PESTICIDES USED IN AGRICULTURE: ECONOMIC CONSIDERATIONS AND ENVIRONMENTAL CONSEQUENCES

by

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CHAPTER I

INTRODUCTION

As a result of the harnessing of inanimate energy a chain of events developed that has resulted in a reduction in the need for man to engage in hard physical labor. At the same time the use of inanimate energy allowed greater and greater division of labor. It also made modern transportation possible, which, in turn, has greatly increased the supply of land available for use in an economic sense. The development of transportation made it easier for different cultures to come into contact with one another. In fact, it has been said that modern transportation has made people more alike, while at the same time it has strengthened the differences between places.[1] The result of all these rapid developments has been turmoil on a scale never before witnessed in the history of mankind.

This turmoil has created problems for mankind, many of which are nowhere near solution. For example, the possibility of rapid cultural interaction through modern transportation has been responsible for rapid acculturation in many areas of the world by many diverse cultures. In some cases the speed and amount of accommodation by subordinate cultures have caused cultural shock, for too many changes took place too rapidly for adequate adjustment to occur. Some feel that this is the basic cause of the wars that have occurred during the twentieth century.[2]

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[1] Edward Ullman, "The Role of Transportation and the Bases of Interaction," Man's Role in Changing the Face of the Earth, ed. William L. Thomas, Jr. (Chicago: University of Chicago Press, 1956), p. 863.

[2] Preston E. James, A Geography of Man (Boston: Ginn and Company, 1951), p. 13.

This harnessing of inanimate energy has been responsible for the rapid expansion of technology. When modern technological innovations are made available, problems arise. For example, one of the major complaints aired in academic communities today is that technological developments are applied before sufficient time has elapsed to evaluate properly their net results. Pesticides serve as a good specific example of this. They are made available in large quantities before their effects on the environment are known.[3] And later when their effects have been studied, it is determined that the damage caused is so severe that the benefits derived from their use are outweighed by the damage done to the environment.

The upshot of the foregoing is simply that although man has made tremendous scientific progress in a relatively short period of time, sufficient time has not passed for his economic, social, and political institutions to adjust to his new powers to control and make use of his environment.

STATEMENT OF THE PROBLEM

With these points in mind, the problem that is the subject of this paper can now be stated. Actually it is a three part problem. What are the problems associated with pesticide use? What economic considerations are involved in pesticide use? And finally, what are the environmental consequences of pesticides used in agriculture?

JUSTIFICATION OF THE PROBLEM

Such a study is justified by the comments on the definition and

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[3]Robert Sherrill, "Real Villains," Nation, September 14, 1970, pp. 208-12.

functions of geography as stated by James and Hartshorne.[4] Essentially it amounts to this: Geography is concerned with studying the areas of the earth according to their causally related differences. Such a study begins with the understanding provided by the systematic sciences. But, geography, as opposed to the systematic sciences, cannot be defined by its subject matter; rather, geography is a "system of procedures."[5]

(1) It applies the theories of the systematic sciences to real situations and extends knowledge by showing how theories are modified by or invalidated by real conditions.

(2) It allows the testing of concepts derived by the systematic sciences.

(3) It is the basis for a realistic appraisal--essential in decision making--of conditions that differ from place to place.

This particular study is concerned with the third function mentioned above. This is accomplished by considering the history of pesticides, their benefits and harmful aspects from a geographer's point of view, to provide insight into needs for the future of pesticide use.

The final justification of this study is the most important. That is, because man is bound to this planet and its resources for some time to come, he must strive to live in harmony with nature, and must not push nature beyond her capacity, or he will not long survive on this earth. An example of this is the decline of the Mayan Civilization. In a fairly short period of time an area that had been supporting dense populations suffered a drastic

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[4]Preston E. James, "Geography," Encyclopaedia Britannica (1970), X, 145. Also see Richard Hartshorne, The Nature of Geography (Lancaster: The Association of American Geographers, 1939), Abstract.

[5]Ibid.

population reduction because the soil was overworked and became exhausted of various important nutrients and minerals. As a result the yields per acre were reduced drastically. This, of itself, is not enough to lead to the demise of a civilization, but due to the primitive nature of the transport methods available, the Mayans could not expand their area of production sufficiently to make up for the decrease in fertility, consequently the civilization declined.

Along these lines it is hoped that the work presented in this paper will shed light on the implications of the problem, and what alternative courses of action are available to man to rectify or to prevent environmental damage while keeping within the parameters set by political and economic feasibility.

METHOD OF APPROACH

In order to obtain information pertinent to the problem, the subject must first be put in historical perspective. The role of the government must then be considered since regulation and control of pesticides and their use lie within the authority of the federal government. This is followed by a look at the nature of the current research of the various agencies responsible for pesticide research. Attention is then turned to consideration of the most basic aspects of pesticide economics, and finally, the environmental aspects are presented and conclusions are enumerated.

CHAPTER II

BACKGROUND AND NATURE OF THE PROBLEMS ASSOCIATED WITH PESTICIDE USE

IMPORTANT DEFINITIONS

In order to communicate one's ideas to other people it is first necessary that the various parties involved understand the meanings of the important terms under consideration. To that end, it is helpful to define several terms as they will be used throughout this paper. First, the term, pesticide. A pesticide is in reality an economic poison. That is, according to the United States Department of Agriculture (USDA), a pesticide is "any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any insects, rodents, nematodes, fungi, weeds, and other forms of plant or animal life or viruses, except viruses on or in living man or animals, which the Secretary of Agriculture shall declare to be a pest." That is the primary definition of a pesticide; secondarily, it is "any substance or mixture of substances intended for use as a plant regulator, defoliant or dessicant."[6] Thus, an insecticide is but one possible type of pesticide.

Secondly, the terms, persistent and non-persistent, need to be defined. The word, persistent, when used in conjunction with pesticides means that long after its application to a specific type of plant it retains much of its strength and remains as a residue in the soil. Additional applications of this compound can result in dangerously high residue build-up in

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[6] U.S., Department of Agriculture, Report on Pesticides and Related Activities, 1968 (Washington: U.S. Government Printing Office, 1969), p. 1.

the soil. Non-persistent, then, refers to a chemical compound that breaks down rapidly after its initial application.

PESTICIDE USE PRIOR TO THE TWENTIETH CENTURY

Pesticides, whether persistent or non-persistent, are not new. In fact, as long ago as 70 A.D. Plinius recommended arsenic as an insecticide. Also, there are references to the use of arsenic sulfide by the Chinese in the late sixteenth century.[7] Non-persistent pesticides such as pyrethrum, rotenone, and nicotine sulfate, are more recent additions. Nicotine sulfate has been in use at least 300 years and pyrethrum was developed in 1828.[8] Edwards says the following about early pesticides.

> The earlier insecticides included various inorganic compounds which contained lead, antimony, arsenic, mercury, selenium, sulfur, thallium, zinc, and fluorine as active ingredients. These compounds, although not very toxic to insects, were very persistent; so sprayed crops sometimes retained sufficient arsenical residues to be potentially harmful to the consumers, and crops were sometimes damaged by residues which accumulated in soils.[9]

However, during the period of time in question the use of pesticides was quite limited and so were the problems of soil residue build-up that accompanied the use of persistent pesticides.

PESTICIDE DEVELOPMENT AND TRENDS, 1900-1944

The gains in scientific thinking and knowledge that came during the nineteenth century had a tremendous impact on chemistry, turning it from a

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[7] K. A. Hassall, World Crop Protection, Vol. 2 (Cleveland: The Chemical Rubber Company, 1969), p. 1.

[8] Ibid.

[9] C. A. Edwards, Critical Reviews in Environmental Control, Vol. I:I (Cleveland: The Chemical Rubber Company, February, 1970), p. 7.

black magic art into one of the first of the quantitative sciences. Nowhere is that more visible than in Germany, the home of modern chemistry. It was here in the year 1874[10] that the most famous, now turned infamous, pesticide--DDT--was first formulated. However, its usefulness as a pesticide was not discovered until 1939. The discovery was made by Dr. Paul Mueller, an employee of J. R. Geigy, Inc., a Swiss chemical company. His discovery was not met with much fanfare at the time; however, DDT went into commercial use in 1943 and gained a world-wide reputation after 1944 when DDT was used to control an epidemic of typhus fever in Naples, Italy.

Within a few years DDT was extensively used throughout the world and was being heralded as evidence of man's control over his environment. It was during the time when this thinking prevailed that Dr. Mueller was awarded the Nobel prize for medicine in 1948.

After the first years of the use of DDT passed, it became a fact of life and was regarded as a savior compound that could help insure man's survival. In recent years this idea has been reversed and DDT has been banned from some uses, while a complete ban in this country is being considered.

RECENT TRENDS IN OUTPUT AND USE OF PESTICIDES

The discovery of the qualities that DDT possessed as an insecticide in 1939 led to its introduction into the commercial market in the United States in 1945. This has had a considerable impact on pesticide production in the United States since that time. The major trends are:

1. The introduction of DDT resulted in a considerable decline in both

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[10]Don Widener, Timetable for Disaster (Los Angeles: Nash Publishing, 1970), p. 1.

the production and domestic use of arsenic compound insecticides. (See Tables 1 and 2.) The pre-war totals for these compounds show them to have been the dominant group of insecticides before the advent of DDT.

2. The once widely used naturally occurring organic substances derived from various plants have also undergone a considerable decline. Of the three major insecticides in this category, two -- pyrethrum and rotenone -- are insignificant when compared to the total amount of synthetic insecticides. And a third, nicotine sulfate, has all but disappeared from use in the United States.

3. Not only has the introduction of synthetic organic pesticides resulted in the partial or complete replacement of older, once widely used substances, it has resulted in a rapid increase in the total quantity of pesticides sold, despite the fact that a pound of the newer compounds can do more than a pound of one of the older compounds. Sales of synthetic organic pesticides increased from 279 million pounds in 1954 to 634 million pounds in 1962.[11] This documents the rapid adoption of the new compounds.

4. Of all the compounds available, the most popular are the chlorinated hydrocarbons. In 1961 these constituted 85 per cent of total insecticide and rodenticide sales by weight. A scant four years prior to that time chlorinated hydrocarbons accounted for only 63 per cent by weight. In recent times this high percentage of total sales has been cut into by organophosphates, which are generally less persistent in the environment, but more dangerous to handle.

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[11] U.S., Department of Agriculture, Agricultural Stabilization and Conservation Service, The Pesticide Situation for 1962-63 (Washington: U.S. Government Printing Office, September, 1963).

TABLE 1

PRODUCTION OF SELECTED PESTICIDES IN THE UNITED STATES FOR SELECTED YEARS

PRODUCT	1939	1945	1950	1955	1960	1963
Calcium Arsenate	41,349	25,644	45,348	3,770	6,590	N.A.
Lead Arsenate	59,569	70,522	39,434	14,776	10,062	N.A.
White Arsenic	44,686	48,698	26,546	--	--	--
Copper Sulfate	134,032	251,000	174,600	156,176	116,000	83,272
Aldrin-Toxaphene group*	--	--	--	77,025	90,671	105,986
Benzine Hexachloride	N.A.	N.A.	70,698	56,051	37,444	6,776
DDT	N.A.	33,243	78,150	129,693	164,180	178,913
Methyl Bromide	--	--	--	9,222	12,659	17,394
Methyl Parathion	--	--	--	--	11,794	15,999
Parathion	--	--	N.A.	5,168	7,434	N.A.
Nabam	--	--	--	--	2,978	2,420
2, 4-D Acid	N.A.	971	14,156	34,516	36,185	46,312

(Figures in million pounds)

*Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor, and Toxaphene.

Adapted from: The Pesticide Problem: An Economic Approach to Public Policy (Baltimore: The John Hopkins Press, 1967), p. 7.

PROBLEMS ASSOCIATED WITH PESTICIDE USE

For all intents and purposes, there were no problems associated with pesticide use prior to the twentieth century. There were many compounds in use as pesticides, as has already been mentioned, and some of these were very

TABLE 2

DOMESTIC CONSUMPTION OF SELECTED PESTICIDES
FOR THE UNITED STATES FOR SELECTED YEARS

PRODUCT	1950-51	1953-54	1958-59	1960-61	1961-62	1962-63
Aldrin-Toxaphene group	N.A.	N.A.	73,331	78,260	82,125	79,275
Benzene Hexachloride	9,600	7,610	4,276	4,577	2,404	1,299
DDT	72,688	45,117	78,682	64,068	67,245	61,165
Parathion	4,670	3,975	N.A.	N.A.	N.A.	N.A.
Calcium Arsenate	39,583	3,190	N.A.	4,874	4,541	3,960
Copper Sulfate	122,449	74,054	84,230	78,220	80,815	80,599
Lead Arsenate	30,174	16,000	N.A.	8,976	7,957	6,954
Pyrethrum	7,098	7,679	N.A.	N.A.	N.A.	N.A.
Rotenone	7,027	6,428	4,827	3,888	3,598	3,336
2, 4-D (Acid Equivalent)	23,494	26,483	34,102	31,067	35,903	33,199

(Figures in million pounds)

Adapted from: U.S., Department of Agriculture, Agricultural Stabilization and Conservation Service, The Pesticide Situation (Washington: U.S. Government Printing Office, selected years).

persistent. However, these compounds were only used on a limited scale, and in general the applications were not closely spaced chronologically because the amount of money necessary to purchase and use pesticides was generally not available to the farmer. As agricultural methods improved, the number of subsistence farmers decreased, and the size of the average farm increased. It became necessary to reduce crop losses significantly in order to compete successfully.. To do this farmers began to apply more and more pesticides to

more and more land. When DDT and other modern pesticides became available, they were rapidly adopted because the cost of purchasing and applying them was more than justified by the returns, for the application of pesticides resulted in both an increase in the yield per acre and an improvement in the quality of crop.

Several problems resulted from the rapid widespread adoption of pesticides. First, chlorinated hydrocarbons were known to be persistent, but at first there was little concern over the possibility of residue build-up in soil to levels sufficient to cause harm to the crops being grown. During the late 1950's and early 1960's evidence was accumulated that indicated the presence of pesticides in the bottom of streams as well as in the soils to which they were applied.

A second problem that developed was a rapid proliferation of chemicals for use as pesticides. These were widely adopted and put to many uses before any significant research was done on their long term effects on the environment.

A third problem is the fact that each of the three major types of pesticides carries with it its own particular kind of hazard. The chlorinated hydrocarbons, of which DDT is the most famous member, was the first group to be developed. They are relatively safe to handle but are very persistent. The organophosphates, which are recent additions to the lineup of pesticides, are quite varied in their properties. They are much less persistent than the chlorinated hydrocarbons but are more dangerous to handle because they can enter the body through contact with the skin.

The newest class of pesticidal chemicals is the carbamates. They represent a search for chemicals which are relatively nontoxic to warm-blooded animals with little residue accumulation in animal tissues. The main

hazard from some of these chemicals is their growth regulating effect on plants.

The fourth problem is the matter of insect resistance to pesticides over time. The basis of this problem is easy enough to understand. The lifetime of insects is quite short in relation to man, usually measured in days, weeks, or months. As a result they are able to develop resistance to some pesticides in a short time through mutations as the generations pass. Some observers see this as an indication that biological means rather than chemical tools will become necessary in the future.

The last major problem associated with pesticide use is the matter of spillover hazards. However, discussion of this problem is deferred until the end of this chapter.

AREAS TREATED WITH PESTICIDES IN THE UNITED STATES ACCORDING TO LAND USE

The data pertinent to this topic are summarized in Table 3. Only 5 per cent of the total area under consideration is treated annually with insecticides. Of all the categories represented on the table, cropland and cropland pasture constitute three-fourths of the area treated. The next largest category is urban or built-up areas which account for 16 per cent of the total area treated. Of the cropland and cropland pasture category, the largest treated area is accounted for by grains. One statistic not presented in Table 3 below is also worthy of mention. That is, the United States Department of the Interior (USDI) estimated in 1963 that 75 per cent of the land area of the conterminous states had never been treated with insecticides.[12]

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[12]U.S., Department of the Interior, Fish and Wildlife Service, Pesticide-Wildlife Studies, Circular 167 (Washington: U.S. Government Printing Office, June, 1963), p. 3.

TABLE 3

AREAS TREATED ANNUALLY WITH INSECTICIDES
IN THE UNITED STATES, 1962
(excluding Hawaii and Alaska)

LAND USE	Million Acres in Category	Acreage on Which Insecticides Applied (Million)	Area Treated as Percentage of Category
Forest Land	640	1.8	0.28
Grassland Pasture	630	1.6	0.25
Desert, Swamps, Dunes, and Wildland	77	2.5	3.24
Water Areas	32.6	0	---
Cropland and Cropland Pasture	457	68.6	15.00
Fruits, Nuts	2.8	2.3	80
Cotton	15.8	11.9	75
Vegetable	4.1	2.1	50
Grains	216.6	32.5	15
All Other Crops	217.6	19.9	9
Urban or Built-up Areas	53.0	15.0	28.3
Nonforested Parks, Wildlife Refuges, Duck Reserves, National Defense Sites	43	---	---
Total U.S. Acreage	1,934.6	89.5	4.6

It is possible to look at the areas treated with pesticides in the United States from other points of view. For example, it is possible to determine the single most important group of pesticide users and then consider the regional distribution of pesticide application for that group. Table 4 shows the percentages of various types of pesticides used by the most important group of pesticide users.

TABLE 4

TOTAL USE OF SELECTED PESTICIDES AND PERCENTAGE USED BY FARMERS IN THE UNITED STATES, 1963

Type of Pesticide	Total Use in United States (Million pounds of active ingredients)	Percentage Used by Farmers in 48 States
Fungicides	125	27
Herbicides		
2,4-D and 2,4,5-T	85	48
Other Herbicides	142	59
Total Herbicides	227	55
Insecticides		
DDT	50	54
Aldrin-Toxaphene	78	68
Others	201	54
Total Insecticides	329	57
Total Pesticides	681	51

Adapted from: U.S., Department of Agriculture, Economic Research Service (Agricultural Economic Report No. 179), Quantities of Pesticides Used by Farmers in 1966 (Washington: U.S. Government Printing Office, April, 1970), p. 6.

Table 4 shows that in 1963 farmers used 51 per cent of all pesticides. Table 5 shows the regional breakdown of the percentages of the various kinds of pesticides used by farmers.

SPILLOVER HAZARDS

In a previous section of this chapter (Problems Associated with Pesticide Use) one of the major problems of pesticide use was deliberately omitted. The reason for that deletion is simple. It was first necessary to

TABLE 5

REGIONAL PERCENTAGES OF PESTICIDES USED ON FARMS FOR CROPS, 1964 AND 1966

Region	Fungicides (Per Cent)		Herbicides (Per Cent)		Insecticides (Per Cent)	
	1964	1966	1964	1966	1964	1966
Southeast	27	17	4	4	24	26
Delta States	1	2	7	5	19	16
Corn Belt	12	18	22	32	10	15
Southern Plains	1	6	8	7	15	12
Appalachian	18	11	6	5	10	8
Pacific	12	9	9	12	9	7
Northeast	21	22	10	6	5	5
Mountain	0.5	1	11	6	3	5
Lake States	7	11	11	10	3	3
Northern Plains	1	3	12	13	2	2

Adapted from: U.S., Department of Agriculture, Economic Research Service (Agricultural Economic Report No. 179), Quantities of Pesticides Used by Farmers in 1966 (Washington: U.S. Government Printing Office, April, 1970), pp. 11, 16, 21.

show the extent of pesticide use before the spillover hazard would be significant to the reader. The spillover hazard is an economic hazard. That is, it is concerned with cost-benefit distribution and resource allocation problems.

Considering first cost-benefit distributions, one finds that it is possible that certain people or groups of people are bearing costs when they do not share in the benefits. One possible example of this concerns pollution

problems arising from pesticide use. It is also possible that certain persons or groups of persons may be sharing the benefits without bearing the costs. In both of these cases action must be taken to see that there is a proper redistribution of costs and benefits.

Considering resource allocation problems, one finds two alternatives. (1) It is possible for too many resources to be pressed into use for the production of pesticides. (2) It is also possible for too few resources to be utilized in the production of pesticides. This implies that there is also a third alternative, that is, to strive for optimal resource use which will be a point of equilibrium somewhere between the two extremes.

CHAPTER III

GOVERNMENT RESEARCH AND PESTICIDE CONTROL IN THE UNITED STATES

In the United States the agency charged with the responsibility to control pesticide registration and use is the Pesticides Regulations Division (PRD) of the Agricultural Research Service of the USDA. As the agency was set up in 1947, its purpose was to protect the country from pesticides that produce more harmful effects than beneficial effects. But basically the primary and most direct concern of the PRD is, from a practical point of view, that a pesticide contains what its manufacturers claim it contains and that it does what its manufacturers claim it will do. In the years since its establishment the PRD has registered nearly 65,000 pesticides. Of this number some 40,000 still remain on the PRD books.

As of 1970, the PRD had thirty-one inspectors under five supervisors who actively collected pesticide samples for testing to determine if a specific sample contained what its manufacturers claimed it contained and to determine if it served its intended purpose. If a pesticide is to be marketed in the United States, it must be registered with this agency, but to be registered by the PRD it must only meet the two criteria mentioned above.

POWERS TO REGULATE AND REMOVE PRODUCTS FROM MARKET

If tests show that a duly registered pesticide is a dangerous product, or that it has been mislabeled, two courses of action are available to the PRD. First, the registration of the product may be cancelled. This lesser

of the two powers makes it possible for the company to continue to market the product until a series of hearings and appeals are heard. The outcome of these hearings will determine if the product will continue to appear on the market or if it is to be removed.

A second power held by the PRD is more effective against a dangerous or mislabeled product. This power gives the PRD the authority to suspend the registration because continued sale of the product creates a hazard to public safety. If and when this power is evoked, distribution of the product must be stopped immediately. Also, the PRD has the power to seize all products that may be suspended. According to one observer's count, the PRD has only used its suspension power three times in its 24 year history, one of them coming after considerable bad publicity for the pesticide in question.[13]

Because other government agencies -- notably the Department of Health, Education and Welfare (HEW) and the USDI -- have interests that concern the registration and use of pesticides, the PRD has arranged to send copies of applications for registration to these departments to see if they have objections. In 1969, 185 pesticides were registered even though one or more agencies in HEW objected.[14] The reason for such action is to be found in political and economic pressures that have been brought to bear on the PRD.

PESTICIDE RESEARCH PROGRAMS

For regulation and control of pesticides to reflect the latest thinking on the subject, the agency involved must be supplied with the

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[13]Robert Sherrill, "Real Villains," Nation, September 14, 1970, p. 209.

[14]Ibid.

necessary research data. For the purposes of this paper one arm of the federal government is most important, in that it not only is charged with research, it also is responsible for regulation and control as well as making information available to the public. Table 6 shows the various USDA agencies which deal in any way with pesticides. Eleven major USDA agency names appear in that table, these containing a total of twenty-three sub-agencies. A total of sixteen agencies or sub-agencies appearing in that table have research and service responsibilities. From the table one observes that the primary agency for regulation itself has no research responsibilities. Depending upon the levels of coordination and cooperation among the various responsible agencies, this may or may not cause problems. And yet, there is reason to believe that not only could improvement be made among the agencies of the Department of Agriculture, the responsibilities and linkages among the USDA, HEW, and USDI should be more clearly defined and strengthened if the interests of the public are to be properly served.[15]

Nevertheless, the USDA has many agencies involved in pesticide research. A look at the names of the agencies participating in pesticide research (Table 6) shows that all points from the economics of pesticide use to the effects of pesticides on human nutrition are considered by one or more agencies.

The best and most concise statement of the goals of the various pesticides research programs carried out by the USDA is provided by a list of the

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[15]U.S., Department of Health, Education and Welfare, Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health, Parts 1 and 2 (Washington: U.S. Government Printing Office, December, 1969), p. 30.

TABLE 6

PARTICIPATING USDA SERVICES AND AGENCIES
Pesticides and Related Activities

Organizational Unit	Activity						
	Research and Surveys	Education	Information	Regulation	Control	Monitoring	
Agricultural Research Service							
Agricultural Engineering Research	X						
Animal Disease and Parasite Research	X						
Animal Husbandry Research	X						
Animal Health					X		
Crops Research	X						
Entomology Research	X						
Human Nutrition Research	X						
Information			X				
Market Quality Research	X						
Northern Utilization Research and Development	X						
Pesticides Regulation				X			
Plant Pest Control					X	X	
Plant Quarantine					X		
Soil and Water Conservation Research	X						
Agricultural Stabilization and Conservation Service							
Policy and Program Appraisal	X						
Farmer Programs					X		
Cooperative State Research Service	X						
Forest Service							
Forest Pest Control					X		
Forest Protection Research	X						
Information and Education		X	X				
Timber Management Research	X						
Watershed, Recreation & Range Res.	X						
Federal Extension Service		X					
Economic Research Service	X						
Consumer and Marketing Service							
Livestock Slaughter Inspection						X	
Processed Meat Inspection						X	
National Agricultural Library		X					
Office of Information			X				
Office of the General Counsel				X			
Research Program Development and Evaluation Staff	X						

Source: U.S., Department of Agriculture, Report on Pesticides and Related Activities, 1968 (Washington: U.S. Government Printing Office, 1969), Appendix A-1.