Joint U.S. Agricultural Run-Off Program: Poland Agriculture and Water Quality Protection Project

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Staff Report 93-SR 62
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ABSTRACT

As Poland's economic transformation progresses, its agricultural sector must adopt new technologies in order to operate safely and efficiently, to remain competitive in the world marketplace, and to meet basic standards of environmental protection. This paper reports on the Poland Agriculture and Water Quality Protection Project (PAWQPP), developed under a cooperative agreement between the Center for Agricultural and Rural Development at Iowa State University and the U.S. Environmental Protection Agency Region VII. The paper discusses the innovative approach of encouraging sustainable management practices, through farm and watershed demonstrations, baseline surveys and environmental monitoring, education, and institutional strengthening. Initial results from all aspects of the project are presented.

JOINT U. S. AGRICULTURAL RUN-OFF PROGRAM: POLAND AGRICULTURE AND WATER QUALITY PROTECTION PROJECT

In mid-1992, the Center for Agricultural and Rural Development (CARD) at Iowa State University, under a cooperative agreement with the U.S. Environmental Protection Agency (EPA) Region VII, initiated the Poland Agriculture and Water Quality Protection Project (PAWQPP). The project is a joint undertaking with the Polish Ministry of Agriculture and Food Economy, the Institute of Land Reclamation and Grassland Management (IMUZ), and local Polish government units (voivodships and gminas) in the targeted regions. Also cooperating in the project are the Polish Ministry of Environmental Protection, Natural Resources, and Forestry; the U.S. Department of Agriculture; the U.S. Peace Corps; and selected Polish nongovernmental organizations (NGOs).

Scope and Focus of the PAWQPP

The purposes of the PAWQPP are the transfer and evaluation of technologies and management methods that have been developed in Western Europe, the United States, and Poland and are designed to reduce agricultural contamination of the environment. The transfer and evaluation activities concentrate on demonstration farms identified in cooperation with local governmental authorities, gminas, voivodships, and ODRs (public institutions responsible for technology dissemination and information transfer in Polish agricultural and rural communities). The transfer and evaluation activities on the demonstration farms and watersheds will be leveraged through educational programs conducted jointly with the ODRs and local agricultural colleges or training schools. Finally, through this cooperative activity (demonstrations of new technologies and management methods, support for the dissemination of information) the policy culture will be influenced, drawing increased attention to environmental problems, to the need for informed government intervention, and to opportunities for designing an educational, regulatory, administrative, and institutional system that is of mutual benefit to agriculture and rural communities and to the environment.

This paper provides a summary of the activities and experiences involved in developing the PAWQPP. Also, the project's potential to contribute to solutions for a number of environmental problems is assessed. These problems are evident in the deterioration of water quality at farm, village, and watershed levels, and the project should address widespread water quality problems in

major rivers and lakes, and in the Baltic Sea. The latter aspects of the PAWQPP build on the approaches that have been suggested by work to improve the management of local watersheds or catchment areas, and the possibility to generalize the experience to stimulate improved coordination of environmental and economic reforms of agriculture on a broader geographic base.

Rationale

The rationale for developing the cooperative PAWQPP is related to the economic transition in Poland and increasing information on the importance of agriculture as a contributor to the degradation of ground and surface water quality locally, and the quality of water in larger bodies including the Baltic Sea. These two aspects of the agricultural and environmental problems in Poland are discussed. The observations are intentionally brief, highlighting the justification and timing for the PAWQPP and its positioning with the economic reforms in Polish agriculture.

The Transition to a Private Enterprise Market System

The transition to a private enterprise market system has created many uncertainties and introduced important structural adjustments in the Polish economy, particularly with the freeing of prices and administrative controls, and the unleashing of supply and demand forces (Csaki 1990a,b). Western economists do not have a good understanding of—and certainly no simple recipes for—designing efficient and equitable transition policies. Still, the distortions and inefficiencies created by the command system have been the subject of extensive research (e.g., Kornai 1980; Stewart 1984). In agriculture the closed nature of the economy, along with state ownership, has concentrated production (especially processing and distribution), often into one-enterprise subsectors, and created farms unable to compete in international markets. A lack of accountability for environmental costs and state-determined incentives emphasizing high output levels have meant that the firms and enterprises seldom conformed to standards for effluent and other by-product discharges. These enterprises, given rational behavior in relation to incentives of the command system, have made inefficient use of natural resources and energy (Roe 1992).

Pollution, or environmental degradation in general, is explained in Western economic theory as occurring from external effects of production and consumption due to market failure or ill-defined property rights that impose the associated costs on society (Baumel and Oates 1988). The corresponding failure in the command economies is related to administrative problems, since most allocative decisions are centrally controlled. Opening the centrally planned economies to market incentives

creates massive unemployment, high inflation, and a falling real output. In agriculture, the sharp rise in input prices (energy, chemicals, seeds, and machinery), accompanied by a less rapid increase in commodity prices, has meant lower yields and smaller planted areas, declining commodity output, worsening terms of trade with other sectors, and a fall in real farm income (ERS 1992). Poland is grappling with the new realities of the market system and responding with policies aimed at stabilizing farm income (e.g., intervention purchasing) while trying to address the major questions associated with privatization and restructuring of state farms and agro-industrial complexes.

During this restructuring of the enterprises and firms in agriculture and the economic system, there is an important opportunity to develop and integrate policies and institutions that contribute to improving environmental quality. Currently, relatively high prices limit the use of agricultural inputs that have led to high levels of contamination. But it is reasonable to assume that, as the restructuring progresses, agricultural technologies similar in productivity to those in Western Europe and the United States will be introduced and will dominate those now used in Poland. Appropriately educating producers, local authorities, and government officials responsible for agriculture and the environment can influence the introduction of these technologies and management methods, helping to assure that agriculture in Poland is more sustainable. This same attentiveness to environment can also lead to improved extrafarm management systems such as watersheds, river basins, and lakes. In short, by raising awareness of the importance of agriculture for the environment and managing the economic restructuring and developing of new technologies, management methods, environmental law, institutions, and administrative structures, Poland can emerge from the transition with a more sustainable agriculture and a healthier environment.

Agriculture and Water Quality

Poland has severe industrial environmental pollution problems primarily due to high coal use, old technologies, and low energy prices. The average annual coal equivalent per person in Poland was almost 900 kilograms in 1989, compared with less than 50 kilograms in the European Community. In addition, 1989 energy prices calculated using a simple index were 60 percent lower in Poland than in the European Community (Hughes 1992). The environmental damage in Poland also stems from concentrating contaminant sources in some of the most populated regions. For example, 50 percent of the airborne pollution originates from 15 percent of the total areas in south and southwest Poland. And in these areas, the maximum 24-hour ambient concentration of black smoke exceeds the European standard more than sixfold. Just three mines, producing 10 percent of the coal output, are

responsible for 20 percent of the 30 million cubic meters of saline water and brine discharged daily as a by-product from coal mining, rendering most of the water of the two main rivers (the Vistula and the Odra) too contaminated even for industrial consumption (World Bank 1992). A heavy concentration of industry and power plants also contributes to water pollution in the main rivers. Self-purification in these rivers is low because of the flat terrain and slow stream flow (Hughes 1992). Changing these and other sources of industrial pollution will require significant capital investment and restructuring of production processes even if an ideal set of laws, administrative procedures, and institutions are in place.

Agricultural runoff, in addition to municipal sewage from urban and rural areas and industrial pollution, also contributes significantly to contamination of ground and surface water (Bouzaher and Jensen 1993). In rural areas, village water quality is rated very low in 20 percent of the household water supply systems, 48 percent of common wells, and 66 percent of home wells. Thus, the health of 50 percent of village populations is adversely affected by nitrate compounds and bacteria in the water supply. In addition, it is estimated that between 1987 and 1989 only 29 percent of the villages had an active water supply system, only 5.3 percent had sewage systems, and only 2 percent had water purification plants (Central Statistics Office 1992). Overall, an estimated 65 percent of Polish surface waters are considered unfit for municipal or even for industrial use.

Agriculture contributes significantly to nitrate contamination of water sources. Mismanagement of animal waste, excess use of chemical nitrogen, poor management of drained wetlands, inappropriate tillage practices, and other aspects of the agricultural technologies and management methods are the sources of an estimated 50 percent of the nitrogen contamination of ground and surface water in Poland (World Bank 1992). And agriculture and the rural communities are closely intertwined in influencing water quality. Village wells are contaminated by agricultural practices and village wastewater treatment contaminates water available for use from agriculture. These natural close connections are even more important in Poland than in other nations because of the sandy and organic soils and high water tables in many of the major agricultural producing areas.

The PAWQPP targets the agricultural and rural communities. The idea is that many of the water quality and environment problems can be addressed by adopting technologies and management methods that complement improved farm income. If these knowledge-based interventions or changes—coupled with appropriate administrative, regulatory, and institutional structures and aggressive educational and dissemination programs—can significantly reduce the contamination from

agriculture and rural communities, then there should be major benefits for local users of ground and surface water and improved water quality in the major lakes, rivers, and the Baltic Sea.

The Structure of the PAWQPP

The PAWQPP has a three-year work plan with an expanding agenda to help improve farming practices, education and outreach, institution building, and shaping the policy culture. The general project design is outlined in Figure 1 and in Table 1. Observe from Figure 1 that the activities proceed from demonstrations and monitoring at the farm and household levels to generalization of these results for their implications for educational programs, institution building, policy recommendations, and legislation. Table 1 focuses in more detail on farm or household activities, watershed management, education and dissemination, and policy and institutional change. Note that the farm and household demonstrations begin in year 1 and continue in years 2 and 3, when they involve more sophisticated technologies and management methods that are more customized to the local agriculture situation.

For the watershed demonstrations, the first year is primarily devoted to surveys and information collection. The idea is to accumulate information on the watersheds where the farm demonstrations reside and to prepare a basis for demonstrations that will involve extrafarm and extrahousehold relationships, and the integration of farm and village initiatives, during years 2 and 3. Also in year 1, monitoring at both the farm and watershed levels is focusing on the ground and surface water quality near the demonstration areas on the farms, in streams near the farms, and at the watershed outlets.

The education and dissemination activities will parallel the demonstration results for farms, households, and in the watersheds. Thus, education and dissemination in year 1 concentrate on farm- and household-level management methods and technologies. These activities in years 2 and 3 will add watershed management to the farm and household demonstrations. Finally, it should be emphasized that the scope of the education and dissemination will increase during the project. In year 1, the focus is on the local voivodships and gminas, but later on they will be used in materials for education and dissemination programs targeted to other agricultural areas in Poland.

The policy and institutional component of the project is the most difficult, in part because formulating policy recommendations and suggestions on institutional design requires great familiarity with the cultural, technological, and other aspects of the economic and political systems unique to Poland. During the first year, the policy and institutional area activities are primarily gathering

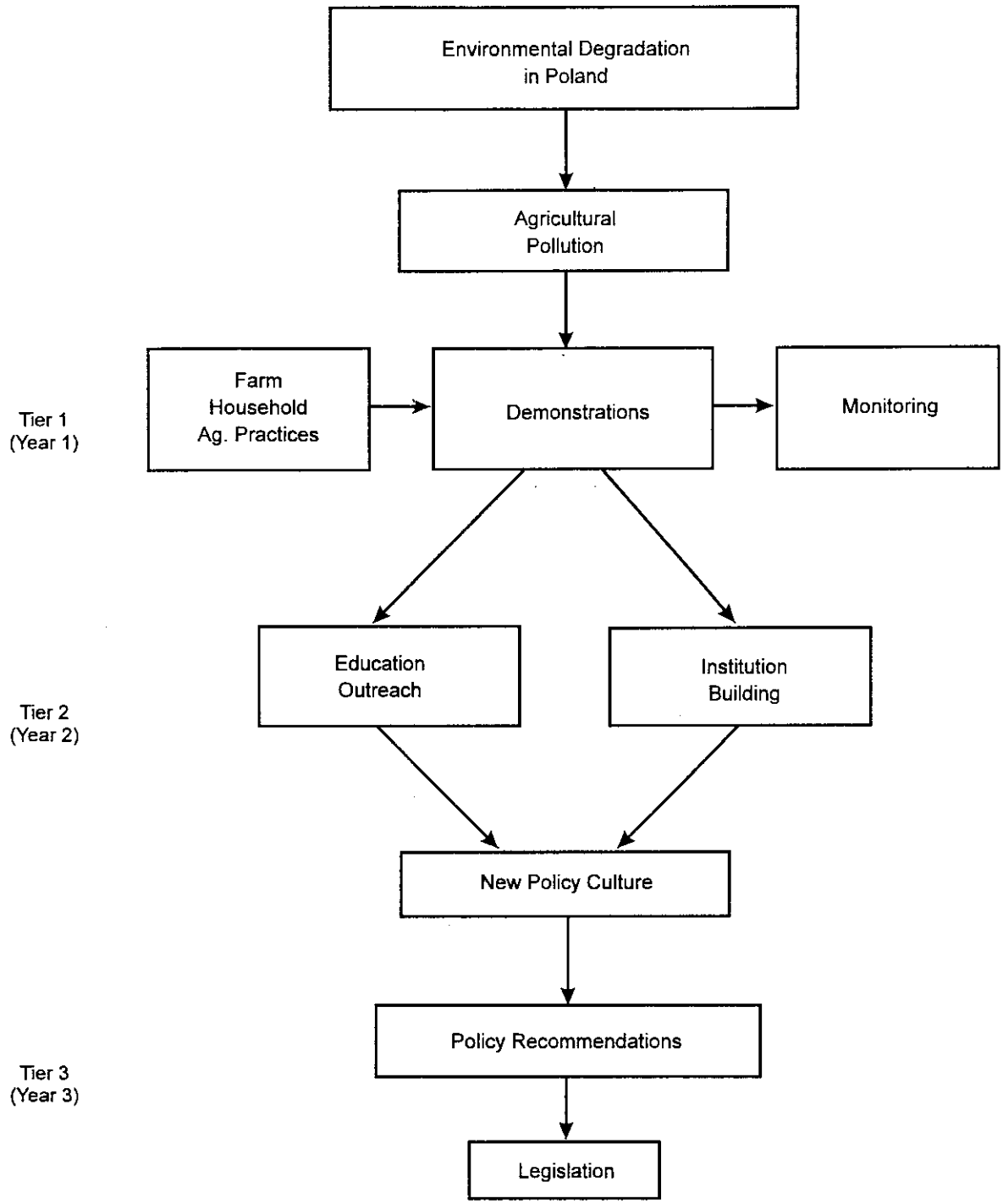

Figure 1. Poland Agriculture and Water Quality Protection Project: A three-tier approach

Table 1. Poland water quality and implementation strategy summary

	Demonstration		Activity	
Year	Farm	Watershed	Education and Dissemination	Policy and Institutional
1	Select farms, implement simple demonstrations	Survey watershed	Review organizations to participate and make contacts	Accumulate legal/regulatory information, determine players
2	Continue demonstrations using more sophisticated technologies	Model watersheds, introductory demonstrations	Prepare materials and conduct dissemination (local)	Negotiate cooperative policy and institutional initiatives
3	Continue selecting and evaluating technologies	Extend to more complex and policy/institutional approaches	Introduce policy and institutional initiatives	

information on regulatory structures, administrative systems, legal and other initiatives for the environment, and on aspects of the economic transition that are important to agriculture and the environment. This information will be used to negotiate experiments that may be set up in the demonstration areas, in cooperating gminas and voivodships, in other areas focusing on changing institutions and the regulatory structure, and as educational initiatives designed to alter the policy culture. Information generated from the household surveys in the targeted watersheds and associated gminas and voivodships will be analyzed. These surveys collect information on how households learn about the environment, what their attitudes are toward the environment, and what their perceptions are of environmental and economic risk.

Thus, the project is a comprehensive package, starting at the grassroots or farm and household levels, and proceeding to address environmental and agricultural problems of greater scope as information is accumulated and the organizations participating in the project become more familiar with one another. The farm demonstrations for year 1 are underway in 1993. The surveys of the watersheds and related gminas and voivodships have been completed and are being analyzed. And the networks to facilitate the dissemination and educational activities and prepare for the policy and institutional initiatives have been activated. Plans are being finalized for the second year of the project and activities are focusing more on watershed management, education and dissemination, and policy and institutional reform.

Project Areas and Demonstrations

Two demonstration areas were selected, primarily with guidance from the IMUZ and other Polish collaborators. In northeastern Poland the demonstration area is in the Ostralenka/Lomza region. In western Poland, the demonstration area is in Szczecin. The two areas are outlined in Figure 2 and emphasize the concentration of the project activity in northern Poland. The Ostralenka/Lomza area is characterized by small farms, sandy soils, diversified cropping patterns, small livestock herds, and a water table quite near the surface. Households on the farms in this area consume water from dug wells as well as from rural water systems.

Agriculture in the Szczecin area more closely resembles that in Western Europe and the United States. This is the area where the large state and collective farms were formed under the old regime. Again, the agriculture is mixed. The soils are tighter and the demonstration area surrounds Lake Miedwe, the main water source for Szczecin. Available data indicate that nutrient contamination levels in Lake Miedwe have been increasing. It is believed that these elevated nutrient

Figure 2. Demonstration areas in eastern and western Poland

levels are related to the intensity of agricultural production in the areas surrounding the lake. Another feature of agriculture in Szczecin is the number of large, concentrated, livestock feeding enterprises.

In the Ostralenka/Lomza demonstration area there are three watersheds: Szafranki, Laddy, and Rupin. Each watershed has three farms:

Farm 1: Manure storage and nutrient management
Farm 2: Grassland management (introduction of clover varieties)
Farm 3: Septic tank and housewaste management

In Szczecin there are two watersheds, each on a tributary of a stream flowing into Lake Miedwe. In each watershed in Szczecin there is only one demonstration farm because of the size of the enterprises. Also, there is one demonstration farm outside the watershed, selected because it is very near Lake Miedwe. The watersheds and demonstration farms are listed below.

- Warnice Watershed
  Rensko: IPM/sugar beet, Nitrogen management
  Chmielewski: Cover crop
- Pyrzyce Watershed
  Przepiórka: Manure storage, Nutrient management
  Sanderek: Silage storage, Nutrient management

Geographic Information System (GIS) maps for two of the watersheds (Lake Miedwe in Szczecin and Rupin in Ostralenka/Lomza) are provided as Figures 3 and 4, and show cultivatable land, cropping patterns, locations of demonstration farms, roads and other infrastructure, villages, and other information. These watershed maps present information that is being accumulated as a basis for selecting demonstration projects at the watershed level that will be undertaken in year 2 of the PAWQPP. Also, this information will help in generalizing the demonstration results to other areas.

Each of the watersheds is located in either a set of gminas and/or a voivodship. Gmina and village officials have been involved in selecting the demonstration farms. The voivodships and their ODRs also support the demonstrations, and are ready to cooperate in the demonstration and educational activities. In each of the two areas there is also an agricultural college. Linkages with these colleges to provide student involvement in the farm demonstrations, educational programs, and in the watershed management demonstrations that are being conducted during summer 1993.

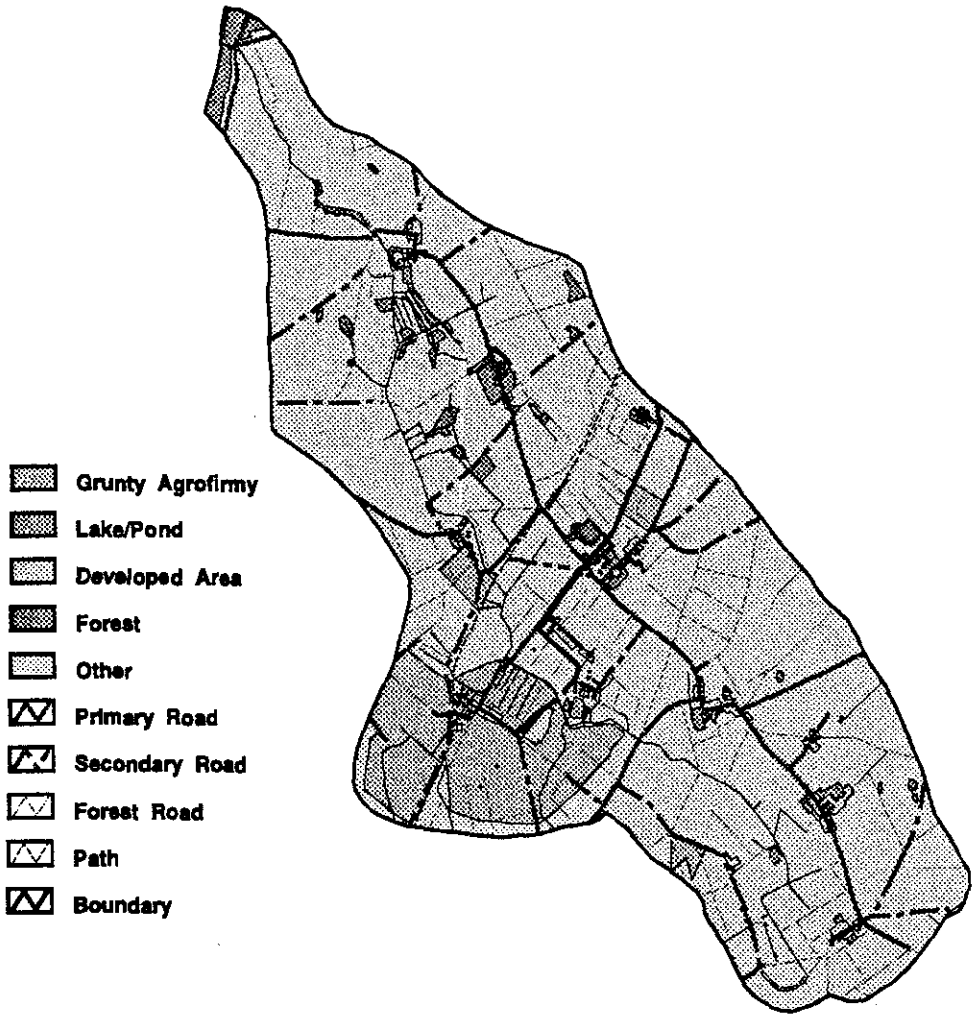

Figure 3. Lake Miedwe subwatershed #1

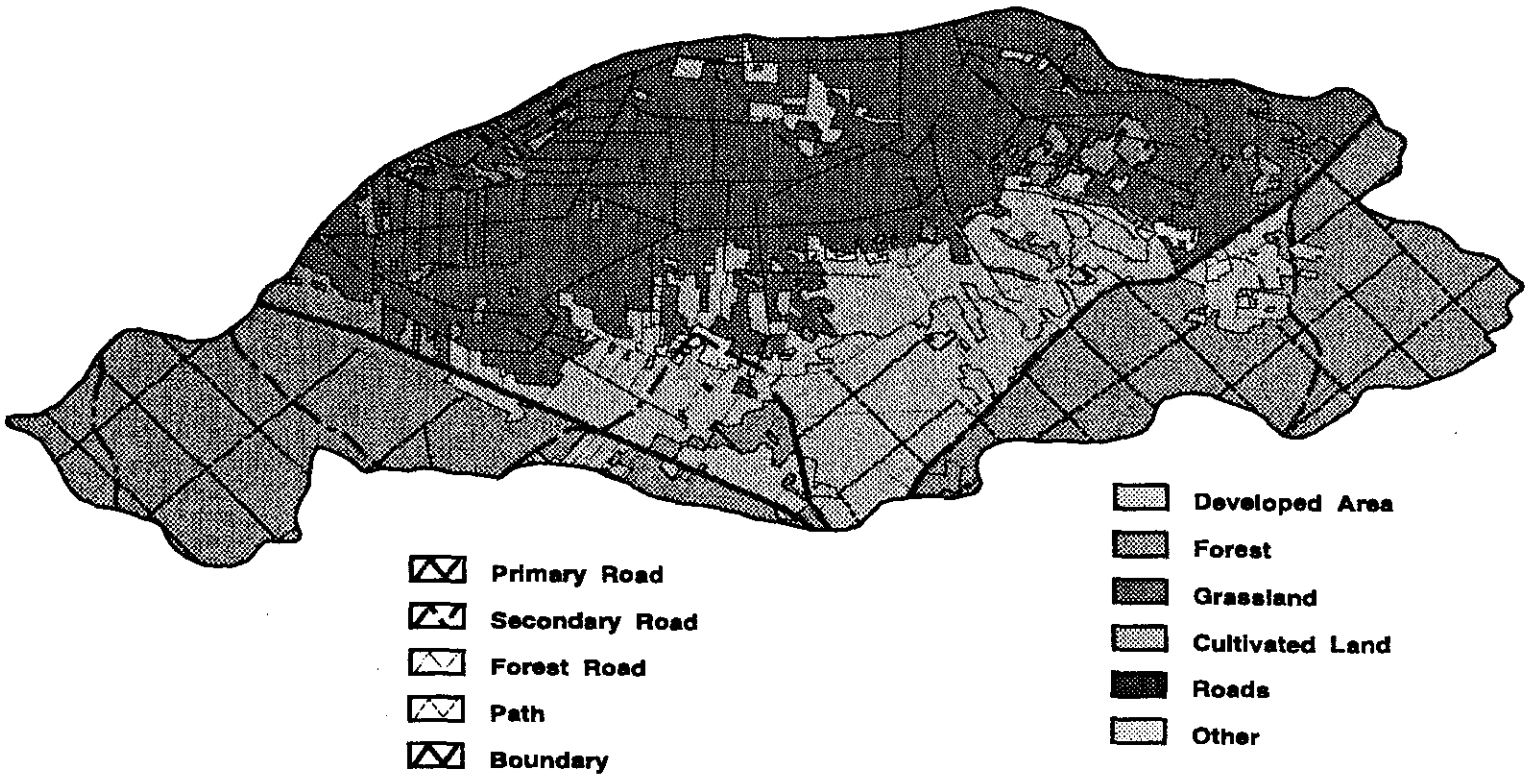

Figure 4. Rupin watershed

Preliminary Results

Results to date from the PAWQPP are in four general areas: organization, technology and management demonstrations at the farm or household levels, monitoring in the watersheds and related areas, and survey and descriptive tabular analyses.

Organizational Results

The organizational results are the least tangible but perhaps the most significant accomplishment. Productive working relationships have been developed with the subcontractors in Poland—IMUZ and the MOAF. Contractually, this working relationship involves matching domestic currency funding of the PAWQPP from the Polish side. The latter is viewed as important by both the U.S. and Polish sides in assuring joint ownership of the project and follow through.

Agreements on cooperation and information sharing have been negotiated with the Ministry of Environment, Natural Resources, and Forestry, domestic NGOs, foreign NGOs, and with scientific institutes in agriculture and kindred disciplines. Finally, an arrangement has been negotiated with the Peace Corps to use volunteers in the demonstration areas, assisting with education and dissemination. All of this organizing has required time and high-level participation in the early part of the project from both the Poland and U.S. sides. Again, the intent is to achieve maximum leverage of the project results and to assure broad participation by interested groups and authorities.

By cooperating with IMUZ and MOAF, working relationships have been developed with gminas and voivodships in the two targeted areas. This cooperation is needed for setting up the demonstration farms and watersheds, and for the educational and dissemination activities with the ODRs and other local institutions, including the agricultural schools. The survey was also made possible by cooperative arrangements with local authorities. Farm participation is, in many ways, almost conditional on the approval and cooperation of local authorities.

Demonstrations

The planned demonstrations, listed on page 9, are in most cases being implemented. That is, construction, education, legal, and other factors associated with the demonstration technologies and management methods have been initiated. To illustrate the planning necessary, Figures 5 through 7 have been included to describe one of the manure storage facilities being constructed. The facility will help to retain the nutrient content of the manure, prevent migration of barnyard contaminants to ground and surface water, and support timely application of the manure to field crops and pastures.

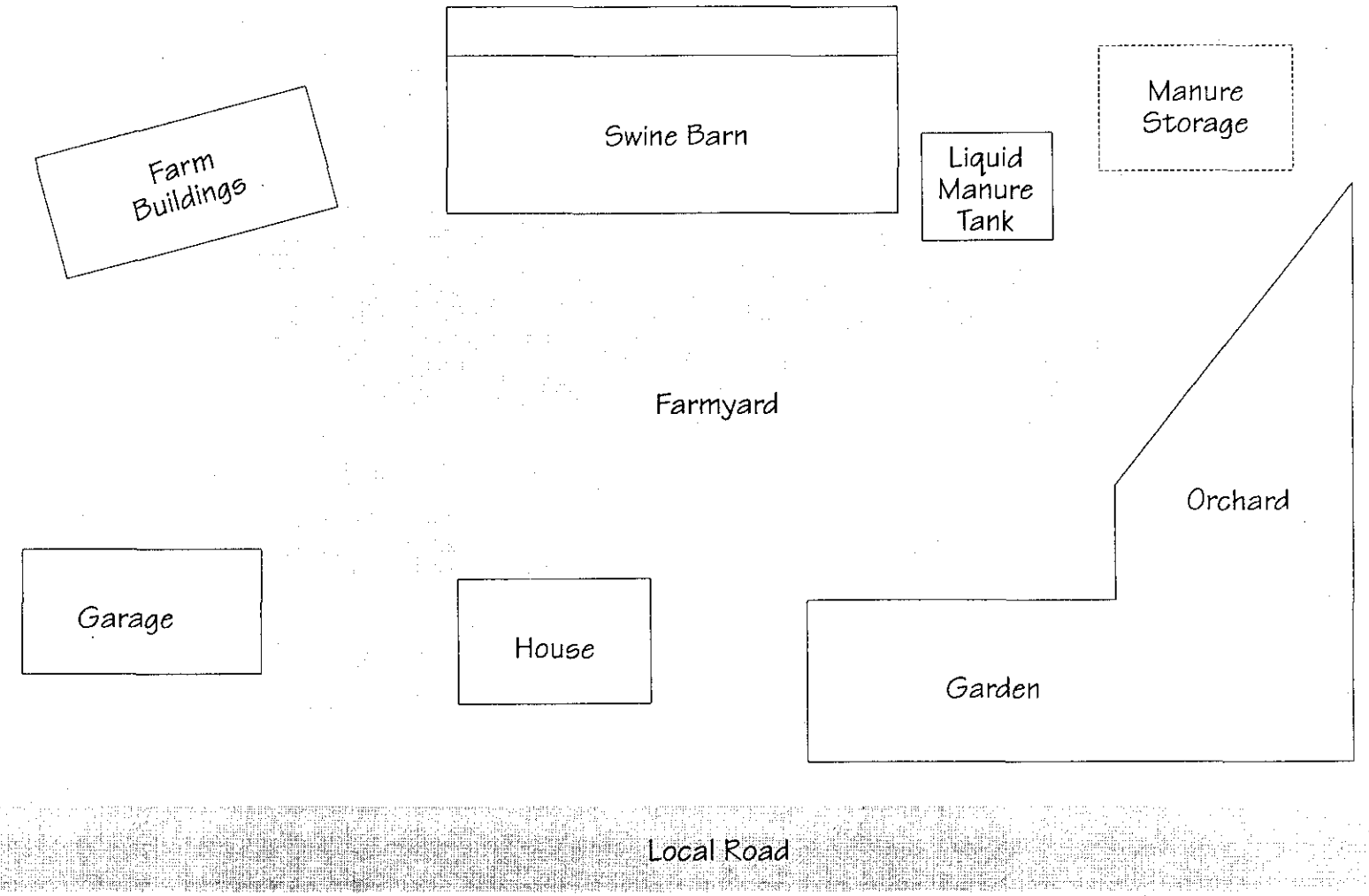

Figure 5. **Farm layout and site of manure storage facility**

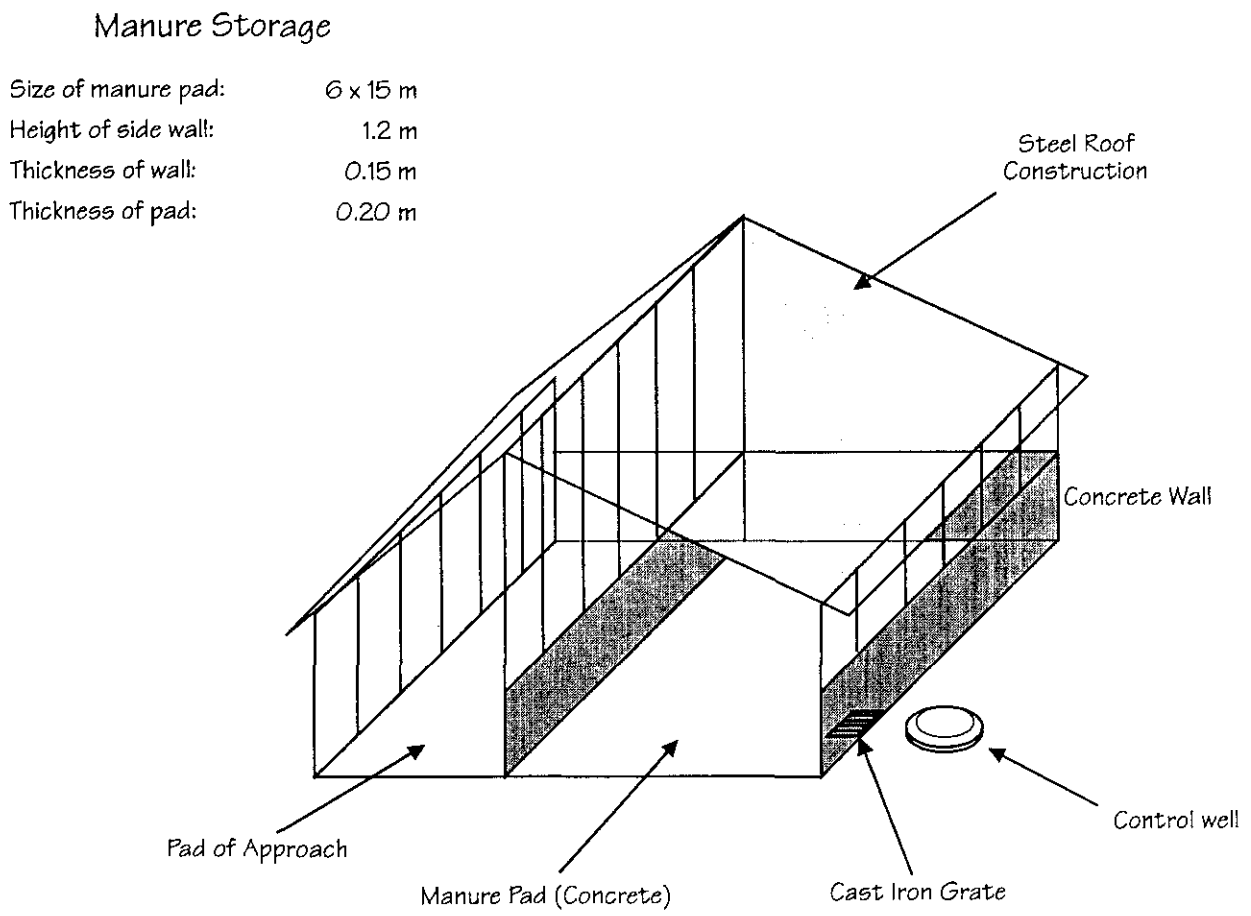

Figure 6. General design of manure storage facility

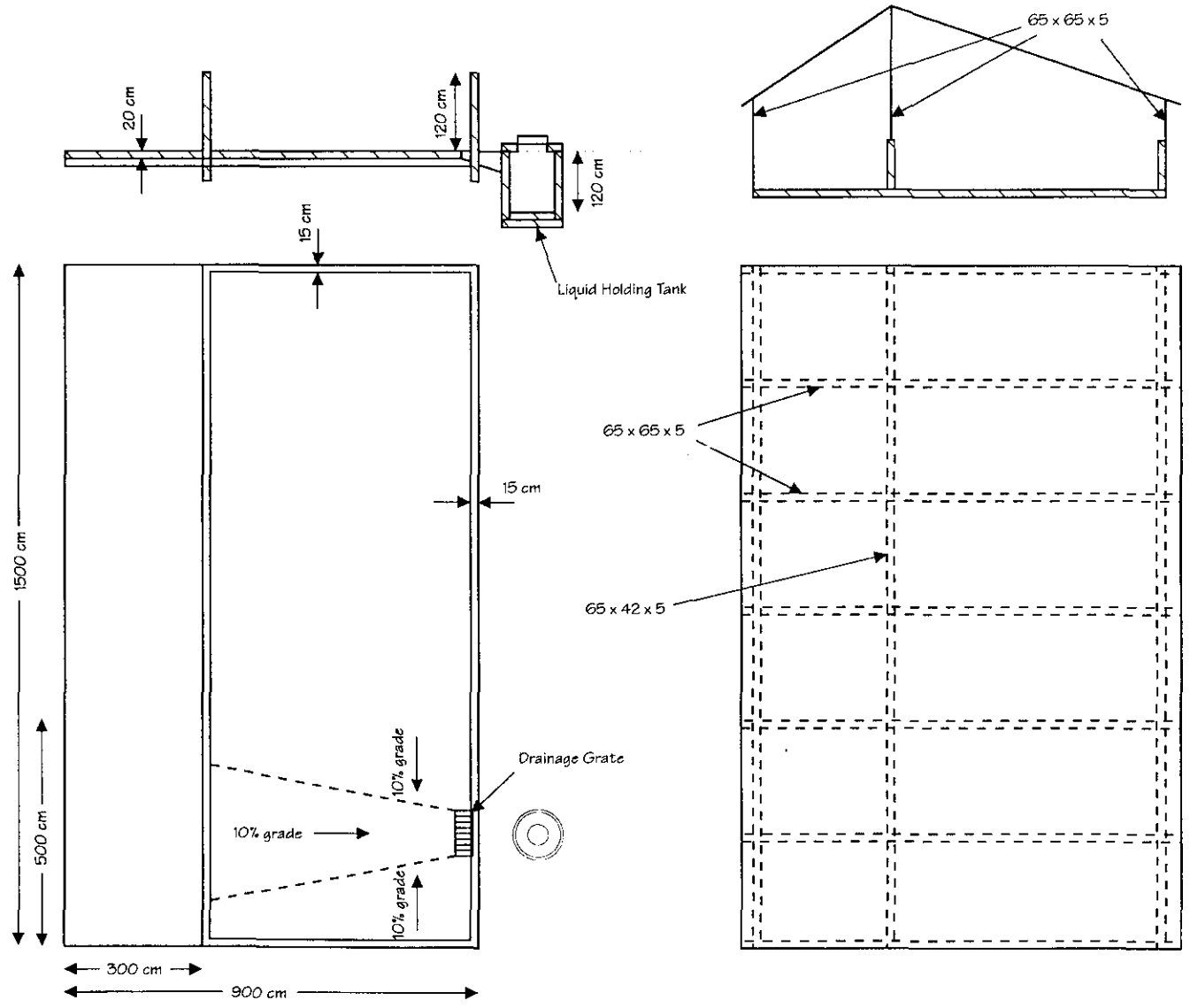

Figure 7. Floor plan of manure storage facility

Costs of demonstration projects are being shared with the farms on which they are located. Generally, the materials are supplied by the project and the labor and other costs for construction are provided by the cooperating farm. Farmers have responded favorably to the opportunity to share costs in exchange for the inconvenience of the farmers during the field days and other dissemination activities and as an inducement to be a first-time experimenter with the technology or management method. The value of the cost-sharing for such a facility in the Ostralenka/Lomza region is U.S. $1,000. It is believed that, at current relative fertilizer and output prices, the manure storage facility can pay for itself in about three years on an average to larger farm in eastern Poland.

Monitoring

The monitoring activity for the project has begun. In fact, by choice of targeted area for the project, well water monitoring data are already available at IMUZ. The general monitoring plan involves both farms and watersheds. At the farm level the monitoring will be conducted for

- Drinking water wells,
- Groundwater on the farmstead,
- Soil water,
- Surface water (canals, outlets, streams),
- Livestock waste testing, and
- Soil testing.

And at the watershed level, the monitoring will be for

- Weather (temperature and precipitation),
- Nutrient content of precipitation,
- Flow mass balance, and
- Water sampling at inlets and outlets.

Indicators on which the monitoring focus are related both to environmental and health risk, and include

- Nutrients and micronutrients,
- Pesticides,
- Biological Oxygen Demand (BOD), and
- Bacteria.

Selected well water monitoring data for the Szczecin and Ostralenka/Lomza areas are provided in Figures 8 and 9. Nitrate concentrations in both areas are at or below the European standard, 11.3 milligrams per liter, in only about 40 percent of the wells. And very high concentrations, about 50 milligrams per liter, were observed in approximately 20 percent of the wells in the Ostralenka/Lomza

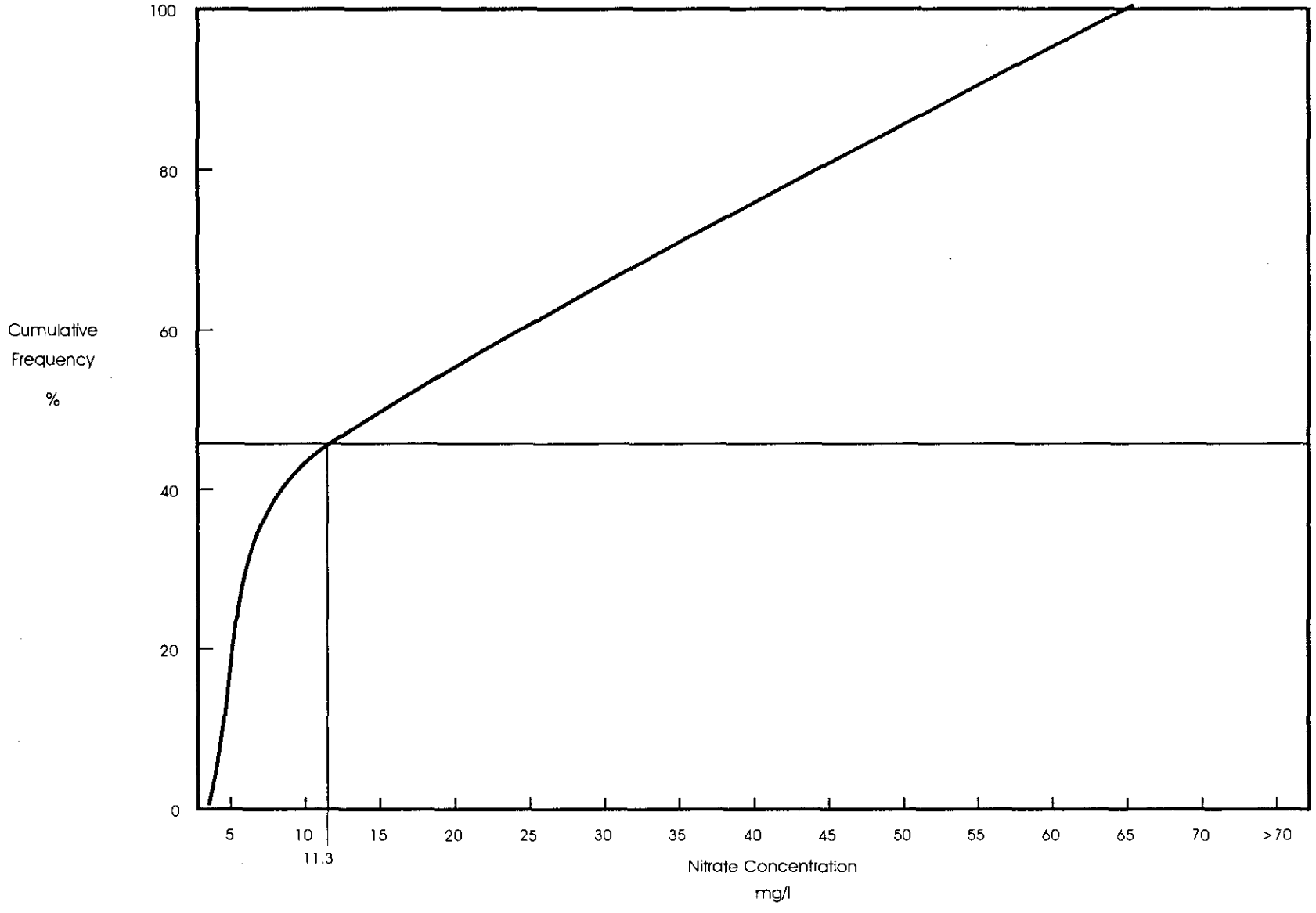

Figure 8. Cumulative frequency distribution of nitrate levels in well water samples from the Ostrolenka region

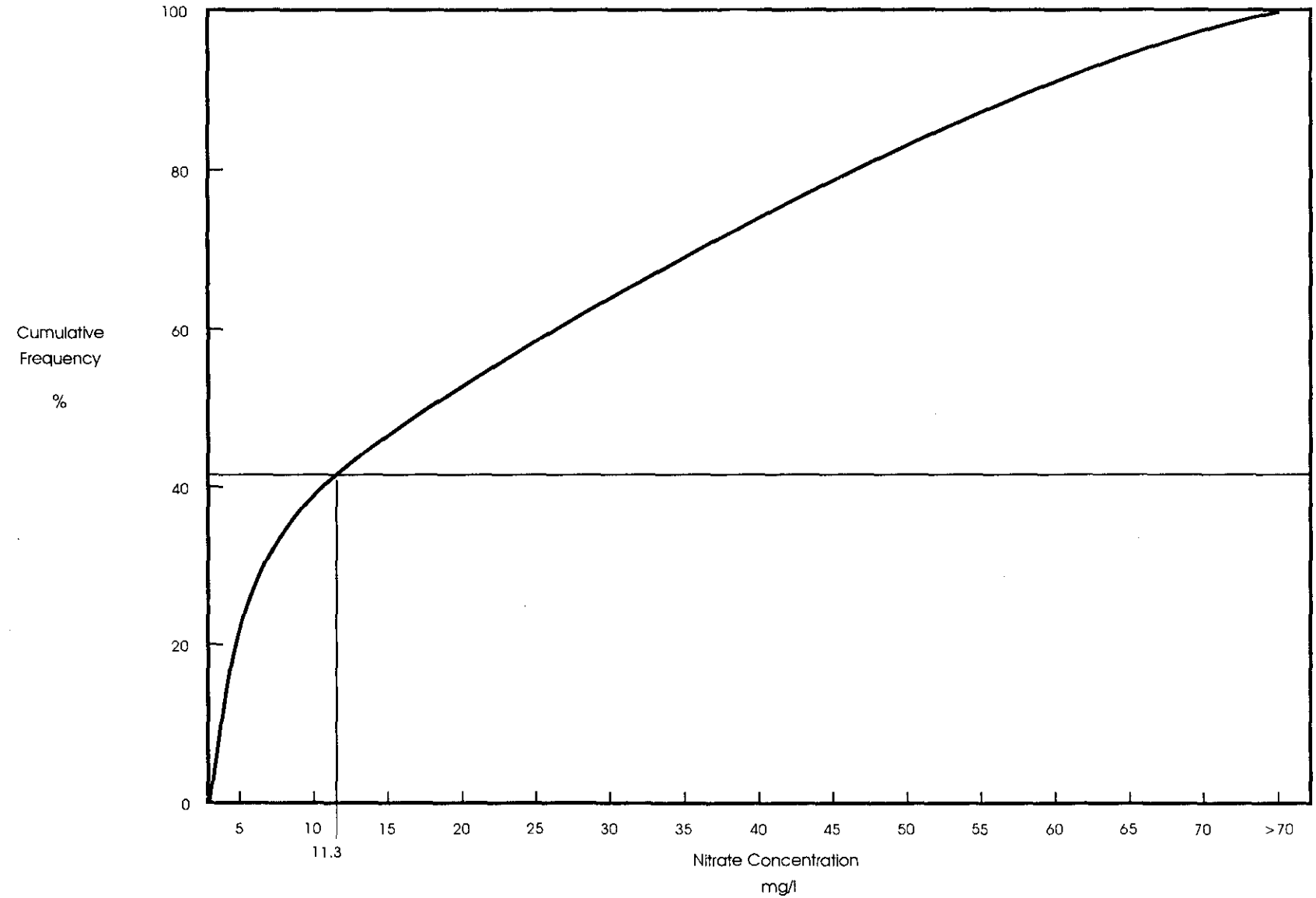

Figure 9. Cumulative frequency distribution of nitrate levels in well water samples, from the Szczecin region

region and 10 percent of the wells in the Szczecin region. In short, the well monitoring data suggest significant nutrient contamination problems in both areas.

Survey

The survey was administered during winter 1992 in both demonstration areas. Generally, the survey was administered to all the households/farms in the demonstration watersheds and a 10 percent sample of the households/farms in the gminas containing the watersheds. The latter was to obtain control data to be used in evaluating the demonstrations, and to provide perspective for the results obtained from the analysis of households in the demonstration watersheds.

Results presented here are from a preliminary analysis of the survey data for the demonstration watersheds in the Ostralenka/Lomza area. The survey contained seven parts: agricultural practices and cropping patterns; farm income and agricultural prices; agricultural inputs management (fertilizer, pesticides, livestock waste, oils); farm management practices; on-farm water source management; perceptions and attitudes toward environmental protection; and expectations about government policy. The results are from a full sample of the completed surveys for the three watersheds in the Ostralenka/Lomza region, approximately 70 farmers. A random sample of roughly one-half of these surveys was analyzed in order to generate these preliminary results.

These results indicate that the watersheds in the Ostralenka/Lomza area are relatively typical of the region. Averaging across the farms, the crops grown are pasture, 30 percent; hay, 37 percent; rye, 15 percent; wheat, 1 percent; oats, 6 percent; potatoes, 4 percent; and triticale, 6 percent. In other watersheds, sugar beets and barley are also grown in addition to the crops from the three demonstration watersheds. Seventy percent of the farms are 0 to 20 hectares, with the largest farms between 41 to 45 hectares. Major livestock commodities produced are poultry (layers), dairy, and swine. Average fertilizer purchases of farmers in the area are nitrogen, 465 kilograms; phosphorus, 281 kilograms; potash, 700 kilograms; and lime, 2,800 kilograms. One hundred percent of the farms reported using herbicides on triticale, rye, oats, barley, sugar beets, and wheat. Insecticides were used only for potatoes, but on 100 percent of the farms growing potatoes.

Farm wells were frequently located in the immediate vicinity of the fertilizer, pesticide, petrol, and other toxic substance storage areas. Also, wells were frequently in the barnyard. Twenty-six percent of the wells had casings at least 30 centimeters above the ground, 4 percent of the wells had casings isolated from the bottom by clay and other material, and 7 percent of the wells were in areas that were isolated from the farmstead. One hundred percent of the wells were covered—38 percent

by wood, 60 percent by metal, and 2 percent by concrete. The average age of the wells was 12.7 years with the oldest at 50 years. Seventy-eight percent of the wells were built by the farmers.

Eighty-five percent of the farms have concrete holding tanks for household waste with an average volume of 6.6 cubic meters. Wastewater from the holding tanks is applied to the fields by 83 percent of the farms. Fecal matter is applied to fields by 92 percent of the farms. This material is disposed of outside the farm or in ditches for the other 8 percent of the farms. Livestock manure is incorporated by 93 percent of the farms. This incorporation is typically completed one time, and within one week. The farms produce an average of 122 tons of manure per year. The manure from each farm was applied to an average of 4.7 acres of land. Livestock on the farms produce an average of 7.3 cubic meters of liquid manure per month. Forty-seven percent of the farms emptied liquid manure holding tanks monthly, while 50 percent emptied these tanks once every three months.

The survey results are summarized in Tables 2 through 4. These summary results has been to briefly describe the situation on the farms in the Ostralenka/Lomza region. Detailed reports from the survey will be available later in 1993. The remainder of these survey results emphasize aspects of the survey that are more special to the demonstration project. These relate to perceptions and attitudes toward environment, expectations about government policy, and other factors. For this purpose, the questions and percentage responses are reported for selected questions from the survey instrument.

First consider the request, "Please tell to what degree the agriculture in your region solves the following problems." Answers to this question indicate that agriculture is perceived as being fair at maintaining high water quality, conserving the soil, and maintaining land productivity. On the other hand, the farmers feel that profitability is low, that farming offers a relatively low standard of rural living, and that there are questions about the suitability of farming as an occupation for the next generation. For more detailed information, including a balanced response to a question about whether farming is providing healthful and safe food, see Table 2.

Table 3 contains summary information on a set of questions that are more related to the environmental issues to which the demonstrations are addressed. The question to which the participants responded is, "In your opinion, what things named here are problems for the farmers in your area?" Interestingly, improper manure storage, surface water pollution, and groundwater pollution were indicated as nonproblem areas by a high percentage of the farmers in the demonstration watersheds. Other responses indicate that a number of the farmers find it useful to obtain additional agricultural production technology information as a basis for improving productivity and income.

Table 2. Percentage responses to survey question regarding the degree to which agriculture solves specific problems in the region

Problem	Poor	Fair	Good
		(percent)	
Maintains productivity of the land	4	74	22
Conserves soil from erosion	4	67	29
Maintains high water quality	7	74	19
Provides habitat for wildlife	22	67	11
Produces reliable supplies of food to consumers	30	37	33
Provides reasonable profit to farmers	89	11	0
Provides healthful and safe food	26	30	44
Offers desirable family life and rural living	81	19	0
Leaves a better condition for next generation	70	26	4

Table 3. Percentage responses to survey question regarding problems for farmers in the area

	Poor	Fair	Good
		(percent)	
Improper storage and disposal of livestock manure	67	33	0
Surface water pollution	74	22	4
Groundwater pollution	85	11	4
Farmers rejecting new ideas and practices that might benefit them	63	33	4
Too many new and untested farming ideas and practices being promoted to farmers	74	26	0
Limited resources (money) and credit buy needed machinery and new buildings	4	22	74
Limited resources (money) and credit to buy needed seeds, fertilizer, and pesticides	4	18	78
Limited genetics for better livestock	7	22	71
Limited skills to increase production and crop yield	26	56	18
Limited skills to make wise business decisions	37	56	7

Table 4. Percentage responses to survey question enumerating environmental concerns

Problem	Agree	Undecided	Disagree
		(percent)	
I worry about the purity of my family's drinking water.	19	11	70
I am confident that agricultural pesticides, if used as directed, are not a threat to the environment	30	55	15
Agricultural chemicals are the best alternative we have to control weeds, insects, and plant diseases	59	33	8
Modern farming relies too heavily on insecticides and herbicides	4	48	48
There is too much attention about the harmful effects of pesticides	15	52	33
There is too little attention paid to the benefits of pesticides	18	63	19
The soil blocks most pesticide movement to your drinking water	44	44	12
In this area, animal manure is not a significant factor affecting water quality	41	26	33
When mixing and applying pesticides, a slightly richer mix or application than the manufacturer recommends is often beneficial	44	15	41
With proper management of livestock manure there is little need for commercial fertilizer on my farm	85	7	8
I am optimistic about the future of farming in Poland today	0	19	81

Table 4 lists responses to environmental concerns. Seventy percent of the farmers were not worried about the purity of the family drinking water source. Answers to other questions in Table 4 suggest significant value for educational programs on application rates and time of application for pesticides. In general, these and other questions suggest dispersed attitudes or information about environment and other aspects of agriculture. Also, there are clear misperceptions about agriculture and the environment that could easily be countered with appropriately designed educational programs.

The final survey question involves information on farmer decision making processes. This question was, "Of the information sources you mentioned, which are the most influential?" The results show clearly that an important source of information for farmers is their nearby neighbors. This has broad implications for the project. It indicates that the demonstration approach, emphasizing farmer-to-farmer communication, is consistent with the most prevalent way that farmers in this region of Poland obtain information about new technologies and farming methods.

Summary and Conclusions

The PAWQPP is now established and focusing in the first year on farm-level demonstrations. Results indicate that the demonstration approach builds on the traditional ways in which Polish farmers learn. These demonstrations are taking place in spring 1993. Related educational and other programs will be introduced and evaluated for their effectiveness. The preliminary survey results have indicated that there are significant areas in which the perceptions of farmers disagree with factual information on agricultural chemical use, manure management, and other technologies and farming methods that have important impacts for water quality.

Well monitoring in the two demonstration areas indicates that nitrate contamination is an important problem. Many of the wells from which drinking water is being used have nitrate levels far in excess of European standards. Casual observation of these wells, both relative to their location and the observed condition of the water, suggest that there are significant BOD and bacteria problems. These factors will be more systematically evaluated as the monitoring program is implemented in the demonstration watersheds. Still, there is sufficient information to suggest that there is a water quality problem, and that it is likely due to agricultural technology and watershed management.

The other achievements of the project refer mainly to organization. A serious attempt has been made to involve all of the government and nongovernment organizations in Poland that are interested in participating. Coordination between the MOAF and the Ministry of Environment,

Natural Resources, and Forestry has been achieved. And the Ministry of Agriculture has regarded the project as sufficiently important to merit matching funds. Organizationally, the necessary local level connections and commitments have been made. Officials of the gminas and voivodships have been contacted and informed of the project, and they support it. ODR directors are aware of the project and are willing to participate. And local agricultural schools are interested in incorporating the demonstration results into stronger environmental training for agricultural specialists.

The implications of the project for the Baltic Sea are suggested by the importance of agriculture to nutrient contamination, and the possibility for significantly influencing attitudes and behaviors as a result of initiatives like the PAWQPP. A significant factor in this connection is the cost of the intervention. Other nutrient contamination of the Baltic Sea is industrial and from municipal waste disposal systems. Modifying these individual and municipal systems would require significant capital investment. And even if the Polish government decided to undertake such modifications, a significant period of time would be required to achieve the modifications, even if the necessary capital were available. In contrast, inexpensive initiatives focusing on improved technologies and management methods, effective dissemination and education, and the formulation of a policy culture for agriculture that is more sensitive to the environment may provide an opportunity for relatively early success in reducing nutrient contamination. The fact that these demonstration and education initiatives may complement increased incomes in agriculture may also mean that transforming the agricultural economy can be part of improving environmental quality.

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