on heavy silty clay soils. Discussions about a county drainage program were also revitalized.

The AWMP coordinated efforts of landowners, contractors, tubing suppliers and show organizers to demonstrate laser grade controlled drain plow tile drainage installations at the Empire Farm Days. The demonstration was observed by hundreds of people. Drainage contractor feedback indicated that tile installation activity was boosted significantly.

Liason has been established with Soil Conservation Service agronomists to investigate no-till practices on poorly drained soils. Poorly drained fields where some drainage has been installed are being used as no-till demonstration areas. An awareness for the need for drainage is likely regardless of the tillage practices.

The importance of and need for adequate soil drainage has been introduced into several in-depth and new extension agent training courses. In addition to increasing the agents' awareness of the resources available at the College, they are being taught to recognize the causes and symptoms of poor drainage, their locations, and how to deal with a farmer/client who is experiencing drainage problems. The results of the water management research are also being transferred through these courses.

Two large scale maps indicating the wet soil areas of New York State have been prepared (Zimmerman, 1982). These maps serve as useful planning tools, and they also include additional drainage related information in the map margins.

Several educational presentations regarding drainage were made to agents, high school agricultural and science teachers, town and county planning boards, and agency personnel to familiarize them with drainage needs and technology. This effort has facilitated coordination between agents and agencies, and has introduced the importance of drainage to the high school agricultural curriculums.

To Improve Capabilities for Drainage Installation

A drainage field day was conducted in cooperation with the New York State Chapter of Land Improvement Contractors of America, four tile suppliers, several machinery manufacturers, and the New York State Agricultural Experiment Station at Geneva. Seventeen different manufacturers exhibited machinery or accessories and some three hundred people attended. Drain plows, wheel trenchers, chain trenchers, excavators, and several different types of tile and filter materials were all demonstrated. The impact of the field day was phenomenal. The awareness of laser grade controlled technology was greatly increased and several drainage contractors became manufacturers' representatives. Shortly after the field day several drainage contractors purchased drain plows which are a more cost efficient subsurface drainage installation method.

In cooperation with the New York Chapter of Land Improvement Contractors of America and the Soil Conservation Service, workshops were presented to improve drainage contractor skills in the design and installation of drainage systems. Soil and Water Conservation District employees have also attended these drainage design workshops. A special workshop was presented to Soil Conservation Service and district employees in the Northern New York area also. Discussions are currently underway with Soil Conservation Service engineers to present more workshops. Assistance has been given to individual contractors who could not attend these workshops or have not immediately associated with these organizations. These training sessions have improved the drainage expertise in the state; therefore, the quality and professionalism used in installations should be improved.

Liason has been established and maintained with the New York Chapter of Land Improvement Contractors of America. Most of the drainage contractors in New York belong to this organization. Close liason with this organization has provided the opportunity to monitor the quantity of drainage installation and trends in such installation. It has also given ready access to contractors for educational or demonstration programs. The costs of drainage installations have remained quite stable given the inflationary times. Agricultural drainage installations, in terms of total footage of tile installed, has nearly doubled in the past five years to approximately ten million feet during 1981.

To Provide Extension Education Programs for the Public

An educational program consisting of three workshop sessions was designed and tested in the Squeak Brook Watershed. Individual sessions were designed to teach farmers about the kinds of soils and their distribution on the individual's farm, methods of identifying and coping with soil management problems, and sources of additional information and technical assistance. One farmer has installed several thousand feet of subsurface drainage as a result of these workshops. Several other farmers have requested additional assistance from St. Lawrence County Cooperative Extension. Requests have been received to provide the educational program in other watersheds.

The Agricultural Water Management Program has provided educational assistance to extension and other agencies. The AWMP has participated in a workshop for farm leaders sponsored by the Franklin County Soil and Water Conservation District. The AWMP has also assisted in extension programs in Chemung, Jefferson, Monroe, Niagara, Oneida, Orleans, St. Lawrence, Seneca, Tioga, Tompkins, Washington, Wayne, and Wymoming counties. A program on draining organic soils was developed. The importance of a comprehensive drainage system was also conducted for highway personnel.

Educational materials prepared included the Agricultural Water Management Program Highlights Newsletter, a series of fact sheets, news releases, and Ag. News Service articles. Several extension bulletins were also written and/or revised (see Geohring, 1979; Milligan, 1979; Swader, 1978; Walter, Black and Steenhuis, 1980; etc.).

Requests for information on irrigation water management, ponds, drainage around the home, well-water problems and septic systems have also been filled by personnel associated with the AWMP. Numerous presentations have also been made with regards to irrigation water management.

AGRICULTURAL WATER MANAGEMENT PROGRAM ORGANIZATION AND BUDGET ALLOCATIONS

The Agricultural Water Management Program is run by a committee which is made up of representatives of the Agricultural Economics Department, the Agricultural Engineering Department, the Agronomy Department, the Rural Sociology Department and Extension Administration. There is a coordinator who essentially acts as the chairman of this committee. The committee makes decisions regarding allocations of funds to various projects and activities and most often the committee members themselves become the principal investigators on the projects. The Dean of the New York State College of Agriculture and Life Sciences has the ultimate responsibility for the Agricultural Water Management Program.

The Agricultural Water Management Program receives an annual state allocation of $75,000. Approximately 40% of the allocation supports personnel in the positions of a research associate, a half-time secretary, and 2 graduate students. The remaining funds are used for research, extension and action project activities. Roughly one-third of the budget is used in each of the categories of research, extension and action projects. However, the amounts to each category has varied from year to year depending on the nature of the action project involvement.

SUMMARY

The Agricultural Water Management Program has attempted to coordinate a wide variety of activities in different departments to constitute a focused effort of improving water management capabilities for landowners and farmers. The activities have been diverse and so has the clientele which the AWMP has served. The action projects were crucial to facilitating real construction projects in getting drainage improvements in the ground. Many of these projects are serving as models to further enhance local activity and solutions to drainage problems. The annual amount of drainage outlet and on-farm drainage improvements has increased in the past 5 years. In some cases, the AWMP had a direct influence on this increased activity.

Research efforts have contributed to a much better understanding of water movement in the soils of New York. This has led to improved design of drainage systems. A better understanding of the profitability of investing in drainage and the benefits obtained were also achieved. The many legal aspects of drainage in New York are now well documented. A better understanding of the environmental impacts of these drainage outlet projects is being developed.

The extension activities are highlighted by the production of a film and several field demonstrations. The development of educational materials, workshops and many presentations with regards to drainage have increased the awareness and general knowledge base of the citizenry of New York State.

The Agricultural Water Management Program's accomplishments have had widespread effects upon the drainage industry, farmers, legislators in several counties, local organizations and agencies, and state and federal agencies. While the majority of accomplishments have had a positive impact, there are still many unresolved issues and challenges. There are still many poorly drained soils and areas with inadequate outlets. Many questions on selecting the type of drainage system for a given situation and its economic feasibility remain. Therefore, even with the many accomplishments reported herein, there are still many challenges and opportunities for improving the agricultural water management capabilities for the citizens of New York State.

APPENDIX A

Publications on the following list were funded wholly or in part by the Agricultural Water Management Program.

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