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Report on the
BEEKEEPER INDEMNITY PAYMENT PROGRAM

by

Frederic L. Hoff
Economic Research Service
U. S. Department of Agriculture

~~December 1976~~
October, 1977

COMMODITY
ECONOMICS DIVISION

ECONOMIC RESEARCH SERVICE U.S. DEPARTMENT OF AGRICULTURE

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PREFACE

The following report summarizes research undertaken from March 1976 through September 1976 by the Economic Research Service (ERS) for the Agricultural Stabilization and Conservation Service (ASCS), both of the United States Department of Agriculture, under interagency agreement number 12-17-03-3-1596.

The report is concerned with identifying and estimating the economic impact of the Beekeeper Indemnity Payment Program on the beekeeping industry. Analysis includes identification of structural characteristics, industry organization, firm revenues, and operating expenses; an in-depth study of the Indemnity Program; and finally, an evaluation of the Indemnity Program's impact upon costs and revenues of beekeepers, colony numbers, pollinated acreage, and honey production.

Within ERS, the project was under the leadership of Frederic L. Hoff. Critique of the analysis was provided by Edward V. Jesse and Robert W. Bohall, ERS, and Jasper Womach, ASCS. Statistical assistance in constructing tables and special tabulations was supplied by Daphene Tippett. Principle contributors of data for the analysis include the U.S. Department of Agriculture's Statistical Reporting Service and Agricultural Stabilization and Conservation Service; U.S. International Trade Commission; and the University of California's College of Agriculture.

CONTENTS

TABLES

TABLES--CONTINUED

ILLUSTRATIONS

APPENDIX TABLES

SUMMARY

The purpose of this study was to, 1) identify structural characteristics, industry organization, firm revenues, and operating expenses of the beekeeping industry, 2) evaluate the performance of the present Beekeeper Indemnity Payment Program, and 3) determine the probable economic impact of termination of the Indemnity Program on costs and revenues of beekeepers, colony numbers, pollination services and honey production.

The study can be summarized as follows:

1. The Beekeeper Indemnity Payment Program was enacted by Congress in the Agricultural Act of 1970 after commercial beekeeping operations in the cotton-growing areas of California and Arizona were virtually destroyed from an extensive spray program to control pink bollworm. The program authorizes indemnity payments to beekeepers who through no fault of their own suffer pesticide damage to honey bees. On December 31, 1977, the legislation authorizing the Indemnity Program expires. A congressional review will likely be held to either terminate the program or extend it for some indefinite period with or without substantive changes.

2. The beekeeping industry has experienced a gradual downward trend from 5,916,000 colonies in 1947 to 4,068,000 colonies in 1972. From 1965 through 1972, the rate of decline accelerated to about 1.7 percent or 81,250 colonies per year. This long-term decline in colony population reflects the impact of low honey prices and increasing injury to honey bees from toxic pesticides. After 1972, colony numbers increased slightly to 4.2 million in 1975 following a sharp increase in honey prices during 1973 and 1974.

3. Honey bees perform a vital pollinating service to agricultural crops valued at an estimated $8 billion in 1975. The major pollination areas include Arizona, California, and Washington. In 1973, about 3.5 million acres of fruits, vegetables, oilseeds, and legume seed crops were dependent upon insect pollination in the U.S. Another 63 million acres derived some benefit from insect pollination.

4. Commercial beekeepers in many parts of the U.S. are alledged to be in financial distress because of depressed honey prices, rising costs for beekeeping equipment, and extensive loss of bees from pesticides. However, this allegation is difficult to confirm or deny because of limited public records detailing current income, cost, and returns for beekeeping operations. Most budgets published since the mid 1960's show that cash receipts usually exceed cash costs for most beekeepers. Data released by the International Trade Commission in June 1976 show net cash profits per colony (before income taxes) for 118 commercial beekeepers to range from $5.84 to $16.15 over the 1971-75 period. This level of income permits beekeepers to pay short-run variable operating costs and part of the family living expenses. However, in the long-run, inclusion of charges for depreciation, interest on investment, and unpaid labor frequently contributes to negative management earnings.

Beekeeping income is affected most by severely damaged and destroyed colonies. Severely damaged colonies may require 6-8 weeks to recover colony strength. If the damage occurs during a major honey flow, the field force will be greatly reduced and honey yields can be lowered 60 percent or more. Severe damage in late summer may weaken a colony preparing for winter and increase the chances for significant winter kill. Unless the

colony is restocked, it is likely to provide inadequate pollination services the following spring. When a colony is destroyed, honey yields may be reduced up to 80 percent or more. Beekeepers estimate it takes about one year for a destroyed colony to regain its income earning potential after restocking.

With negative long-run earnings, one may question why and how beekeepers continue to operate their honey bee colonies. For many beekeepers, honey bees have been a way of life within the family for many years as colonies and equipment have passed from one generation to the next. Consequently, these beekeepers may postpone equipment repairs or borrow capital for short-run improvements with hopes that income will improve in the near future. Also, some beekeepers or members of their immediate family may seek alternative employment to supplement beekeeping income. Other beekeepers desiring to liquidate their operation may find there is no market for the colonies and beekeeping equipment. However, regardless of the reasons that beekeepers remain in business, many lack the capital to improve buildings and equipment or expand the size of operation.

5. Although beekeepers throughout the continental United States are reporting honey bee losses from pesticides, the largest concentration of damage to bee colonies has occurred in the West, Southwest, and Southeast. During 1972-74, beekeepers in Arizona, California, Florida, Georgia, Idaho, Mississippi, Texas, and Washington claimed pesticide damage to about 11 percent of the total honey bee population in the eight States--65 percent of the colonies registered with ASCS. At the same time, beekeepers in the rest of the United States reported damage to less than 2.5 percent of their colonies. Beekeepers in California, Washington, and Arizona received $3.35

million in indemnity payments during 1972-74--nearly half of all payments made during the three years. Over this span of time, the most significant loss of honey bees occurred in Arizona where about 63 percent of the State's bee population suffered pesticide damage that resulted in indemnity payments. Although indemnity claims were filed on less than 10 percent of the bee population in California, the large number of honey bee colonies in the State make it the largest recipient of indemnity payments.

6. The twenty beekeepers who have collected the largest total volume of indemnity payments received more than $4.6 million for pesticide damage from 1967 to 1974. This is about 28 percent of the payments paid nationwide for bee losses. Though payments of this magnitude may appear excessive, they in fact represent a level of pesticide damage experienced by other beekeepers in the area. In other words, the twenty largest payees have received sizable indemnity payments simply because they maintain a large number of hives.

7. If the Beekeeper Indemnity Payment Program is terminated at the end of 1977 and no alternatives are legislated, beekeepers must turn to the market system for higher pollination fees to recover the added cost of operating in areas where there is high risk of pesticide damage. Thus, one may conclude that besides being a subsidy to beekeepers, the Indemnity Program has also benefited orchardists through lower pollination fees.

A substantial rise in honey prices above the 1975 average of 51 cents per pound would likely have little impact on the number of bee colonies available for pollination. The major expansion from higher honey prices would probably be from hobbyists and a few commercial beekeepers who would select safer locations for their honey bees outside the main pollination

areas. Further, increases in honey production would tend to lower honey prices.

Pollination fees are only a very small part of the total cost to produce most agricultural crops requiring pollination. Consequently, it is likely that farmers would bid pollination rental fees upward to assure adequate supplies of bees. In Washington, this could result in beekeepers demanding at least $10 per colony more in rental fees per year. However, if the higher rental fees are allocated over the two or three crops normally pollinated by a colony of bees each year, costs for specific commodities are only marginally increased. On a hundredweight basis, the additional cost of producing most of the major pollinated crops in California and Washington would be less than 10 cents.

The speed of the market adjustment in the absence of an Indemnity Program is a crucial unknown factor. Reliance on the market system for adjustment of pollination fees may create short-run financial problems for some beekeepers. Farmers may be initially hesitant to pay the sharply higher rental fees likely to be demanded by beekeepers. Not knowing the exact response of specific crops to various levels of pollination, farmers may initially reduce the number of colonies they place in their fields and orchards. But, if farmers detect lower yields they would likely pay the higher rental fees in subsequent years to obtain adequate pollination.

8. In the absence of any form of Indemnity Program, it appears that severe colony damage would likely be the most disastrous financially for beekeepers engaged strictly in honey production. Pollinators and, especially, producers of packaged bees can recover most losses through higher prices for their service or product. However, the market price for

honey has shown virtually no response to the many isolated instances of colony damage.

9. In the way of an overall conclusion, honey bee pollination provides enourmous economic benefits to producers of many specialty crops in the United States. Yet, because of a lack of technical data relating crop yields to colony numbers, it is not possible to precisely measure these benefits. However, pollination benefits undoubtedly exceed present pollination costs by a very large factor. The Beekeeper Indemnity Program has kept pollination costs low by indirectly subsidizing crop producers through direct payments to beekeepers providing pollination services. Termination of the Program would ultimately raise pollination costs relative to benefits, but only marginally. The rate of increase would depend on how rapidly crop producers recognized the value of pollination. Hence, the decision concerning continuation of the Beekeeper Indemnity Payment Program largely involves the extent to which it is deemed desirable to provide short-run financial assistance to beekeepers and long-run public subsidy to producers of pollinated crops.

BEEKEEPING AND PESTICIDES

The Beekeeper Indemnity Payment Program was established by Title VIII, Sec. 804 of the Agricultural Act of 1970 (P.L. 91-524). Legislation for the program came after heavy bee kills occurred in the cotton-growing areas of California and Arizona due to an extensive spray program to control the pink bollworm. As stated in the Agricultural Act, "the Secretary of Agriculture is authorized to make indemnity payments to beekeepers who through no fault of their own have suffered losses of honey bees after January 1, 1967, as a result of utilization of economic poisons near or adjacent to the property on which the beehives of such beekeepers were located. On December 31, 1977, the authorizing legislation for the Indemnity Program expires." A Congressional review of the Indemnity Program will likely be forthcoming in 1977 and a decision should be adopted to either permit the program to terminate or extend it for some indefinite period with or without substantive changes.

Beekeeping in Perspective

Honey bees (Apis Mellifera L.) are native to the Old World--Europe and Asia. Although the actual date of importation to the United States is unknown, the German or black race was brought into New England before 1638 (Gates, 1911). About 1860 the Italian bee, which almost entirely displaced the black bee, was introduced into eastern United States and California (Harbison, 1861).

After 1670, beekeeping in the American colonies declined rapidly--probably because of a disease known as American foulbrood. Proper care and inspection of bees was impossible because of the primitive beekeeping practices of the day. Bees were kept in wooden boxes, a section of hollow log, or a straw skep and were allowed to build comb as instinct dictated. Inspection of combs and

removal of honey could only be accomplished by seriously disrupting or destroying the colony. Significant advances in beekeeping methods didn't occur until the middle of the 19th century when Langstroth discovered bee space and developed the modern movable-frame hive. The bee smoker was another equally indispensable development of the period. This renewal of beekeeping stimulated a worldwide search for new and more satisfactory strains or races of bees.

Descendents of the British and German stocks brought to North America by the early colonists were highly susceptible to European foulbrood, swarmed excessively, and were difficult to handle. After a long period of research, three significantly superior races, Italian, Caucasian, and Canniolan, were established and accepted by beekeepers in the United States (Nelson, 1971). Thereafter, the honey bee became important not only as a producer of honey and wax and as a pollinator, but also as a research animal in biological studies.

The honey bee is a social insect and consequently has little chance of surviving if separated from its own social group, or colony. The colony's survival depends on how successfully it can cope with the environment. The individual bees are organically separated, but they are inseparably united in the colony--bound together by intricate behavioral and physiological patterns (Caron, 1975).

The Pesticide Problem

Agriculture, including beekeeping, has undergone rapid technological changes in the 20th century. Farms have become larger and more specialized. To feed the population of the world and maintain the quantity and quality of food demanded by the consumer it has become necessary to use large amounts of

artificial fertilizers and pesticide materials. 1/ A major problem faced by beekeepers is the use of certain highly toxic chemical compounds which are applied to control plant and animal pest species, but which also impair the efficiency of bees in the production of honey and crop pollination (see Appendix A for a discussion of pesticide toxicity).

The widespread use of pesticides has affected the economic position of beekeepers. Adjustment to increasing costs of operation has forced beekeepers to alter traditional beekeeping practices. Transportation has become a costly means of survival. Today, bee colonies are continually being moved (1) to provide pollination services because changing agricultural practices and pesticides have eliminated or drastically reduced natural pollinator species, (2) to secure honey crops because population pressures and intensive crop production have resulted in fewer natural areas of flowering plant species and more concentrated plantings of agricultural crops like alfalfa and clover that are beneficial to bees, and (3) to avoid repeated pesticide kills as some areas may be "safe" during one part of the season but require repeated chemical applications at other times to control certain pests. Pesticides have reduced colony growth so that many beekeepers can no longer divide their own bees to replace colony losses. Consequently, an additional expense is the purchase of replacement bees which in 1976 are reported to cost about $15 per package. With weaker colonies, revenues have been reduced because of lower honey production and fewer bees available for package sales and pollination services.

1/ "Pesticide" means, but is not limited to, any substance or mixture of substances intended to prevent, destroy, control, repel, or mitigate any insect, rodent, nematode, mollusk, fungus, weed and any other form of plant or animal life or virus (except virus on or in living man or other animal) which is normally considered to be a pest.

How Poisoning of Honey Bees Occurs

Most poisoning occurs during the blooming period when pesticides are applied to crops being worked by bees for pollen and nectar. By nature, honey bees visit flowers located within a radius of about 5 miles from the colony. The intensity of visitation to a particular area is determined by the relative attractiveness of the flowers. The extent of damage to the colony by a pesticide application is influenced not only by the relative toxicity of the spray material, the number and methods of application, the time of day, and the weather conditions, but also by the strength of the field force visiting flowers in the treated area, the type of food (nectar or pollen) being collected, the type of flower being worked, the season of the year, and even the influence of forage available to the bees before and after the application (McGregor, 1976).

Quick-acting poisons kill field bees (foragers) before they can return to the hive. With less toxic materials, the bees may return to die in the hive or crawl from the entrance and die nearby. Contaminated food may be transported to the hive where it acts as a stomach-poison when fed to other bees and brood. Poisonous material may be obtained from the treated field or it may drift from unattractive plants, such as young lettuce or tomatoes, onto attractive plants in bloom like alfalfa, melons, or flowering weeds.

Bees may be killed by nerve-type poisons such as parathion when flying through or over the treated area while the spray is in a gaseous form. Poisons may also be contacted by imbibing water in the form of dew on plants or from watering places within the treated area.

During extremely high temperatures, a colony can experience severe losses if the water supply needed for cooling the hive is stopped for only a few hours. If water carriers become poisoned in flight, the colony may suffer both directly in the loss of water carriers and indirectly from lack of water.

Pesticides applied to plants may get into the nectar directly or reach it indirectly by moving from the treated parts through the plant system (Jaycox 1964, King 1964). However, when nectar is contaminated the bees carrying the nectar usually die before returning to the hive. The likelihood of poisonous materials reaching the public in marketable honey is remote.

Symptoms of Pesticide Poisoning

Identification of bee losses from pesticides is not always an easy task. This is due to the nature of the different chemical compounds and the fact that bees are a social insect with a complex life history not perfectly understood. The following are some usual symptoms of pesticide poisoning (Torchio, 1971). However, not all symptoms are likely to be seen at any one time nor are they conclusive of pesticide poisoning.

(1) An excessive number of dead bees in front of the colony.

(2) An unusual number of dead colonies at one time, particularly if they contain honey.

(3) A depleted population when the colony should be strong.

(4) Sudden cessation of food storage.

(5) Dead or deserted brood, with honey in the hive.

(6) Dead bees on the floor of the hive during mild weather.

(7) A severe break in the brood rearing cycle.

(8) A cessation in flower visitation.

(9) Bees crawling from the entrance to die nearby.

(10) Dead bees in the hive--on tops of frames or on the bottom board.

(11) The absence of the usual "hum" of workers in the air.

(12) Incoming nectar- or pollen-laden bees attacked at the hive entrance by other bees.

(13) An unusual number of bees emerging from the entrance carrying dead bees--the normal daily death rate inside a colony is about 100 bees.

(14) Paralyzed, stupefied, or preening bees on weeds or other objects in the apiary.

Any of the symptoms listed may also stem from the other main causes for bee deaths--pests, disease, and old age. It is only by residue analysis of dead bees that one is able to positively identify pesticides as causing a bee loss.

Extent of Losses

For over 80 years the beekeeping industry has sustained serious losses from agricultural pesticide applications. The problem of bee poisoning became unusually severe in connection with the use of arsenical sprays on fruit crops in the early part of the century. As a result, several States enacted legislation which prohibited the spraying of trees in bloom.

Another surge of pesticide damage occurred during the late 1920's when ground and air machines began large-scale application of calcium arsenate on cotton and other crops (Hawes and Eisenberg, 1947). These applications increased in volume during the 1930's and into the early 1940's, causing great

damage to beekeeping.

During the mid-1940's, damage subsided as farmers shifted from the use of arsenicals to DDT which is less toxic to bees (McGregor and Vorhies, 1947). However, by the late 1960's, use of DDT was decreased sharply because of insect tolerance to the poison. Finally, use of DDT and other chlorinated hydrocarbons was banned because of environmental concerns. In most cases, the highly toxic phosphates and carbamates were used in place of the banned sprays. This increased the problem of bee loss to the point of disaster for many beekeepers.

Statistics on colonies damaged by pesticides are incomplete. Partial colony losses are not always easy to detect, especially with pesticides that kill foraging bees away from the hive. Pesticides may weaken colonies to such a point that they do not survive the winter. This type of loss is often ascribed to winterkill rather than pesticides. Further, this loss may be extended to the replacement bees placed in contaminated equipment the next season. Often, not all losses are discovered soon enough after the chemical application to determine the exact cause of death.

Following are accounts of bee poisoning in the fruit-growing area of eastern Washington that were traced to specific spray applications (Johansen, 1962).

Parathion: Serious bee poisoning problems arose in 1951 when orchardists applied parathion to control cutworms, leaf rollers, and aphids. This caused considerably trouble when sprays were delayed by poor weather and applied to open blooms. Despite special precautions and warnings, an estimated 1,000 colonies were completely destroyed during 1951-53.

Dieldrin: During the summer of 1957, at least 3,000 colonies of honey bees were damaged by dieldrin applications to alfalfa seed and other crops in the lower Yakima Valley. Bee poisoning also occurred when a prebloom spray for pear psylla was applied while interplants or adjacent orchards of apricots or peaches were blooming.

Sevin: During 1958, Sevin was found to have an even longer residual hazard to honey bees than Dieldrin. In August of 1960, the worst bee poisoning situation in many years occurred in the Yakima Valley. It involved the application of Sevin on sweet corn for control of corn ear worm. Honeybees came into contact with the spray as they foraged for pollen on the sweet corn. Some losses also resulted from spraying of mint.

In the Sacramento Valley of California, insecticide treatment of grain sorghum or milo has caused severe damage to bees and resulted in the further reduction of a dwindling bee pasture. Bee losses have also occurred in newly established mosquito-control districts. During 1967 in the California cotton-growing areas of the Imperial Valley and in Arizona, beekeepers experienced severe losses to many thousands of colonies due to an extensive spray program to control the pink bollworm.

In the 1971 annual Apiary Inspectors' Newsletter, 76,000 colonies of bees were estimated lost in California in 1967 from pesticides (table 1). This compares with 55,000 colonies lost in 1966 and 89,000 in 1970. The sharp decline in pesticide losses since 1971 in California is largely attributable to the strict control of spray application imposed by the California State Department of Agriculture (see Appendix B).

Table 1--Honey bee colony losses from pesticides and other causes in relation to the total number of colonies in California, 1962-74

Period	Colonies of bees	Loss from pesticides	Other losses	Total losses
	Thousand colonies			
1962	--	82	--	--
1963	--	41	--	--
1964	--	41	--	--
1965	--	49	--	--
1966	--	55	85	140
1967	559	76	86	162
1968	565	83	84	167
1969	537	82	117	199
1970	521	89	70	159
1971	511	76	32	108
1972	500	40	30	70
1973	500	36	31	67
1974 1/	500	54	33	87

1/ Preliminary.

Source: Compiled by the California Department of Food and Agriculture and reported in the Annual Apiary Inspectors' Newsletter.

In the late 1960's, the application of DDT was banned. This led to the introduction of several highly toxic chemicals (organo-phosphates being the most toxic) which caused heavy bee losses, not only in California and Washington, but in many other areas of the United States. During the past year, toxic time release pesticides were introduced on the market. Application has already contributed to severe bee losses (both adult and brood) in Idaho. It appears that the spray particles are being carried back to the hive along with pollen where the time release action continues.

Antidotes for Reducing Bee Losses from Pesticides

The concern of State Universities, Government officials, beekeepers, and farmers over the increasing loss of bees from toxic chemicals has promoted legislation to control pesticide application and encouraged comparative studies on the toxicity of pesticides to honey bees. Additionally, leaflets have been circulated to make people aware of the pesticide problem.

Government Publications

A U.S. Department of Agriculture bulletin cites that observance of several precautions by farmers and beekeepers can significantly reduce bee injury from pesticide poisoning (U.S. Department of Agriculture, 1972). Precautions for farmers include:

(1) Use pesticides only when needed;

(2) Select the right pesticide;

(3) Apply granules or sprays rather than dusts;

(4) Time pesticide application; and

(5) Notify beekeepers.

Precautions for beekeepers include:

(1) Select safe locations;

(2) Identify your colonies for farmers;

(3) Know the pesticide;

(4) Confine your bees; and

(5) Relocate colonies.

Although observance of these precautions may greatly reduce bee injury, beekeepers report their size and system of operation often preclude following all safety measures. During June 1976, selected beekeepers in California and Washington were contacted to discuss the pesticide situation and the Beekeeper

Indemnity Payment Program. Beekeepers in Washington report there are no safe locations for bee yards. One beekeeper said, "No matter where I place my bees in the Yakima Valley, they will be sprayed at least once within ten days." A beekeeper in the San Joaquin Valley of California described his efforts to protect his apiaries as "playing musical chairs with 40 loads of bees." For many of the larger beekeepers who operate several thousand colonies, time does not permit relocating all colonies before spray application. Several beekeepers said that even if they did move their colonies to another location, it could be sprayed the next day. When beekeepers were questioned about confining their bee colonies during pesticide application they remarked that severe loss could result from overheating within the hives.

Regulations

The State of California has imposed strict regulations concerning agricultural pest control operations and pesticide storage and transportation. Sections 29121, 29154, 29245, 29248, 29252, and article 5.5, section 3096 of these regulations is directly concerned with protection of bees (Appendix B). The regulations specify that any person performing pest control must advise beekeepers (who have apiaries located within one mile of the spray cite and have requested notification) of his intentions 48 hours in advance of the planned spray application. Each beekeeper who desires notice must report to the agricultural commissioner of the county in which his apiaries are located (on a form approved by the commissioner) the location of apiaries for which notification is sought. This report must be mailed to the commissioner within 72 hours before locating or relocating apiaries.

While these regulations have created public awareness for the plight of beekeepers, they only have limited potential to reduce bee losses. First, bees commonly forage 3 to 5 miles away from the hive. Secondly, large commercial beekeepers generally do not have the time or capability to constantly transport hives from one location to another in response to notification by pesticide applicators. Thirdly, alternative locations safe from pesticides are often unavailable.

Civil Court Action

The civil court system has failed to provide relief to beekeepers for their pesticide losses. Honey bees create an unique problem for the imposing of strict liability; they fly. Courts have held that if your honey bees cross over into your neighbors' field and procure poison, carry it back to the hive and subsequently the whole colony dies, you, the beekeeper, cannot collect damages for the poisoning of your bees. You cannot collect damages unless the poison was distributed wantonly, maliciously, or with the deliberate intent to injure or destroy your bees (Happ, __). In layman's terms, everytime honey bees leave their hives and travel to a neighboring field to pollinate and gather nectar, the courts consider them trespassers.

With the growth of specialized equipment and techniques for pesticide application has come the employment of commercial applicators. These individuals, considered independent contractors, give issue to a problem of liability. Who should be held responsible for any damage sustained by the use of pesticide, the landowner-employer or the applicator-employee?

As a general rule, an employer would not be liable for the negligence of an independent contractor. 2/ However, a well recognized exception to this rule continues to hold an employer liable if the act engaged in by the independent contractor is inherently or intrinsically dangerous. 3/

Under this exception the employer-landowner will not be permitted to escape the responsibility or liability for negligent injury to property of another, even though the negligence is that of the independent contractor, when such injury results from inherently or ultra-hazardous activities. 4/

Crop dusting and crop spraying are classified as inherently dangerous and ultra-hazardous activities by most courts, thereby invoking the exception and imposing liability on a landowner, as well as an independent contractor, when damage arises from the application of pesticides. 5/

In general, beekeepers seldom have a basis for court action. Most injury to honey bees occurs when they contact pesticides in neighboring fields. Also, whenever pesticides are accidentally sprayed over a bee yard, the beekeeper is seldom present to record evidence of the applicator's negligence.

2/ See, e.g. S.A. Gerrard Co. vs. Fricker, 42 Ariz. 503, 27 P. 2d 678 (1933); McKennon vs. Jones, 219 Ark 671, 244 S.W. 2d 138 (1951); Heeb vs. Prysock, 219 Ark. 899, 245 S.W. 2d 577 (1952); Pendergrass vs. Lovelace 57 N.M. 661, 262 P. 2d 231 (1953); Lawler vs. Skelton, 130 So. 2d 565 (Miss. 1961); Loe vs. Lenhardt, 227 Ore. 242,362 P. 2d 312 (1961).

3/ Ibid.

4/ Ibid.

5/ See, cases cited in note 53 Supra, Conta, Pitchfork Land & Cattle Co. vs. King, 162 Tex 331, 346 S.W. 2d 598 (1961); The effects of this decision were drastically curtailed by Leonard vs. Abbott, 357 S.W. 2d 778, 781 (Tex. Civ. App. 1962), where the court found that the Texas Herbicide Control Act, by implication, declared the use and application of herbicides to be inherently dangerous and thus the exception applied.

The Beekeeper Indemnity Program itself discourages civil court action. Beekeepers know the Indemnity Program will make a quick settlement for pesticide losses even though the compensation is only partial. In retrospect, seeking retribution against spray applicators can cost beekeepers several thousand dollars in legal fees and, even if the court rules in behalf of the beekeeper's claim, involve a couple of years to reach settlement. Then, for those beekeepers who receive an indemnity payment and are awarded a court settlement, the Government makes first claim on the award in the amount of the indemnity payment.

Greater use of the civil court system by beekeepers to seek compensation for pesticide losses could reduce applicator negligence. As the program presently functions it discourages legal action against pesticide applicators, thereby reducing the precaution taken by them to avoid damaging bees.

STRUCTURAL ANALYSIS OF THE BEEKEEPING INDUSTRY

Bee culture is practiced throughout the United States in areas with widely different types of climate and flora. Consequently, beekeeping systems vary greatly with respect to geographic area, farming practices, and colony size. Some beekeepers provide pollination service to supplement low honey yields as pastures continue to decrease. In areas of good bee pasture, some beekeepers specialize in honey production. Other beekeepers in California and the southern tier of States specialize in producing package bees and queens for stocking hives.

Like many farm enterprises, beekeeping is very specialized. It is often a family business and frequently handed down from father to son. The peak labor loads for the beekeeper usually occur when caring for the bees during the spring, when moving bees for pollination (commonly at night), and when harvesting and extracting honey. Beekeeping is not dependent on land ownership. However, most beekeepers usually own a small acreage which serves as a base of operation.

Beekeeper Population

In 1975 there were about 211,600 beekeepers in the United States (U.S. International Trade Commission, 1976). The largest concentration of beekeepers was reported in North Carolina and West Virginia (figure 1). However, these are not major-honey producing States because of significantly low honey yields per colony. Generally, beekeepers are classified as either hobbyists, part-time (sideliner), or commercial producers.

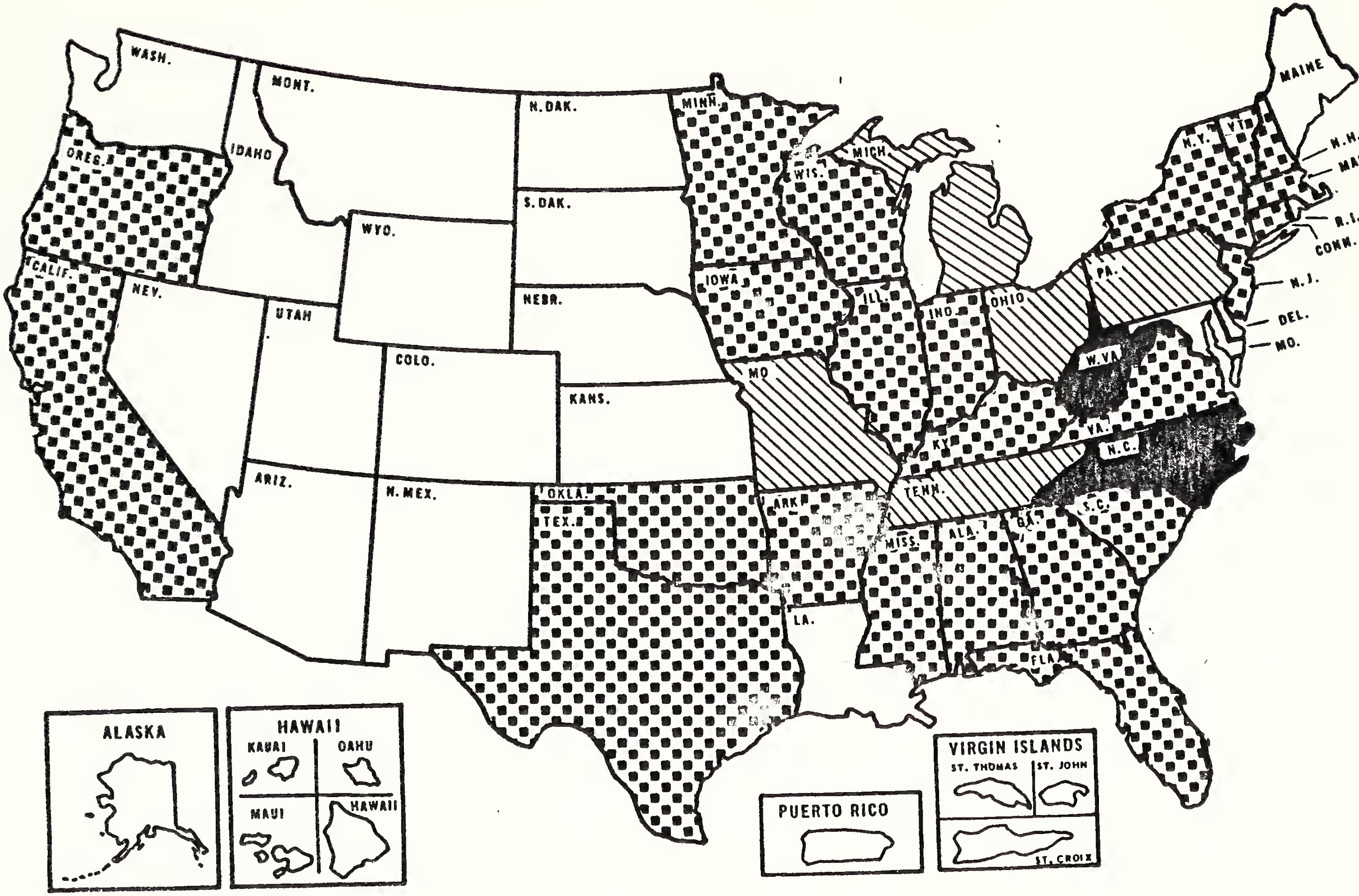

Figure 1.-- Honey producers by State, 1975

less than 1,000
1,000 to 4,999
5,000 to 9,999
10,000 and over

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2-62

The Hobbyist Beekeepers

The beekeeping industry has a preponderance of small operators who keep bees as a hobby, or for small-scale pollination of orchard and field crops. Although hobbyist beekeepers are recognized in the industry, they are not clearly defined. For the purposes of this study, a hobbyist is defined as a beekeeper who owns less than 25 colonies. Bauer estimated that 90 percent of the nation's beekeepers in 1957 were hobbyists with an average of 10 colonies (Bauer, 1960). Hobbyists represent an extremely wide variety of people, and are drawn from numerous occupations; including all the professions, and many skilled trades.

In 1975, the Trade Commission estimated there were about 200,000 active beekeeping hobbyists in the nation--95 percent of all beekeepers (U.S. International Trade Commission, 1976). Most of the honey produced by hobbyists is for home use and given to friends or relatives. Hobbyists generally receive a much lower honey yield per colony than commercial honey producers.

The Part-time Beekeepers (Sideliner)

Part-time beekeepers are defined in this report as owners of 25 to 299 colonies. Units of this size are not large enough to employ a beekeeper full-time and generally could not serve as the principal source of income. There were about 10,000 part-time beekeepers in the United States last year. Together, hobbyist and part-time beekeepers accounted for about half the colonies and 40 percent of the honey extracted in the United States during 1975.

A majority of the honey produced by part-time beekeepers finds its way directly to retail markets. Although concerned with prices and costs, part-time beekeepers generally do not depend on honey as their sole source of income. Many such operators are retired or elderly.

The Commercial Beekeepers

This group of beekeepers numbered about 1,600 throughout the United States in 1975, a figure which represents approximately 0.8 percent of the estimated total beekeeper population. The group contains most of the industry leaders and in 1975 produced about 60 percent of the honey extracted in the United States.

Commercial beekeepers can be divided into two groups: migratory and nonmigratory. Most professional beekeepers relocate their bee colonies three to five times or more during the growing season (traveling several miles or several thousand miles) to provide pollination services, to reach the most abundant sources of nectar, and often to escape damage from pesticides. By migrating, beekeepers can also provide their bees with a longer supply of nectar by extending the production season. Frequently, beekeepers collect fees for the pollination services provided by their bees. This is especially true if an agricultural crop requires pollination but seldom happens when pollination isn't essential for normal production.

Another group of migratory beekeepers move their colonies twice a year. One move is made in the fall from the colder areas of the northern United States to the Southeast or Southwest. In the southern areas, the colonies are overwintered and divided to make several new colonies. After a buildup of bee numbers, the new colonies are returned north in the spring in time

for summer pollination and nectar flows. Many of these beekeepers receive fees from pollinating crops being produced along the migratory routes.

The nonmigratory beekeepers seldom move their colonies over any significant distance. The colonies are normally left in the same bee yard, summer and winter. Overwintering colonies in the northern areas often requires supplemental feeding of honey and pollen substitutes. Sugar is generally used as the honey substitute. However, when the cost of sugar is high, it is economical for some northern producers to kill their bees in the fall, extract the seasons honey crop and restock with package bees the following spring.

A select group of beekeepers specialize in the production of queens and package bees. Today, this industry is a multimillion-dollar business in the United States which produces hundreds of thousands of queens and hundreds of tons of bees for shipment to beekeepers throughout the United States and Canada. These bees are purchased by producers to replace colonies killed in the fall in northern areas; to strengthen colonies weakened by overwintering, disease, or pesticides; and to stock new colonies. The majority of package bees and queens are shipped in March, April, and May. Consequently, most commercial queen and package bee producers are located in the southern tier of States and California, where the mild winter and early springs are ideal to develop and maintain populous colonies.

Colony Numbers

The peak year in colony numbers was reached in 1947 when, according to Statistical Reporting Service estimates, there were 5,916,000 colonies in

the United States (table 2). In the succeeding 25 years, the beekeeping industry experienced a gradual downward trend to 4,068,000 colonies in 1972—a decline of 1,848,000 colonies. This averages to a net loss of 74,000 colonies per year. From 1965 through 1972 the rate of decline accelerated to about 1.7 percent per year. This is a net loss of 650,000 colonies for the 8 years or an average loss of 81,250 colonies per year. Beekeepers contend the long-term decline in colony numbers is reflective of exceptionally low honey prices and excessive injury to bees from pesticides.

Since reaching a low in 1972, colony numbers have increased slightly in 1973-75—reaching 4.2 million in 1974 and 1975. The recent upturn in colony numbers is probably reflective of the increase in honey prices the last five years and benefits from the Beekeeper Indemnity Payment Program. Colony numbers are greatest in California, Florida, and Texas (figure 2).

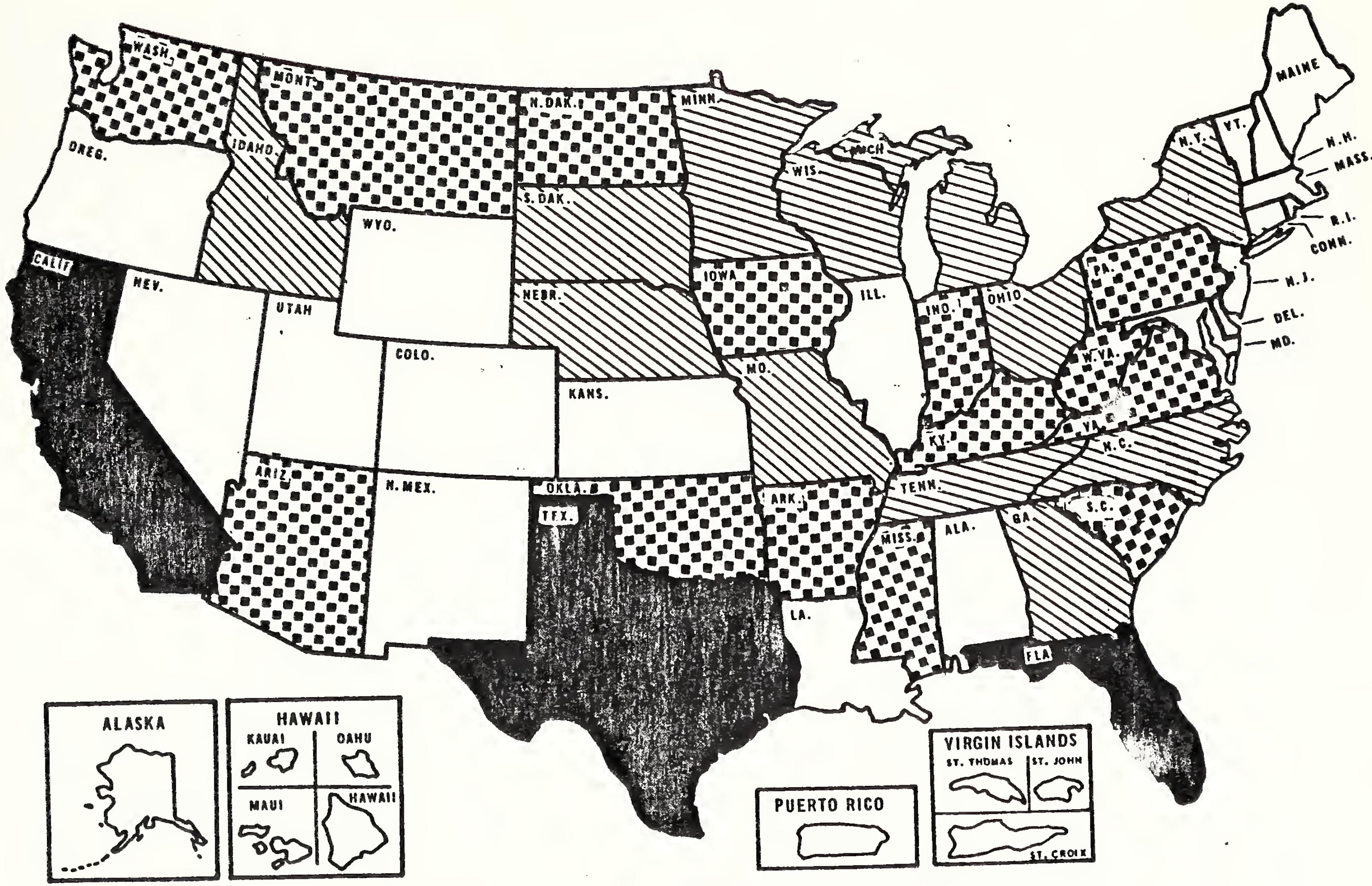

Figure 2.-- Honeybee colonies by State, 1975

- less than 50,000 colonies
- 50,000 to 99,999 colonies
- 100,000 to 199,999 colonies
- 200,000 colonies or more

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Table 2.—U.S. colonies of bees, 1945-75

Period	Colonies of bees	Period	Colonies of bees
	Thousand colonies		Thousand colonies
1945	5,460	1960	5,005
1946	5,787	1961	4,992
1947	5,916	1962	4,900
1948	5,721	1963	4,849
1949	5,578	1964	4,840
1950	5,601	1965	4,718
1951	5,546	1966	4,646
1952	5,493	1967	4,635
1953	5,520	1968	4,539
1954	5,461	1969	4,433
1955	5,252	1970	4,290
1956	5,195	1971	4,110
1957	5,199	1972	4,068
1958	5,152	1973	4,103
1959	5,109	1974	4,195
		1975	4,163

Source: Compiled from statistics of the U.S. Department of Agriculture, Statistical Reporting Service (SRS).

Honey and Beeswax Production

During 1971-75, annual production of honey in the United States ranged from a high of 238 million pounds in 1973 to a low of 185 million pounds in 1974 (table 3). Honey production averaged 206 million pounds for the five-year period. Also, about 3.7 million pounds of beeswax were sold annually. Production data with trend lines for the 1945-75 period and the more recent 1965-75 period are plotted in figure 3.

Honey production varies widely among regions and from year to year depending on rainfall, soil conditions, temperature, various other environmental factors, and management. During 1971-75, annual yields of honey per colony ranged from a low of 33.1 pounds in 1974 to a high of 57.9

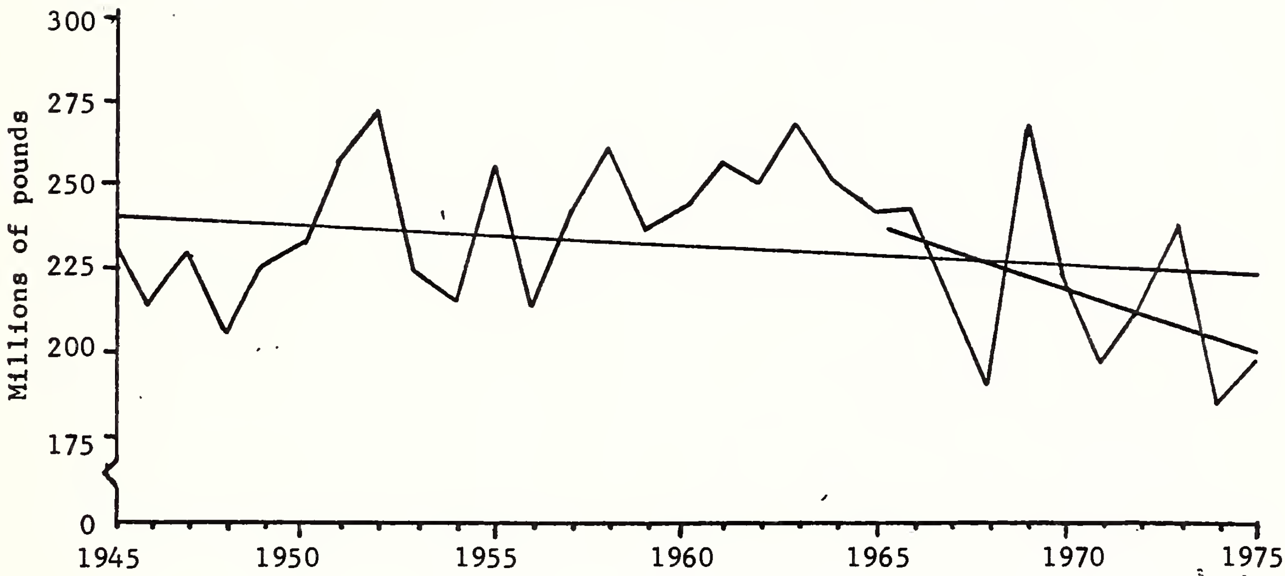
Table 3.—U.S. production of honey and beeswax, 1945-75

Period	Honey production 1/		Beeswax production	
	Quantity	Value	Quantity	Value
	Million pounds	Million dollars	Million pounds	Million dollars
1945	233.1	43.4	4.5	1.9
1946	213.8	52.2	4.4	1.9
1947	228.6	56.9	4.5	2.0
1948	206.2	36.9	4.0	1.7
1949	226.3	34.1	4.1	1.6
1950	232.4	35.6	4.3	1.8
1951	257.5	41.2	4.7	2.4
1952	272.0	44.1	4.8	2.1
1953	223.8	37.0	4.1	1.7
1954	216.4	36.7	4.0	1.8
1955	255.2	45.4	4.6	2.3
1956	214.0	40.6	4.1	2.2
1957	241.2	45.0	4.5	2.6
1958	260.5	45.1	4.7	2.2
1959	236.6	40.1	4.2	1.9
1960	242.8	43.5	4.4	1.9
1961	255.9	46.1	4.7	2.1
1962	249.6	43.5	4.8	2.1
1963	266.8	48.1	4.8	2.1
1964	251.2	46.6	4.7	2.1
1965	241.8	43.0	4.7	2.1
1966	241.6	41.9	4.6	2.1
1967	215.8	33.7	4.4	2.6
1968	191.4	32.4	3.8	2.3
1969	267.5	46.7	5.2	3.2
1970	221.8	38.6	4.4	2.6
1971	197.4	43.1	3.6	2.2
1972	214.0	64.6	4.0	2.5
1973	237.7	105.4	4.2	3.1
1974	185.1	94.4	3.4	3.9
1975	196.5	99.4	3.4	3.4

1/ Includes only shipments from Hawaii prior to April 1948 and from Puerto Rico prior to May 1951.

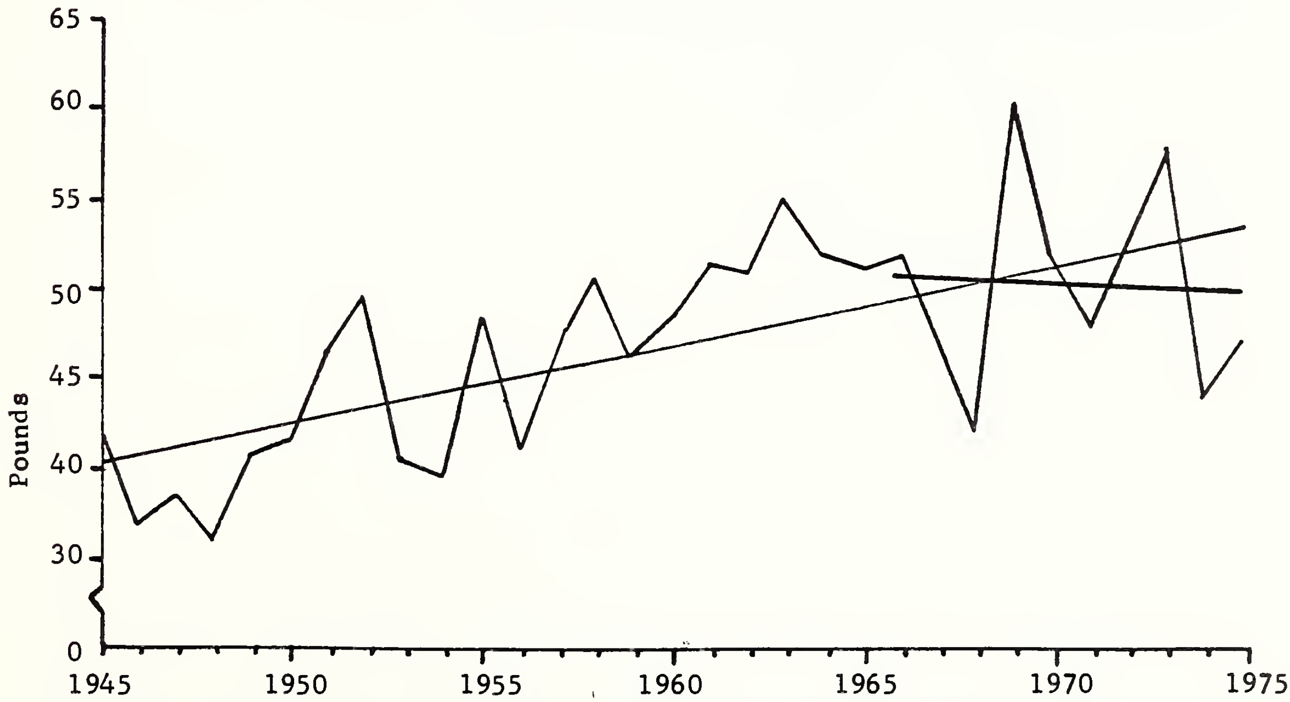
Source: Compiled from statistics of the U.S. Department of Agriculture, Statistical Reporting Service (SRS).

Figure 3.--Honey: U.S. production, with trend lines, 1945-75



Source: Compiled from official statistics of the U.S. Department of Agriculture.

Figure 4.--Honey: U.S. yield per colony, with trend lines, 1945-75



Source: Compiled from official statistics of the U.S. Department of Agriculture.

pounds in 1973, and averaged 49.9 pounds (figure 4).

From 1971-75, annual production of commercial beekeepers in the 20 major States averaged 111 million pounds of honey from 1,658,400 colonies of bees, or 67 pounds of honey per colony (table 4). In 1975, some 1,300 commercial beekeepers in the 20 major States accounted for 41 percent (1.7 million) of all the bee colonies in the United States and for 54 percent (107 million pounds) of all honey extracted. Commercial honey production is concentrated in California, Florida, and South Dakota (table 5). These three States alone accounted for 34 percent of the total production by commercial beekeepers in 1975.

The value of U.S. honey was relatively stable from 1945 to 1972. In 1973, however, a drawdown of world sugar stocks boosted honey prices and caused a sharp jump in the value of the honey crop (table 3). Honey prices have remained high with the short crops of 1974 and 1975. In 1975, the value of the honey and beeswax production was estimated at 102.8 million dollars. This is second only to the record year of 1973.

Table 4.—Honey: Colonies of bees and yield per colony for U.S. producers with 300 or more colonies in 20 major producing States, by State, 1971-75

State	Commercial colonies of bees					Yield per colony				
	1971	1972	1973	1974	1975	1971	1972	1973	1974	1975
	Thousand colonies					Pounds				
Arizona	41	43	47	43	40	60	52	77	57	45
California ..	431	418	385	385	390	40	50	65	48	50
Colorado	37	32	31	31	30	55	71	54	85	73
Florida	130	130	136	136	132	80	97	106	58	80
Georgia	67	69	70	70	72	55	38	49	25	44
Idaho	91	86	91	93	96	39	47	60	64	44
Illinois	12	11	10	10	10	80	63	70	70	42
Iowa	42	42	36	36	37	95	80	112	103	90
Michigan	61	61	54	58	57	70	55	85	47	55
Minnesota ...	79	91	98	105	105	84	98	117	75	85
Montana	72	72	75	77	75	55	110	102	89	95
Nebraska	102	104	110	123	126	56	80	75	84	51
New York	51	53	54	54	49	70	59	61	58	63
North Carolina ..	6	6	6	7	7	79	60	70	52	64
North Dakota	55	59	68	75	82	77	142	100	80	94
Oregon	28	25	25	23	21	40	41	55	48	45
South Dakota	106	115	125	138	150	97	124	110	50	71
Texas	66	81	93	100	104	52	96	61	61	72
Washington ..	70	77	76	75	77	26	43	47	34	37
Wisconsin ...	58	55	50	52	66	104	72	120	72	45
Total	1,605	1,630	1,640	1,691	1,726	60	73	80	60	62

Source: Compiled from statistics of the U.S. Department of Agriculture, Statistical Reporting Service (SRS).

Table 5.—Honey: U.S. honey production by producers with 300 or more colonies, by State, 1971-75

State	Commercial production				
	1971	1972	1973	1974	1975
	Million pounds				
Arizona	2.5	2.2	3.6	2.5	1.8
California	17.2	20.9	25.0	18.5	19.5
Colorado	2.0	2.3	1.7	2.6	2.2
Florida	10.4	12.6	14.4	7.9	10.6
Georgia	3.7	2.6	3.4	1.8	3.2
Idaho	3.5	4.0	5.5	6.0	4.2
Illinois	1.0	.7	.7	.7	.4
Iowa	4.0	3.4	4.0	3.7	3.3
Michigan	4.3	3.4	4.6	2.7	3.1
Minnesota	6.6	8.9	11.5	7.9	8.9
Montana	4.0	7.9	7.7	6.8	7.1
Nebraska	5.7	8.3	8.3	10.3	6.4
New York	3.6	3.1	3.3	3.1	3.1
North Carolina	.5	.4	.4	.4	.4
North Dakota	4.2	8.4	6.8	6.0	7.7
Oregon	1.1	1.0	1.4	1.1	.9
South Dakota	10.3	14.3	13.8	6.9	10.7
Texas	3.4	7.8	5.7	6.1	7.5
Washington	1.8	3.3	3.6	2.6	2.8
Wisconsin	6.0	4.0	6.0	3.7	3.0
Other States 1/	10.8	13.4	14.8	11.3	12.0
Total	106.6	132.9	146.2	112.6	118.8

1/ Commercial production estimated by the U.S. International Trade Commission from data submitted by U.S. commercial beekeepers.

Source: Compiled from statistics of the U.S. Department of Agriculture, except as noted.

Pollination Services

Honey bees perform a vital pollinating service to agricultural crops valued at an estimated $8 billion in 1975. Although a few other insects contribute to pollination as they visit flowers or blossoms, honey bees are the most efficient and only dependable pollinators.

Research results have consistently indicated that honey bees are a necessary requirement for the production of many food and fiber crops. An estimated 15 percent of the plant-derived portion of our diet comes from plants dependent upon or benefited by insect pollination. Most of the animal products we consume consist of beef and dairy products, much of which is produced on insect-pollinated legumes (alfalfa, clovers, lespedeza, etc.). About half this portion of our diet is dependent upon insect pollination. Thus, about one-third of our total diet is derived, directly or indirectly, from insect-pollinated plants (McGregor, 1973). Table 6 includes fruit, vegetable, seed, nut, and forage crops grown in the United States that require insect pollination or that show definite increases in yield or quality as a result of the pollinating activity of bees (Stanger, et al, 1975), (Levin 1971).

McGregor estimated in 1973 that we had about 3.5 million acres of fruits, vegetables, oilseeds, and legume seed crops that are primarily dependent upon insect pollination. Another 63 million acres are devoted to crops that derive some benefit from insect pollination. He further estimates that only about 1.25 million colonies are available at some time during the year for immediate movement to specific crops for pollination. Of these, only about half a million colonies are actually transported to specific crops for pollination purposes. These colonies pollinate an

Table 6.—U.S. crops pollinated by honey bees

Crop type	Crops dependent 1/		Crops increased 2/	
Fruit and nut crops	Almond	Plum	Apple	Mandarin
	Apple-most varieties	Prune	Apricot	Mango
	Apricot-some varieties	Tangelo	Bushberry	Nectarine
	Avacado	Tangerine	Blackberry	Passion fruit
	Cherry	Tung	Blueberry	Peach
	Chestnut		Cranberry	Pear
	Lychee fruit			
	Peach-some varieties		Dewberry	Persimmon
	Pear-some varieties		Gooseberry	Raspberry
			Huckleberry	Strawberry
			Macadamia nut	
Forage seed crops	Alfalfa	Red clover	Crimson clover	
	Alsike	Sanfoin		
	Berseem	Crown vetch		
	Birdsfoot trefoil			
	Ladino clover			
Vegetable seed crops	Asparagus	Leek	Eggplant	
	Broccoli	Melon		
	Brussel sprouts	Mustard		
	Cabbage	Onion		
	Carrot	Parsley		
	Cauliflower	Parsnip		
	Celery	Pumpkin		
	Chinese cabbage	Radish		
	Collards	Rutabaga		
	Cucumber	Squash		
	Kale	Turnip		
	Kohlrabi	Watermelon		
Vegetable crops	Cucumber	Pumpkin		
	Melons	Squash		
Oil seed crops			Flaxseed	Rape
			Safflower	
Tree seed crops	Chestnut	Red maple		
	Catalpa	Yellow poplar		
	Black locust	Holly		

1/ These are unable to produce a commercial crop without cross-pollination.
2/ These generally produce a larger crop when honey bee pollinated.
Source: (Stanger, 1967).

average of two crops per year. McGregor concludes there is a need for 5 to possibly 20 times the number of colonies that are presently available, or 2.5 to 10 million mobile colonies (McGregor, 1973).

Since the need for insect pollination is increasing, one would assume that the number of colonies available to meet this demand would also be increasing. Such is not the case as indicated by the steady decline in colony numbers in the United States for more than two decades. Generally, colonies have either shifted to the suburbs where they are operated by hobbyists and part-time beekeepers on weekends, or they are operated by large-scale commercial beekeepers. This situation has disturbed the once even distribution of pollinators across the countryside, and even created a serious deficiency in some areas.

Hobbyists and part-time beekeepers cannot economically justify investment in equipment to transport bees from one pollination site to another. Consequently, most of these small units are engaged strictly in honey production. The majority of the pollination in the United States is provided by the large commercial beekeepers who rent colonies to the growers. In some instances, rental fees have not increased over the last five decades. There are several reasons for the low fees being charged. First, there is no organized use of bees for pollination. Each beekeeper is free to set his own rental price. Sometimes the bees are supplied almost as a favor in exchange for apiary locations. Secondly, beekeepers may be hesitant to ask higher fees for fear other beekeepers might move into their "territory" by undercutting the rental fee.

Unfortunately for growers, when beekeepers provide pollination services at low rental rates they may try to make up their fees elsewhere. This may be accomplished by supplying an inadequate number of colonies for maximum pollination, the colonies may be weak and lack the desired population of worker bees, or they may not be appropriately managed or strategically distributed throughout the field being pollinated. However, it is possible that a population of bees necessary for maximum set of fruit or seeds on the crop may be far greater than the location will support for honey production or colony maintenance.

Research to determine the yield response of various crops to increased pollination has been limited because of the difficulty in establishing a controlled environment. However, experience of Michigan highbush blueberry growers is a good example to illustrate the importance of adequate pollination. As reported by Michigan State University (Martin, 1966):

(1) Practically no fruit is produced on a blueberry bush without pollination by some type of bee. Yields are negligible when bees are excluded, averaging 1.5 to 2 pounds per bush.

(2) Honey bees work blueberries well and are proficient pollinators. Yields up to 52 pounds per bush were obtained from bushes caged with honey bees.

(3) With adequate pollination, yields are greater; berries are larger and mature ready for market earlier.

Prior to 1964 practically no honey bees had been brought into plantations for pollination purposes. During the 1967 season between 10,000 and 12,000 colonies were placed on 6,000 acres of berries operated by the Michigan Blueberry Growers Association. Beekeepers of the State

benefited by about $70,000 in 1967 and blueberry growers benefited by many times this amount.

For a crop such as almonds, profitable production depends upon the cross-pollination of practically all flowers. Growers desire the heaviest set of almonds because there is no fruit-thinning problem and nuts with small kernels are in greatest demand. By comparison, pollination of 5 percent of the blossoms on an apple tree can produce an economic yield.

For most beekeepers the value of honey and beeswax produced far exceeds rental fees received for pollination services. However, large commercial beekeepers in the Pacific Coast States derive about a third of their income from pollination. Some beekeepers obtain significant income from rental fees in New England, the Middle Atlantic States, Florida, and Texas. Elsewhere, the income from pollination is generally insignificant. Rental fees are usually inversely proportional to the value of honey produced. When bees pollinate crops that produce little or no nectar, the amount of honey in the colonies may be reduced.

Cost and Returns

Financial analysis of the commercial beekeeping industry is difficult because of the tremendous variation in colony numbers and the wide geographical distribution of beekeepers throughout the United States. Most beekeepers receive income from honey, beeswax, pollination services, and bee sales but the relative importance of these sources of income varies among beekeeping operations. Analysis is further handicapped by a lack of published data on the capital investment, income, and expenses of beekeepers.

For this analysis, financial characteristics of beekeepers were obtained from four recent publications on the economics of beekeeping. Two of the reports (Anderson, 1969) (Reed and Horel, 1976) are based on theoretical operations and the remainder on survey data (Owens, Cleaver, and Schneider, 1973) (U.S. International Trade Commission, 1976).

Capital Investments

The amount invested in equipment and facilities is affected by the type of beekeeping operation as well as the number of colonies. Beekeepers engaged in providing pollination services usually own more trucks, hive loaders, and forklift trucks compared to honey producers whose major investment may go into mechanizing the honey house. Also, few commercial beekeepers purchase new hives. The usual practice is to start with a few hives and purchase more secondhand from other beekeepers who are going out of business. Some large operators purchase lumber and construct hive bodies and supers during the slack winter months. Further cash savings are made in foundation material, which is cheaper if the operator furnishes his own beeswax to the manufacturer. Basic equipment for the honey house and highway vehicles are usually purchased new. Most beekeepers own a minimum acreage of land where they maintain their headquarters, warehouse, and service area.

In 1969, a study was made at the University of Illinois covering the economics and practices of typical beekeepers in the Midwest (Wisconsin and Illinois) and Southwest (Arizona and California) for the 1968 production year (Owens, Cleaver, and Schneider, 1973). Information was gathered from 18 beekeeping enterprises in the Midwest and 41 in the Southwest. These

enterprises varied from 300 to 5,500 colonies and were classified into four size classes.

Investments in land, buildings, and equipment for the beekeepers in the study areas are shown in Appendix C, table 1, and summarized as follows:

Southwest	Average investment per colony
Class I (300 to 499 colonies)	$80.06
Class II (500 to 999 colonies)	70.67
Class III (1,000 to 2,999 colonies)	52.63
Class IV (5,000 to 5,999 colonies)	45.45
Midwest	
Class I (300 to 499 colonies)	69.15
Class II (500 to 999 colonies)	89.67
Class III (1,000 to 2,999 colonies)	66.97

The analysis shows that the capital investment of beekeepers in 1968 varied among different geographic areas and size classes. In the Southwest, total investment per colony trended downward as the size of operation increased from $80.06 for Class I size to $45.45 for Class IV size. The larger operators appear to be better able to reduce their investment per colony by more fully utilizing land, buildings, and equipment.

Beekeepers in the Midwest, however, showed a different trend. Class II operators had a much higher total investment ($89.67 average) than those in Classes I and III—mostly due to higher investment per colony in buildings and bee equipment.

Investment differences between the two areas show that 1) land investment in each class is higher in the Southwest, 2) building investment in the Southwest is less than half the building costs in the Midwest, 3)

investments in both bee equipment (except for Class I) and honey and wax equipment are lower in all classes in the Southwest than in the Midwest, and 4) power equipment costs are higher in all classes in the Southwest largely because 81 percent of all beekeepers studied in the area provided pollination services.

More recently, Reed and Horel estimated the total investment costs for a 1,000 hive operation in 1975 to be $79.50 per hive (Appendix C, table 2). The investment items are summarized as follows:

	Investment per hive
Land	$ 3.00
Warehouse	7.20
Well & pump	2.00
Pickup & truck	12.50
Hives	29.80
Bees	14.00
Warehouse equipment	5.00
Extraction equipment	6.00
Total investment	$79.50

The number of hives could be increased materially without increasing the total investment--except for hives and bees. Consequently, by increasing the number of hives, investment cost per hive could be reduced substantially.

Income, Cost, and Returns

Since few detailed public records of current income, cost, and returns are available, it is difficult to confirm or deny the allegation that beekeepers are in financial distress. Anderson supports this thesis with observations made during his investigation of the beekeeping industry in 1966 and 1967 as follows: First, the industry has attracted few young men

in recent years, and many beekeepers reported that they would not encourage their sons or other young men to enter this business because of the poor financial returns they are experiencing. Second, the general appearance of buildings and hives indicated that maintenance was neglected. Furthermore, beekeepers were slow to invest in labor saving equipment. It should be noted that Anderson's analysis was made before legislation of the Beekeeper Indemnity Program during a period of low honey prices and sizable pesticide damage to bee colonies.

Budgets developed by Reed and Horel for 1975 estimate the returns for beekeepers becoming established in the business. Results from their simulated income and cost analysis (summarized in table 7) indicate that except for those selling queens and packaged bees, beekeepers in general are sustaining an economic loss in the long-run (see Appendix C, tables 3-5 for budget details). Except for pollinators, the beekeeper who can provide most of the labor requirements, is not paying cash for management, has his investment clear of debt, and has equipment which has been completely or largely depreciated, can operate and show some net cash income in the short run. However, since these budgets are based on new equipment and building prices, they may not be truly representative of the large commercial beekeepers who are innovative and can reduce operating expenses.

The foregoing analysis indicates that beekeepers who are primarily providing pollination service are in a worse economic situation than are the honey and package bee producers. The economics of providing pollination service at various rental rates per hive and at three sizes of operation are summarized below (see Appendix C, tables 6–10 for budget details). The estimated net income for a 1,000 hive operation at different

Table 7.--Summary of income and expenses for 1,000 hive operations, 1975

	Honey producer	Bee producer	Pollination
	Dollars per hive		
<u>Income</u>			
Honey	30.00	6.00	7.50
Wax	1.00	1.00	1.00
Bees	2.10	28.00	2.80
Queens		28.00	
Pollination	3.55	4.60	10.70
TOTAL INCOME	36.65	67.60	22.00
<u>Expense</u>			
Labor	7.50	14.62	8.12
Social Security, etc.	.90	1.75	.97
Feed - sugar	.80	1.97	.40
- candy		.06	
Bees and queens	3.78		7.00
Supplies			
Packages		1.50	
Feeder cans		.20	
Lath		.10	
Smokers	.02	.02	.02
Veils	.04	.04	.04
Hive tools	.02	.02	.02
Honey tins	3.00	.60	.75
Queen cages		.20	
Drugs and fumigants	.20	.20	.20
Foundations	.45	1.12	1.12
Wax	.37	.38	.38
Repairs	.60	.60	.60
Gas, oil, truck repair	3.00	3.00	3.00
Render wax	.33	.33	.33
Utilities	.35	.35	.35
Insurance	.60	.60	.60
Taxes	.80	.80	.80
Location rent	.15	.15	.15
Miscellaneous	.90	.90	.90
Interest on operating capital	1.07	1.33	1.16
TOTAL CASH EXPENSE	24.88	30.84	26.91
Management 5% of gross income	1.83	3.38	1.10
Depreciation	7.00	7.00	7.00
Interest on investment @ 8%	3.86	3.86	3.86
TOTAL EXPENSE	37.57	45.08	38.87
NET INCOME	〈.92〉	22.52	〈16.87〉

Source: (Reed and Horel, 1976).

incomes per hive are as follows:

Pollination income per hive	Net income per 1,000 hives
$ 8.50	$18,960 loss
10.50	17,060 loss
12.50	15,160 loss
14.50	13,260 loss

According to these data, a pollinator with 1,000 hives would need to receive about $27.76 per hive to cover all expenses including the opportunity cost of capital and management.

Once a beekeeper has acquired a basic component of equipment and facilities, he can usually expand the size of his operation without proportionate increases in investment. Consequently, fixed costs per hive for depreciation, interest, taxes, insurance, and certain other costs are reduced. The net incomes for three sizes of operations at various rental fees are shown in table 8. Although the net incomes are negative, the data illustrate that the larger beekeepers have an economic advantage over the small operators.

Table 9 summarizes the costs and returns reported on the Illinois survey by beekeepers in the Midwest and Southwest (see Appendix C, tables 11-13 for details of cash and noncash costs and income). Total labor was the largest expense for all classes--assuming $2 per hour wage paid to the beekeeper and all family labor. Cash operating costs were low for Class II operations in the Midwest because a limited amount of hired labor was employed. In the Southwest, hired labor increased with increases in size. However, total labor used per colony decreased as the size of operation

Table 8.—Net income for three sizes of operations at various pollination incomes per hive, 1975

Number of hives	Pollination income per hive			
	$8.50	$10.50	$12.50	$14.50
	Net income per hive			
1,000	18.96 loss	17.06 loss	15.16 loss	13.26 loss
2,000	14.13 loss	12.23 loss	10.33 loss	8.43 loss
3,000	12.59 loss	10.69 loss	8.79 loss	6.89 loss

Source: (Reed and Horel, 1976)

TABLE 9.–*Summary of costs and returns per colony in commercial beekeeping, Southwest and Midwest, by size of operation*

(1) Size of operation [1]	(2) Replace-ment	(3) Gross returns	(4) Cash costs	(5) Total costs	(6) Labor: Paid	(7) Labor: Unpaid	(8) Labor: Total	(9) Power equip-ment	(10) De-pre-ciation	(11) Inter-est	(12) Earnings: Man-age-ment (3–5)	(13) Earnings: Busi-ness family (7+11 +12)	(14) Earnings: Cash (3–4)
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Midwest													
Class I	75.15	18.76	9.53	25.93	2.17	8.63	10.80	2.19	5.10	3.20	(−7.17)	4.66	9.23
Class II	95.67	10.62	7.12	24.56	.19	6.89	7.08	3.11	6.89	3.88	(−13.94)	(−3.17)	3.50
Class III	72.97	13.03	9.59	21.21	3.13	3.45	6.58	2.30	5.32	3.19	(−8.18)	(−1.53)	3.44
Southwest													
Class I	86.06	11.60	7.35	26.12	.78	9.80	10.58	5.04	4.94	3.84	(−14.52)	(−0.88)	4.25
Class II	76.67	14.60	7.53	22.87	.89	7.06	8.95	4.15	5.31	3.45	(−8.27)	2.24	7.07
Class III	58.63	12.87	7.95	17.82	2.12	4.08	6.20	3.48	4.09	2.63	(−4.95)	1.76	4.92
Class IV	51.45	14.90	8.80	16.38	3.74	1.26	5.00	2.94	3.69	2.49	(−1.48)	2.27	6.10

1/ See Appendix C, table 1, footnote 1, for explanation of size of operation. Costs shown here are for average size.

Source: (Owens, Cleaver, and Schneider, 1973).

increased for all beekeepers surveyed.

Management earnings (gross returns minus total cost) were negative for beekeepers in the study areas in 1968. In this analysis, beekeepers receiving pollination fees of $15 or more per colony and those selling package bees and queens netted a larger profit than honey producers.

Business and family earnings (management earnings plus unpaid labor and interest) were positive for Class I in the Midwest and Classes II, III, and IV in the Southwest. These earnings ranged from $4.66 to a loss of $3.17 per hive. Cash earnings of all beekeepers studied exceeded cash costs and ranged from $3.44 to $9.23 per hive.

The most recent report of the financial records of U.S. beekeepers was released to the public in June 1976 by the U.S. International Trade Commission. The data, representing the "profit-and-loss" experience of 118 commercial producers of honey for the years 1971-75, was collected in connection with the investigation of honey imports. However, unlike the previously cited budgets, the Commission's data only report cash receipts and expenditures. No charge is made for unpaid labor, interest on investment, and management. Consequently, these data do not provide an account of the economic profitability of beekeeping in the United States.

As shown in table 10, the 118 commercial honey producers realized positive net cash returns, in the aggregate, during the 1971-75 period (see Appendix C, table 14 for income and expenditures by State or area). 6/

6/ A number of the 118 producers operated as partnerships and a few were incorporated. To present comparable profit-and-loss data, all officers' and owners' salaries, where known, were removed as an operating expense. Thus, net profit before income taxes supports more than 118 families.

Table 10.--Honey: Net cash income for 118 commercial beekeeping firms on their beekeeping operations, 1971-75

Item	1971	1972	1973	1974	1975
Beekeeping income:					
Honey and beeswax sold------1,000 dollars--	3,841	5,406	9,358	9,024	9,868
Package bees sold, including queens------do------	142	177	285	340	444
Pollination fees------do------	808	752	773	1,014	1,171
Other beekeeping income------do------	156	669	723	665	643
Total beekeeping income------do------	4,947	7,004	11,139	11,043	12,126
Total beekeeping expense------do------	3,611	4,598	6,731	7,954	8,713
Net cash profit before income taxes------do------	1,336	2,406	4,408	3,089	3,413
Ratio of net beekeeping profit before income taxes to total beekeeping income------percent--	27.0	34.4	39.6	28.0	28.1
Honey produced------1,000 pounds--	16,327	19,491	24,030	18,980	19,882
Number of colonies reported------1,000 colonies--	228.5	250.6	272.9	286.1	296.4
Net profit before income taxes per colony------	$5.84	$9.60	$16.15	$10.80	$11.52
Pounds of honey produced per colony------	71	78	88	66	67
Average price per pound for honey sold------	$0.24	$0.28	$0.39	$0.48	$0.50

Source: Compiled by the International Trade Commission from data submitted by commercial beekeepers.

Total beekeeping receipts increased yearly during this span of time--ranging from $4.9 million in 1971 to $12.1 million in 1975. Honey and beeswax sales accounted for 77 percent or more of the producers' total beekeeping receipts during the five year period. Pollination fees were the second largest source of receipts. Bee indemnity payments accounted for most of "Other beekeeping income" during 1972-75.

Total beekeeping expense per colony increased (86 percent) from $15.80 in 1971 to $29.40 in 1975. Hired labor was the largest expense item for most of the larger honey producers (1,650 colonies or more)--normally increasing with colony size. Depreciation was another major expense for honey producers, especially the last 3 years, when increasing profits motivated many beekeepers to make investments in equipment and facilities. For beekeepers in the northern United States who kill their bees at the end of the honey-producing season, expenditures for package bees and queens to restock hives are substantial.

The net cash income of the 118 beekeepers, by State or area, is presented in table 11. The producers are listed with the State where they were headquartered or where a major share of their honey was produced. Some beekeepers operate in several States. As shown in this table, receipt margins on beekeeping operations varied among States and from year to year. Net cash income per colony increased from $5.85 in 1971 to $16.15 in 1973, declined to $10.91 in 1974, and then increased to $11.52 in 1975. During 1973-75, total beekeeping receipts increased 10 percent (from $11.1 million to $12.1 million). At the same time, total beekeeping expenses increased 29 percent. Consequently, the increase in beekeeping expenses, coupled with lower yields of honey, resulted in lower margins in 1974 and 1975 than

Table 11.--Summary of net cash income for 118 producers on their beekeeping operations, by State or area, 1971-75

State and area	Net cash profit or (loss) before income taxes				
	1971	1972	1973	1974	1975
	Per colony				
Arizona	(2.38)	4.89	23.94	11.94	.37
California	6.04	8.85	20.35	12.04	15.59
Colorado, New Mexico, Utah and Wyoming	6.01	8.56	14.25	10.16	8.37
Florida	6.81	7.94	10.22	8.68	8.60
Georgia	8.31	13.38	17.55	17.02	12.80
Idaho	4.75	5.94	10.23	12.42	8.33
Iowa, North Dakota, and South Dakota	9.17	13.39	17.76	7.30	14.95
Michigan	5.68	(.76)	8.68	9.14	5.00
Minnesota	5.06	10.67	17.85	13.97	10.10
Montana	4.04	9.78	19.77	13.43	11.94
Nebraska	4.88	5.41	5.82	8.50	8.07
Oregon and Washington	4.75	15.93	13.97	8.91	15.21
Texas	7.31	16.22	19.12	13.46	12.11
All other reporting States	4.29	6.23	5.67	8.84	5.36
Total	5.85	9.60	16.15	10.91	11.52

Source: Computed from data compiled by the U.S. International Trade Commission.

in 1973. Of the 118 honey producers surveyed, only 14 reported negative net cash income in 1971; 12 were negative in 1972 and 1975; 6 in 1973; and 13 in 1974.

For the 1971-75 period, beekeepers with 900 to 1,549 colonies reported slightly higher net incomes ($12.61) than producers in other size groups (table 12). Usually, a beekeeper with about 1,000 colonies of bees can operate with family and part-time labor. In 1975, total beekeeping expenses per colony ranged from a low of $24.56 for producers with 900 to 1,549 colonies to $33.63 for those with 1,550 to 2,699 colonies.

Short-Run and Long-Run Implications

The financial budgets cited in this analysis indicate that the cash earnings of most beekeepers exceed cash costs. This permits payment of short-run variable operating expenditures. In the long-run, however, returns to capital, management, and unpaid family labor are low for most beekeepers and even negative in some cases. Consequently, damaged and worn-out beekeeping equipment can only be replaced during years when exceptional yields of honey boost income.

To the beekeeping industry, an extended period of low returns would be expected to be accompanied by a gradual decline in the number of honey bee colonies--especially commercial operations. Generally, hobbyists and part-time beekeepers can supplement low earnings from honey bees with income from other sources. The commercial operators, however, are usually employed full-time with their beekeeping operations and have only limited sources of other income.

Table 12.--Summary of net cash income for 118 beekeeping enterprises, by colony size, 1971-75

Colony size	Net cash profit before income taxes				
	1971	1972	1973	1974	1975
	Per colony				
300 to 899	4.50	6.40	16.15	13.12	9.77
900 to 1,549	7.41	14.13	14.84	13.04	13.61
1,550 to 2,699	7.93	10.25	15.38	12.08	12.10
2,700 and over	5.00	8.90	16.64	9.83	11.11
Total	5.85	9.60	16.15	10.91	11.52

Source: Computed from data compiled by the U.S. International Trade Commission.

EVALUATION OF THE BEEKEEPER INDEMNITY PAYMENT PROGRAM

For the nine year period spanning 1967-75, the Beekeeper Indemnity Payment Program made payments in excess of $18.8 million to over 2,600 different beekeepers in the United States and Puerto Rico for nearly 2,055,000 damaged colonies of honey bees (table 13). For 1976, the agricultural budget included $3 million to cover the cost of claims filed under the Indemnity Program.

The 1970 Indemnity Program permitted beekeepers to receive multiple payments per colony for pesticide damage occurring during a given calendar year. However, the 1974 Indemnity Program imposed limitations on payments. The program now stipulates that only one payment may be made on a colony of bees for losses occurring during any given calendar year. If more than one loss is suffered by a colony, the beekeeper may claim payment based on the most severe loss suffered by the colony during the year. Since January 1, 1974, payments have been computed on the basis of $22.50 for each colony destroyed, $15.00 for each colony severely damaged, $7.50 for each colony moderately damaged, and $7.50 for each queen nucleus destroyed. 7/

In this section, data compiled by the Agricultural Stabilization and Conservation Service (ASCS) from claims submitted under the Beekeeper Indemnity Payment Program are analyzed to determine the distribution and importance of indemnity payments on an individual and regional

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7/ The ASCS Handbook for the Beekeeper Indemnity Payment Program defines a "colony destroyed" as a colony in which the kill of bees by pesticides was so severe that the colony will not survive. A "colony severely damaged" is a colony in which field bees were killed by pesticides and the brood suffered damage, but the colony did survive. A "colony moderately damaged" is a colony so damaged by pesticides as to destroy field bees, but not the brood.

Table 13.--Damaged colonies for which indemnity payments have been made, 1967-75 1/

Period	Damaged colonies claimed	Indemnity payments	Beekeepers receiving payments
	Colonies	Thousand dollars	Number
1967	243,493	1,758	370
1968	228,781	1,629	390
1969	226,859	1,660	442
1970	215,272	1,652	469
1971	304,421	3,244	818
1972	247,265	2,146	647
1973	205,351	1,678	658
1974	243,608	3,029	932
1975	140,111	2,064	746
Total	2,055,161	18,860	2/ 5,472

1/ As of March 1, 1976.
2/ This represents 2,628 individual payees.

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

basis. Special attention is focussed on claims submitted by beekeepers in Arizona, California, Florida, Georgia, Idaho, Mississippi, Texas, and Washington from 1972 through 1974. Data for these three years reflect the normal operation of the Indemnity Program and do not include retroactive payments. Excluding Florida, these States have received the major proportion of indemnity payments--nearly $11.3 million. From 1972-74, beekeepers in these eight States received nearly 72 percent of all indemnity payments made in the United States (table 14). Florida was selected for analysis because it is an important beekeeping State--ranking second, after California, in total colonies of bees. However, Florida beekeepers have filed few indemnity claims. Analysis is also conducted for the twenty beekeepers who received the largest total amount of indemnity payments through 1975.

Table 14.--Distribution of beekeeper indemnity payments, 8 selected States, 1972-74 1/

State	Period 1972	1973	1974	Average
	Percent of payments			
Arizona	10.8	15.5	14.9	13.7
California	19.2	17.0	16.2	17.4
Florida	1.7	0.3	0.5	0.8
Georgia	6.1	8.2	11.2	8.5
Idaho	7.8	9.9	5.4	7.3
Mississippi ...	1.8	3.4	3.4	2.9
Texas	2.6	3.9	3.2	3.1
Washington	26.9	12.6	14.3	17.8
All 8 States.	76.9	70.8	69.1	71.9

1/ As of March 1, 1976

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

Participation in the Beekeeper Indemnity Payment Program

To qualify for indemnity payments, beekeepers must file an inventory report each year by July 15 with the county ASCS office where they maintain their headquarters. The purpose of this report is to establish the maximum number of colonies and queen nuclei for which payment can be made each year. Beekeepers must amend this report to reflect any change in the number of colonies or queen nuclei maintained after the initial report is submitted.

During 1972-74 (table 15), 1,881 individual beekeepers or beekeeping firms registered approximately 625,000 bee colonies with county ASCS offices in seven of the eight States studied (excluding Washington). This is estimated to be about 11 percent of all beekeepers and 43 percent of the bee colonies headquartered in the seven States. Of those beekeepers who registered bees with ASCS, approximately 33 percent received at least one indemnity payment during 1972-74. However, in Idaho, a large portion of the registered beekeepers have suffered damage from pesticides as 82 percent received at least one indemnity payment during this time.

For all beekeepers (registered and nonregistered) in the eight States, only 2 percent received an indemnity payment. For the United States, less than 0.6 percent of all beekeepers received an indemnity payment in any one year.

Table 15.--Number of honey bee colonies by State and participation in the Beekeeper Indemnity Payment Program, 8 selected States, 1972-74 average 1/

State	Total colony number	Registrations in the Indemnity Program		Percent of registrants receiving indemnity payments	
		Number of beekeepers	Number of colonies	Beekeepers	Colonies
	(1,000)	(No.)	(1,000)	Percent	
Arizona	55	129	45	45.7	84.4
California	500	649	311	13.6	42.4
Florida	360	134	29	10.4	27.6
Georgia	164	261	66	19.5	71.2
Idaho	103	93	80	29.0	72.5
Mississippi	55	73	15	17.8	80.0
Texas	205	542	79	12.7	50.6
Washington 2/	95	--	--	--	--
All 8 States	1,537	1,881	625	17.1	53.6

1/ As of March 1, 1976.
2/ Incomplete data for registered beekeepers in Washington.

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

Almost equal proportions of hobbyist, part-time, and commercial beekeepers registered for the Indemnity Program in the eight States during the 1972-74 period (table 16). California, Washington and Idaho had the highest percent of registered commercial beekeepers.

Table 16.--Distribution of registered beekeepers by colony size, 8 selected States, 1972-74

State	Classification of beekeepers		
	Hobbyist (0-25 colonies)	Part time (26-299 colonies)	Commercial 300 colonies or more
		Percent	
Arizona	16.3	51.2	32.5
California	27.6	31.2	41.2
Florida	17.8	42.7	39.5
Georgia	41.2	32.7	26.1
Idaho	8.1	20.3	71.6
Mississippi	35.1	47.3	17.6
Texas	48.5	37.1	14.4
Washington	7.2	33.9	58.9
All 8 States	32.8	35.5	31.8

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

Geographic Location of Indemnified Bee Losses

Beekeepers throughout the continental United States are reporting honey bee losses from pesticides. However, the largest concentration of damage to bee colonies has occurred in the West, Southwest, and Southeast beekeeping regions of the United States (figure 5). During 1972-74, beekeepers in Washington, California, and Arizona received \$3.35 million in indemnity payments. This is nearly half of all the payments made during the three years (table 14).

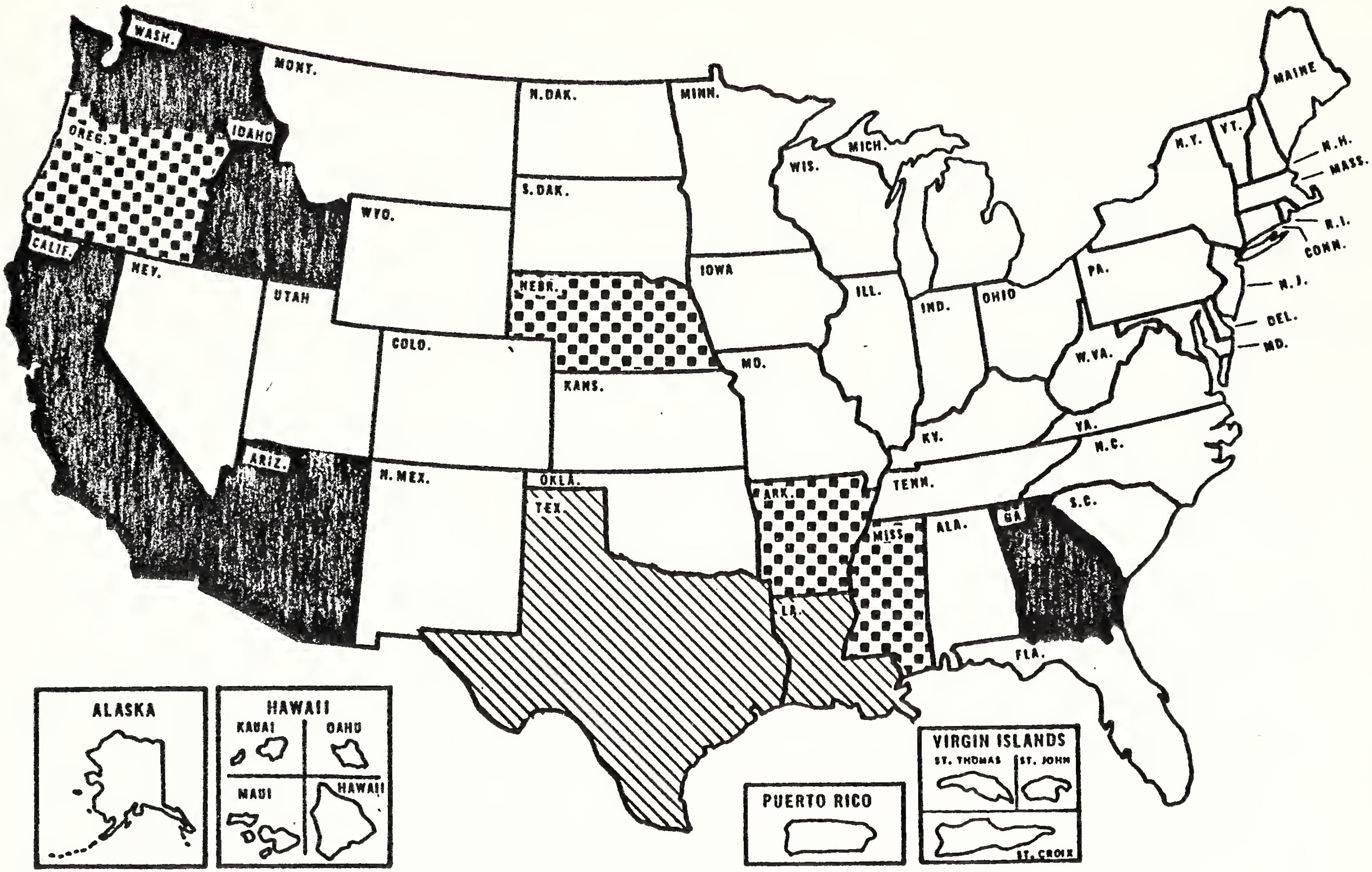

Figure 5.-- Damaged colonies receiving beekeeper indemnity payments, 1972-74 average 1/

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less than 5,000 colonies per year
5,000 to 9,999 colonies per year
10,000 to 14,999 colonies per year
15,000 colonies or more per year

1/Includes colonies destroyed, severely damaged, and moderately damaged.

Washington beekeepers in Yakima and Grant Counties received about $1.04 million of indemnity payments during 1972-74. This is nearly 80 percent of all payments made in Washington. The Yakima Valley and Lower Columbia Basin are situated within these two Counties. These are irrigated, intensively cultivated fruit, vegetable, and forage producing areas where a timely spray program is utilized to control the many types of insects and diseases continually attacking the crops. Most of the pesticides are applied to crops by aerial spray applicators. Due to the wide variety of crops grown in the Yakima Valley, it is reported that about 85 percent of the bees in Washington are maintained in this area.

Honey bees are essential to the production of California crops worth more than $300 million. Bees are needed in the fertile valleys like Imperial, San Joaquin, and Sacramento to pollinate the wide variety of seed, forage, vegetable, fruit, and nut crops under cultivation. Like the Yakima Valley, these crops require extensive applications of pesticides which each year damage or destroy thousands of bee colonies. As of March 1, 1976, payments to beekeepers in California over the 1967-75 period totaled about $3.6 million. The major bee damage has occurred in the counties of Riverside, Imperial, Fresno, Kern, and San Joaquin.

The Southeast is the headquarters of most queen breeders and package bee shippers in the United States. In addition, thousands of bee colonies are trucked from the northern States to winter-over in bee yards situated throughout this area. With the warmer southern climate, honey bees can gather pollen and nectar during most of the winter. This conserves valuable stores of honey that would be consumed by bees wintering in the northern States. Except for sizable areas in Florida, little commercial

pollination is provided in this region. Only occasionally are bees rented for pollination in fruit orchards and fields of melons and legume seed. Most damage in Georgia and Mississippi has resulted from pesticide applications in soybean and cotton fields located adjacent to bee yards.

Degree of Pesticide Damage to Bee Colonies

Beekeepers in the eight selected States maintained an estimated 1,537,000 colonies of honey bees during 1972-74. This is nearly 37 percent of all colonies reported in the United States. The number of colonies ranged from 55,000 in Arizona and Mississippi to 500,000 in California (table 15). During this time, beekeepers in these States claimed pesticide damages on 517,737 colonies of bees (table 17). This is an average of 172,579 colonies damaged each year or about 11 percent of the total honey bee population in the eight States--65 percent of the registered colonies. At the same time, beekeepers in the rest of the United States claimed damages on only 59,500 colonies per year--less than 2.5 percent of all bee colonies reported in these States.

Indemnity payments made to beekeepers in the eight States for claims filed during 1972-74 reflect damage to bee colonies in the order of 5.2 percent destroyed, 50.0 percent severely damaged, and 44.8 percent moderately damaged (table 18). However, claims filed by Florida beekeepers indicate about 23 percent of the injured colonies are evaluated by inspectors as destroyed. Actually, this percentage is greatly inflated by four large beekeepers who claimed that 48 percent of their damaged colonies were destroyed (table 19). In Washington, beekeepers have claimed less than 2 percent destroyed colonies, but over 67 percent severely damaged

Table 17.--Number of colonies for which indemnity payments were made according to degree of damage, 8 selected States and remainder of United States, 1972-74 1/

State	Degree of damage to honey bee colonies			
	Destroyed	Severe	Moderate	Total colonies Damaged 2/
	Colonies			
Arizona	8,513	59,287	35,887	103,687
California	4,741	40,727	98,610	144,078
Florida	1,065	1,609	1,891	4,565
Georgia	6,093	33,100	11,193	50,386
Idaho	1,948	31,525	20,707	54,180
Mississippi ...	1,061	9,650	8,251	18,962
Texas	1,397	5,976	19,979	27,352
Washington	2,156	76,878	35,493	114,527
All 8 States .	26,974	258,752	232,011	517,737
Remaining States	15,020	89,686	73,781	178,487

1/ As of March 1, 1976.
2/ In 1972 and 1973 multiple claims could be made on an individual colony.

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

colonies.

Beekeepers outside the major loss areas have reported a slightly higher percent of destroyed colonies and fewer moderate losses. An explanation may be that these beekeepers maintain fewer bee colonies and are more reluctant to take time to file claims unless a colony is severely damaged or destroyed. In fact, beekeepers (hobbyists, part-time, and commercial) in the eight States maintained an estimated 88 colonies per management unit during 1975 compared to only 22 colonies per unit in all other States. The

Table 18.--Distribution of damaged colonies for which indemnity payments were made by severity of loss, 8 selected States and the remainder of the United States, 1972-74 1/

State	Degree of damage to honey bee colonies											
	Destroyed				Severe				Moderate			
	1972	1973	1974	Ave.	1972	1973	1974	Ave.	1972	1973	1974	Ave.
	Percent of colonies											
Arizona.......	7.7	4.6	12.2	8.2	49.8	52.4	70.3	57.2	42.5	43.0	17.5	34.6
California....	3.7	3.2	2.9	3.3	30.0	30.2	24.6	28.3	66.3	66.6	72.5	68.4
Florida.......	24.7	14.2	23.4	23.3	42.9	34.5	16.3	35.2	32.4	51.3	60.3	41.5
Georgia.......	14.5	11.8	10.8	12.1	56.9	68.2	69.3	65.7	28.6	20.0	19.9	22.2
Idaho.........	4.0	2.3	4.8	3.6	66.5	63.3	41.2	58.2	29.5	34.4	54.0	38.2
Mississippi...	2.7	7.4	5.7	5.6	41.3	51.7	56.1	50.9	56.0	40.9	38.2	43.5
Texas.........	4.5	4.6	6.2	5.1	16.3	22.2	26.5	21.8	79.2	73.2	67.3	73.1
Washington....	2.1	1.1	2.2	1.9	86.6	43.8	58.8	67.1	11.3	55.1	39.0	31.0
All 8 States..	5.2	4.1	6.2	5.2	53.9	45.9	49.2	50.0	40.9	50.0	44.6	44.8
Remaining States 2/	6.2	8.9	9.8	8.4	54.6	43.2	52.3	50.3	39.2	47.9	37.9	41.3

1/ As of March 1, 1976.

2/ Averages for United States exclude data for the 8 selected States.

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

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Table 19.--Distribution of damaged colonies for which indemnity payments were made by size of operation, 1972-74 average, 8 selected States 1/

State	Number of colonies registered					
	Less than 1,000			1,000 or more		
	Destroyed	Severe	Moderate	Destroyed	Severe	Moderate
		Percent			Percent	
Arizona	9.3	66.0	24.7	8.0	58.1	33.9
California	3.4	28.4	68.2	3.3	28.2	68.5
Florida	8.1	26.9	65.0	47.6	48.5	3.9
Georgia	13.2	68.6	18.2	10.9	62.6	26.5
Idaho	0.9	65.7	33.4	3.8	57.6	38.6
Mississippi	17.0	64.7	18.3	1.7	46.1	52.2
Texas	5.0	25.7	69.3	5.3	15.9	78.8
Washington	2.1	68.2	29.7	1.8	66.9	31.3
All 8 States	8.6	52.5	38.9	4.2	49.1	46.7

1/ As of March 1, 1976.

Source: Compiled from Statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

large commercial operators (300 or more colonies) maintained an average of 1,100 colonies in the eight States compared to 1,000 colonies in other parts of the United States in 1975.

The most significant loss of honey bees during 1972-74 occurred in Arizona. Over this span of time, about 63 percent of Arizona's bee population suffered pesticide damage that resulted in indemnity payments (table 20). This was over 90 percent of the bee colonies registered for the Indemnity Program with county ASCS offices in Arizona.

In California, indemnity claims were filed on less than 10 percent of the bee population. However, due to the large number of honey bees in California (500,000 colonies) this amounts to about 144,000 damaged colonies (48,000 per year)--more than any other State.

Table 20.--Damaged colonies for which indemnity payments were made as a percent of total State colony population and colonies registered with ASCS, 1972-74 average for 8 selected States 1/

State	Degree of damage to honey bee colonies					
	Percent of total State colony population			Percent of colonies registered with ASCS 2/		
	Destroyed	Severe	Moderate	Destroyed	Severe	Moderate
	Percent			Percent		
Arizona	5.2	36.2	21.9	7.4	51.5	31.2
California	0.3	2.7	6.6	1.2	10.3	25.0
Florida	0.1	0.2	0.2	4.7	7.1	8.4
Georgia	1.2	6.7	2.3	4.4	23.7	8.0
Idaho	0.6	10.2	6.7	1.1	18.0	11.9
Mississippi	0.6	5.8	5.0	3.0	27.1	23.1
Texas	0.2	1.0	3.2	1.2	4.9	16.5
Washington	0.8	27.1	12.5	1.5	52.7	24.3
All 8 States	0.6	5.6	5.0	2.3	22.5	20.2

1/ As of March 1, 1976.
2/ Colonies registered with ASCS by beekeepers who received indemnity payments.

Source: Compiled from statistics of the U.S. Department of Agriculture, Statistical Reporting Service (SRS) and the Agricultural Stabilization and Conservation Service (ASCS).

In contrast, beekeepers in Florida who maintain about 360,000 colonies of bees report indemnity claims on less than 0.5 percent of their bees yearly. Damage is minimized because after pollinating the citrus crops, beekeepers have adequate locations in Florida where they can yard their bees to reduce contact with pesticides. On the other hand, most beekeepers in California and Washington lack access to forage areas where they can place their bees to avoid contamination.

To determine whether the degree of colony damage differs by size of operation, indemnity claims for beekeepers in the eight States were categorized into two size groups. As shown in table 19, beekeepers maintaining 1,000 or more colonies of bees during 1972-74 did, in fact, file claims that indicated a smaller percent of destroyed and severely damaged colonies. This difference is probably attributable to better management by large beekeepers, both in placement of bee yards to minimize contact with pesticides and in movement of bees upon receiving notice of planned chemical application at or adjacent to their bee yards.

Largest Indemnity Payees

Twenty beekeepers have received indemnity payments totaling more than $4.6 million for pesticide damage to bee colonies from 1967 to 1974 (table 21). This is about 28 percent of the payments paid nationwide to beekeepers for bee losses. The top 5 beekeepers (ranked according to the total payments received over the 1967-74 period) accounted for about 15 pe

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percent of the indemnity payments. The largest indemnity payment paid to an individual beekeeper was $225,400 in 1972. The same beekeeper claimed damages in 1974 estimated at $228,000 which still remain subject to approval.

The twenty largest payees have registered about 117,200 colonies of bees per year with ASCS, 1972-74, or nearly 5,860 colonies per beekeeper (table 22). This is 3 percent of all bee colonies in the United States and 6 percent of those operated by beekeepers with 300 or more colonies.

Table 21.--Concentration of indemnity payments for the twenty largest payees, 1967-74

Year	Payee rankings							
	Top 5		Top 10		Top 15		Top 20	
	Dollar payments	Percent	Dollar payments	Percent	Dollar payments	Percent	Dollar payments	Percent
	(1,000)		(1,000)		(1,000)		(1,000)	
1967	273	15.5	364	20.7	476	27.1	537	30.6
1968	322	19.7	396	24.3	503	30.8	598	36.7
1969	311	18.8	374	22.5	429	25.8	499	30.0
1970	282	17.0	383	23.2	468	28.3	526	31.8
1971	582	18.0	748	23.1	878	27.1	1,051	32.4
1972	379	17.7	551	25.7	604	28.1	655	30.5
1973 1/	331	19.8	483	28.8	532	31.7	561	33.4
1974 1/	394	13.0	574	18.9	666	22.0	703	23.2
Total 2/	2,427	14.5	3,426	20.4	4,108	24.5	4,683	27.9

1/ Includes an estimated value for 1 beekeeper.
2/ Estimated amounts not included.

Source: Compiled from Statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

Table 22.--Colony damage claimed by twenty beekeepers receiving the largest total indemnity payments, 1972-74.

Payee Rankings	Year					
	1972 1/		1973 1/		1974	
	Colonies Registered	Percent Damaged	Colonies Registered	Percent Damaged	Colonies Registered	Percent Damaged
Top 5	57,417	64.4	54,239	81.3	55,612	49.9
Top 10	87,304	65.8	84,013	79.2	83,083	52.2
Top 15	99,751	63.0	96,496	74.4	98,781	51.9
Top 20	119,428	57.4	114,732	65.4	117,171	45.9

1/ For 1972 and 1973, the number of damaged colonies could exceed registered colonies due to multiple claims.

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

In Arizona, five beekeepers received $1,043,431 in indemnity payments for pesticide damage (1967-74). During 1972-74, these five beekeepers registered 41,441 bee colonies with ASCS and received indemnity payments totaling $394,451. This amounts to a payment of $9.50 per colony registered. One of these beekeepers registered 9,505 bee colonies (1972-74) and filed multiple indemnity claims for 14,533 damaged colonies which resulted in payments of $122,510--about $12.89 per registered colony.

For the twenty largest payees, the proportion of registered colonies damaged was greatest in 1972 and 1973. During this period, beekeepers could make multiple claims on a colony if it was damaged more than once during the year. In fact, one beekeeper in Arizona received payments for damage to 153 percent of the colonies he registered with ASCS from 1972 to 1974. In 1974, most of the large payees suffered damage to about 50-55 percent of their colonies. Though damages of this magnitude may appear

excessive, they are in line with those experienced by other beekeepers in Arizona and Washington who received indemnity payments. Thus, it appears that the twenty largest payees have received substantial indemnity payments simply because they maintain a large number of honey bee colonies.

The economic impact that the Beekeeper Indemnity Payment Program has made on the beekeeping industry and potential adjustments to program expiration are assessed in the remainder of this report. The analysis assumes that a viable beekeeping industry, particularly to supply pollination services, is a necessary prerequisite for the commercial production of a wide variety of agricultural products. Further, it is assumed that the primary objective of the Indemnity Program is to assist in maintaining an adequate number of bee colonies in the U.S. by providing some compensation to beekeepers who claim damages for bees poisoned by pesticides. A corollary assumption is that maintenance of U.S. honey production is of less concern because foreign honey and manufactured sweeteners are readily available.

Pesticide Damage Centralized

Records of indemnity payments indicate that the pesticide problem, though prevalent throughout the Nation, is centered in a few major agricultural areas. During 1972-74, the highest percent of indemnified colony damage was suffered by bee colonies headquartered in Washington and Arizona. About 40 to 60 percent of the bee colonies in these two States, respectively, were damaged by pesticides each year over the three year period (table 23). At the same time, Idaho beekeepers suffered damage to 18 percent of their colonies and beekeepers in California, Georgia, and Mississippi incurred 10 percent damage. However, California beekeepers have received the largest total amount of indemnity payments due to the large bee population in the State. For the remainder of the Nation, less

than 3 percent of the bee colonies have suffered pesticide damage indemnified under the Beekeeper Program.

From recent discussions with beekeepers, State officials, and ASCS personnel in Arizona, California, and Washington, it is generally agreed that the Indemnity Program has provided the financial assistance necessary to keep most beekeepers in business after suffering extensive colony damage from pesticides. Without indemnity payments, the sizable expense associated with restocking severely damaged and destroyed colonies and the lower volume of earnings from reduced honey yields could force many operators out of the commercial beekeeping business.

Table 23.--Percent of colonies damaged by pesticides, 8 selected States and remainder of United States, 1972-74 1/

State	Period			Average
	1972	1973	1974	
	Percent of colonies			
Arizona	71.2	58.2	60.7	63.2
California	11.3	7.8	9.7	9.6
Florida	0.8	0.1	0.4	0.4
Georgia	8.2	8.5	14.1	10.3
Idaho	19.1	18.9	14.5	17.5
Mississippi	8.4	12.6	13.3	11.4
Texas	4.2	4.7	4.4	4.4
Washington	51.6	31.6	37.3	40.3
All 8 States	12.7	9.8	11.2	11.2
Remaining States	2.1	2.1	2.7	2.3

1/ As of March 1, 1976.

Source: Compiled from statistics of the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS).

On the other hand, some commercial beekeepers contend the indemnity payments have permitted, and in some cases encouraged, the survival of marginal beekeeping operations. The "marginal manager," in this context, was characterized as any beekeeper who had become dependent upon indemnity payments as a source of revenue. Usually, these individuals do not employ the latest beekeeping practices and technology to lower production costs. When notified of impending spray application near, or adjacent to, their bee yards they are more likely to leave their hives in the yards and chance receiving only minimal pesticide damage. Consequently, bees of "marginal beekeepers" are more inclined to be weaker and provide a poor job of pollination. In a weakened condition, these bees are prime targets for infectious diseases.

Several large commercial beekeepers in California claimed the Indemnity Program was not essential to the continued viability of their operations. These operators worked closely with farmers and spray applicators to minimize pesticide damage. They also had access to alternative forage locations in national forests, neighboring States, and foothills that are relatively safe from sprays. However, other beekeepers claim they have no safe alternative locations. They say, "all the permits for national forest land have been issued," "we cannot locate in neighboring States which maintain registered bee locations," and "more and more people are buying land in the foothills for development."

Beekeepers further state that most pesticide damage occurs when bees are foraging in crops which are not being pollinated for a fee. Generally, farmers who rent bees for pollination schedule their spray applications so as to minimize damage to the colonies.

For commercial beekeepers in Arizona and Washington, pesticides pose a much more serious economic impact. Each commercial beekeeper interviewed in Washington claimed his economic survival depended upon the Indemnity Program. Yakima and Grant Counties are intensively irrigated and produce a diversity of crops. Thus, these two counties form the center of commercial beekeeping activity in Washington. Since the only bee pasturage available in this area is irrigated agricultural crops, these beekeepers have little escape when toxic sprays are applied. Consequently, the continual exposure to pesticides generally produces a high degree of colony damage. From 1972 through 1974, about 69 percent of the claims paid in Washington were for severely damaged or destroyed colonies (table 17).

Implications for Beekeepers

To estimate the financial impact that expiration of the Beekeeper Indemnity Program could have on the beekeeping industry in general, and beekeepers in particular, the cost and returns data collected by the U.S. International Trade Commission are examined further. The analysis assumes the data are representative of the financial attributes of commercial beekeeping operations in the designated States.

The estimated average net cash income per colony in seven of the study areas are shown in table 24. The income was computed from data shown in Appendix C, table 14. However, the estimates of "total beekeeping expense" reported by the Commission were adjusted to include a charge for management and interest on investment comparable to the amount reported in the budgets developed by Reed and Horel (1976). No charge was calculated for unpaid family labor. As such, these financial data portray the beekeeping

Table 24.--Income and expenditures of selected U.S. beekeepers, by State or area, 1971-75 average

State or area	Income				Total beekeeping income	Total beekeeping expense 1/	Net beekeeping profit or (loss) before income taxes	
	Honey and beeswax	Package bees and queens	Pollination fees	Other income			with indemnity payments	without indemnity payments
	Dollars per colony				Dollars per colony		Dollars per colony	
Arizona . . .	14.05	0.84	2.50	11.02	28.41	25.23	3.18	(7.67)
California. .	25.86	0.25	13.30	2.89	42.30	35.37	6.93	5.49
Florida . . .	63.77	----	0.28	0.02	64.07	62.64	1.43	1.41
Georgia . . .	23.28	0.92	----	1.24	25.44	16.52	8.92	8.58
Idaho	18.84	0.02	0.70	1.05	20.61	16.85	3.76	2.71
Texas	24.58	15.59	0.55	0.24	40.96	33.20	7.76	7.52
Oregon and Washington.	25.18	0.01	10.60	6.91	42.70	36.81	5.89	(0.81)

1/ Management was costed at 5 percent of total beekeeping income.

Interest on investment was costed at 8 percent of the average value-cost or half of new cost in the case of depreciable items. For all 7 States or areas this cost was assumed to be $3.86 per colony as reported by Reed and Horel (1976).

Source: Compiled from data collected by the U.S. International Trade Commission.

industry as providing a positive return to unpaid labor during the 1971-75 period.

Average net income per colony (before income taxes) ranged from $3.18 in Arizona to $8.92 in Georgia. As expected, pollination fees are an important source of revenue to beekeepers in California and Washington as is honey to Florida beekeepers. However, indemnity payments also add significantly to the total income of beekeepers in several States. Assuming these payments represent most of the income reported as "other income" in the Commission's data (as shown in Appendix C, table 14) for the years 1972-75, they are estimated to account for about 16 percent of the total beekeeping income in Washington and 40 percent in Arizona. 8/

The estimates of average net income further indicate that many beekeepers in Arizona and Washington would sustain a long-run economic loss if they did not receive indemnity payments. Unless these losses could be recovered through the market system by increasing pollination fees, the number of bee colonies located within these hazardous areas would be expected to decline substantially.

While it appears that the beekeeping industry in most States could survive without the Indemnity Program, this is no consolation to those beekeepers who suffer serious colony damage and loss of income. To estimate the effect of various levels of colony damage on beekeeping income, a sensitivity analysis was conducted for beekeepers in California

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8/ Since most indemnity payments (including those that were retroactive) were not paid until 1972, it was assumed that "other income" reported by the Commission for 1971 contained few indemnity payments. Consequently, indemnity payments in 1972 through 1975 for the selected States were assumed to be approximately equal to the "other income" reported for 1972-1975 minus "other income" for 1971.

and Washington. This analysis determined the various combinations of damage (moderate, severe, destroyed) which would provide beekeepers with zero return to their unpaid family labor.

Using the financial data in Appendix C, table 14, estimates of income and expense for beekeeping operations in the two States were computed for 1975. The total operating expenses were adjusted to include a charge for management, interest on investment, and the cost of replacing damaged colonies. Income was reduced to reflect lower honey yields and reduced colony strength for pollination associated with weakened bees. The estimated cost to replace damaged colonies are shown in table 25. For all three levels of damage, the estimated replacement expenses exceed the payment limitations established by the Indemnity Program.

Table 25.--Estimated cost to replace damaged colonies, 1975

Item	Degree of colony damage		
	Moderate	Severe	Destroyed
	Dollars per colony		
Bees	1/ 5.00	2/ 10.00	3/ 16.00
Feed	4/ 4.12	5/ 8.25	13.75
Labor	4/ 2.03	5/ 4.00	6.75
Total cost	11.15	22.25	36.50
Present indemnity rates	7.50	15.00	22.50

1/ Includes cost of 1 pound bees.
2/ Includes cost of 2 pound bees.
3/ Includes cost of 2 pound bees with queen.
4/ 30 percent of cost of destroyed colony.
5/ 60 percent of cost of destroyed colony.

According to Commission data for 1975, net income (return to unpaid family labor) per colony averaged about $7.60 in California and $1.20 in Washington. This income differential reflects the higher honey yields and greater opportunities for pollination fees in California. It should be noted here, however, that the high level of colony damage experienced by Washington beekeepers is largely responsible for their lower honey yields. If colony damage was more uniform between California and Washington there would be less difference between the average income per colony in the two States. Consequently, the income estimates in this section are low, especially in Arizona and Washington, for beekeepers who suffer minimal colony damage.

A few of the many combinations of colony damage which are estimated to provide zero return to unpaid labor are shown in tabel 26. In California, beekeepers who do not receive indemnity payments could suffer moderate damage to about 52 percent of their colonies before incurring a negative average net return. This assumes no severe damage or destroyed colonies. If the colonies suffer only severe damage, injury to over 16.7 percent would provide negative returns. Beekeepers receiving indemnity payments in California could earn a positive return of about $0.41 per colony for their unpaid labor even if all the colonies were moderately damaged. However, returns become negative if more than 25 percent of the colonies are severely damaged or 17 percent destroyed.

During 1972-1974, less than 7 percent of all bee colonies in California received moderate damage and 3 percent were destroyed or severely damaged (table 20). Comparing this level of injury with data in table 26, it is evident why many beekeepers in California claim they could absorb moderate

Table 26.--Sensitivity of beekeeping income to various levels of colony damage, Arizona and Washington, 1975

State	Degree of damage to honey bee colonies: Moderate	Severe	Destroyed	Net beekeeping income per colony
	Percent of colonies damaged			Dollars
California				
With Indemnity Payments				
	100.0	0.0	0.0	0.41
	90.0	3.7	0.0	0.00
	90.0	0.0	2.5	0.00
	0.0	24.8	0.0	0.00
	0.0	0.0	16.6	0.00
Without Indemnity Payments				
	51.9	0.0	0.0	0.00
	20.0	10.3	0.0	0.00
	0.0	16.7	0.0	0.00
	0.0	0.0	11.2	0.00
Washington				
With Indemnity Payments				
	18.8	0.0	0.0	0.00
	0.0	4.6	0.0	0.00
	0.0	0.0	3.0	0.00
Without Indemnity Payments				
	8.7	0.0	0.0	0.00
	0.0	2.9	0.0	0.00
	0.0	0.0	1.9	0.00

damages as a normal part of their operating expenses. Even the beekeepers who registered for the Indemnity Program and received damage to about 37 percent of their colonies could earn a small return for the family labor.

Using the same type of sensitivity analysis for beekeeping income in Washington, it becomes evident that indemnity payments have been a significant factor in maintaining a relatively stable population of bees in the face of extensive colony losses. Without indemnity payments, net returns to unpaid family labor become negative whenever more than 9 percent of the colonies are moderately damaged; or 3 percent severely damaged; or 2 percent destroyed (table 26). However, (with payments) moderate damage may be suffered by about 19 percent of the colonies or severe damage to 5 percent before negative returns are attained.

The data presented in table 26 were used to construct figures 6-9 which show all the various combinations of colony damage in California and Washington which provide zero returns. The levels of severely damaged and destroyed colonies are measured on the horizontal and vertical axis, respectively. A constant level of moderate damage is measured along each diagonal. A value at the intersection of the horizontal axis and a diagonal indicates no colonies destroyed. A value at the intersection of the vertical

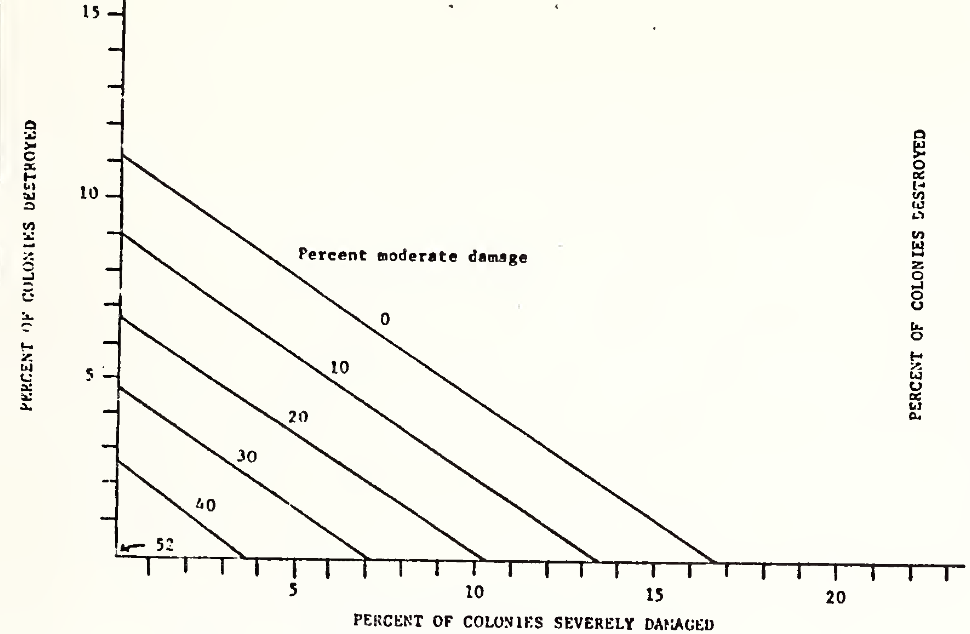

Figure 6.--Levels of colony damage providing zero return to unpaid family labor (without Indemnity Payments), California, 1975

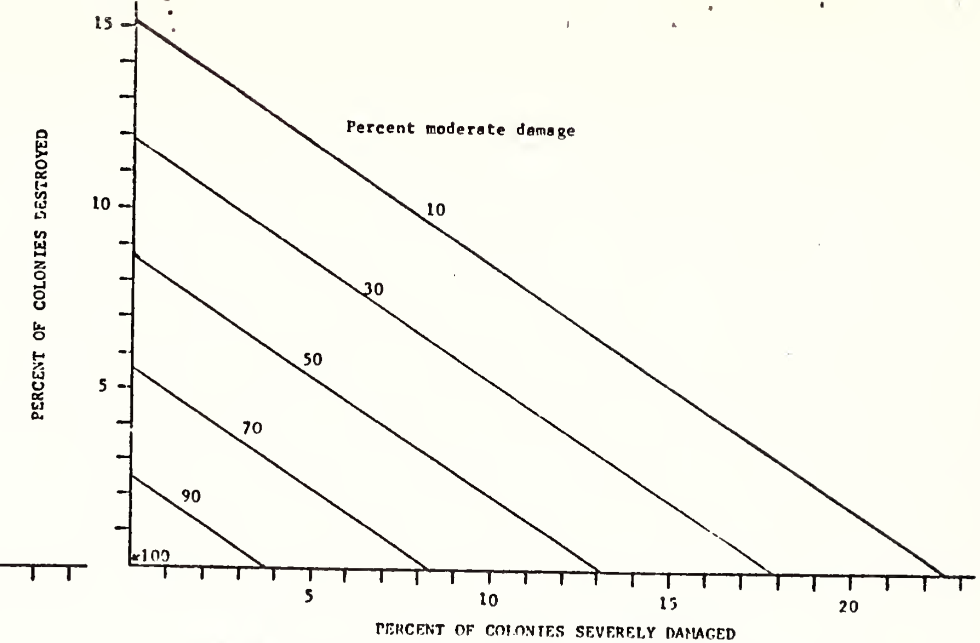

Figure 7.--Levels of colony damage providing zero return to unpaid family labor (with Indemnity Payments), California, 1975

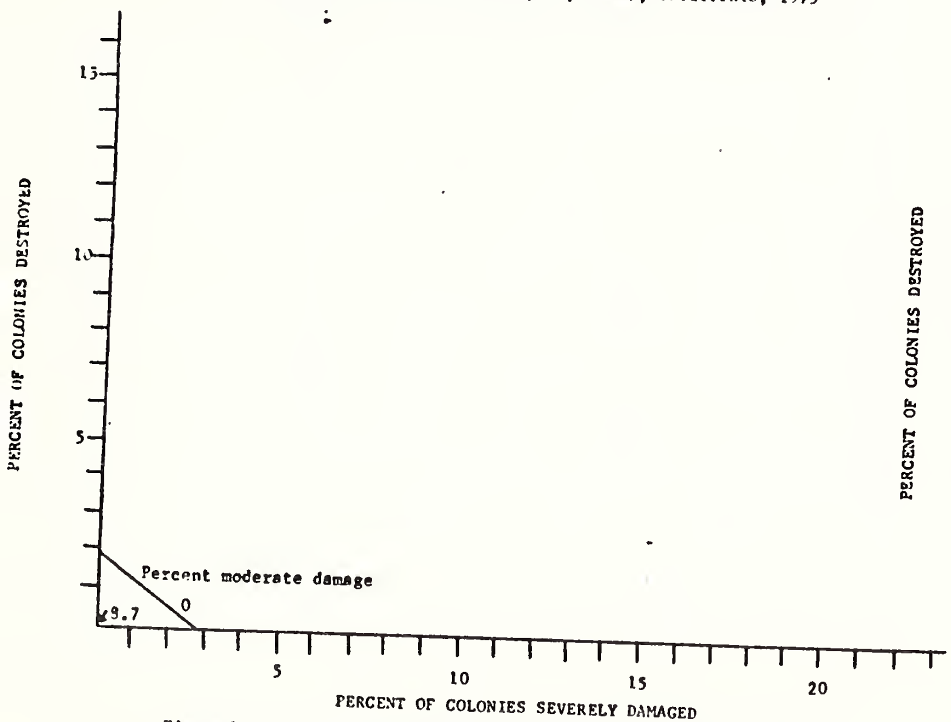

Figure 8.--Levels of colony damage providing zero return to unpaid family labor (without Indemnity Payments), Washington, 1975

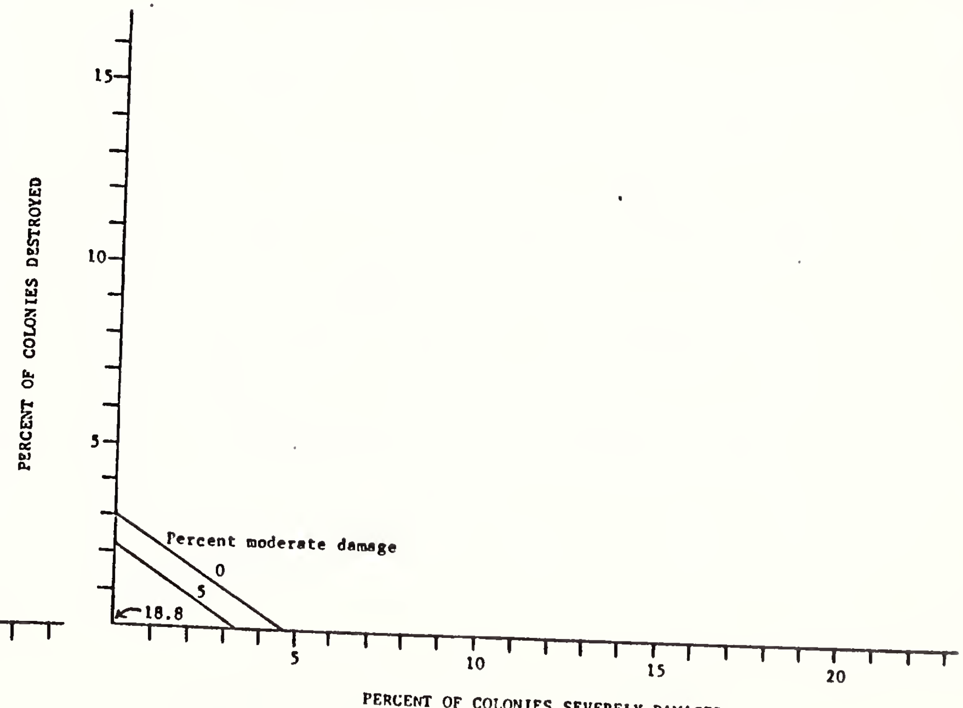

Figure 9.--Levels of colony damage providing zero return to unpaid family labor (with Indemnity Payments), Washington, 1975

axis and a diagonal indicates no severe damage. A value at the origin indicates only the specified level of moderate damage with no colonies severely damaged or destroyed.

This analysis shows that beekeeping income is affected most by severely damaged and destroyed colonies. Severely damaged colonies may require 6-8 weeks to recover colony strength. If the damage occurs during a major honey flow, the field force will be greatly reduced and honey yields could be lowered 60 percent or more. Severe damage in late summer may weaken a colony preparing for winter and increase the chances for significant winter kill. Unless the hive is restocked in early spring to buildup colony strength, it will provide inadequate pollination services. When a colony is destroyed, honey yields may be reduced up to 80 percent or more. If these colonies are not restocked or combined with other weak hives, bees from neighboring hives may rob all the honey and wax moths can cause a substantial loss of combs and bee equipment. Beekeepers estimate it takes about one year for a destroyed colony to regain its income earning potential.

Since damages claimed by Washington beekeepers, and a few beekeepers in other States, far exceed those levels estimated to provide zero returns in the long-run, it is evident many of these beekeepers are incurring an economic loss on their beekeeping enterprise. Consequently, the question may be raised as to how these beekeepers can remain in business. For many beekeepers, cash income exceeds cash expenditures which allows for payment of the variable operating expenses and also provides revenue to cover some of the family living expenses. Other beekeepers may have alternative sources of income. Also, with low incomes from beekeeping there is virtually no market for beekeeping equipment, so the operators remain in business and hope that income

will improve in the future. However, regardless of how these beekeepers manage to remain in business, few have the capital to make long-run improvements in buildings and equipment or expand the number of colonies managed.

Requisite Market Adjustments

Many individuals, besides beekeepers, are concerned about the potential economic effects associated with expiration of the Beekeeper Indemnity Payment Program. Fruit and vegetable producers need an adequate supply of bees for pollination. Legislative and policy officials as well as consumers are concerned that the Nation's food and fiber be produced and marketed as efficiently and cheaply as possible. For the operations of commercial beekeepers, the future depends upon 1) the price of honey and pollination fees relative to production costs, 2) the availability of adequate bee pasturage that is relatively safe from pesticides, and 3) the level of pesticide damage to bee colonies.

In the absence of any form of subsidy, beekeepers must turn to the market system to recover the added cost of operating in areas where there is a high risk of having bees contaminated with pesticides. This adjustment would need to come in the form of higher prices for honey and/or pollination fees—packaged bees and beeswax provide only minimal income for most beekeepers.

During 1972-74, Washington beekeepers received indemnity payments totaling $1.22 million for damages to 114,500 colonies of honey bees. Over the same period of time, these beekeepers registered 145,800 colonies with ASCS to be eligible for indemnity payments. Assuming each registered colony produces 40 pounds of honey (the 1972-74 average yield per colony in Washington) for

market, the price of honey would need to rise about $.21 per pound to compensate Washington beekeepers at a level comparable to the amount of indemnity payments actually received.

However, a substantial rise in honey prices above the 1975 average of 51 cents per pound would likely have little impact on the number of bee colonies available for pollination. The majority of any expansion would probably be from hobbyists and a few commercial beekeepers that would select safer locations outside the main pollination areas. Any increase in honey production would act to lower honey prices. Also, many of the fruit and vegetable crops requiring pollination provide only small quantities of nectar which is needed for honey production.

Without indemnity payments, the most significant loss of honey bees would occur in the extensive agricultural areas where large quantities of toxic chemicals are applied to the fruit and vegetable crops. Consequently, farmers seeking pollination services would have to pay substantially higher rental fees to obtain bees.

Based on indemnified colony damage suffered in Washington from 1972 to 1974 by registered beekeepers, rental rates would need to rise from the 1976 level of $10-$15 to a level of at least $20-$25 per colony to compensate beekeepers at a level of colony damage comparable to that of the 1972-74 period. This assumes that 80 percent of the colonies registered with ASCS are used for pollination. In California, a $4 increase in pollination feeds would provide compensation comparable to indemnity payments made over the 1972-74 period.

As was shown in table 25, indemnity payments do not cover the estimated cost actually incurred by beekeepers to replace damaged colonies. Consequently, based on the levels of damage reported in Washington over the 1972-74 period, rental rates would need to increase about $19 per colony above the 1976 rate if all replacement costs are to be recovered. In California, a $7 increase above 1976 rental fees would recover replacement costs.

Given that pollination fees are a very small part of the total cost to produce most agricultural crops requiring pollination, it is likely that farmers would bid polination rental fees upward to assure adequate supplies of bees. The impact of the higher pollination fees (should the Indemnity Program be terminated) likely to be added to the cost of producing selected fruit, nut, and berry crops requiring pollination in California and Washington is shown in table 27. In Washington, apple producers could expect to pay $5 to $7.50 more per acre for pollination services in the absence of an Indemnity Program. This is based on placement of one-half to three-fourths colony per acre of orchard at $10 more per colony. With a yield of 465 boxes of apples per acre (37 pounds per box), the higher rental fees would add only 1 to 2 cents per box to the total production cost. For a yield of 700 boxes per acre, production costs would be increased 1 cent or less per box. In California, almond producers using 2 to 3 colonies per acre could pay $8 to $12 more per acre for pollination services. This would add about $0.60-$1.00 to the cost per hundredweight of unshelled almonds or $1.08-$1.62 per hundred pounds of meat. On a hundredweight basis, the added cost of producing most of the major pollinated crops in California and Washington would be less than 10 cents.

Table 27.--Estimated impact of increased pollination fees on the total cost of producing selected crops, California and Washington, 1975

State and crop	Colony placement	Increased cost of pollination to growers 1/	Production 2/	Increased production cost per unit of output for pollination	1975 market price 3/
	Colonies per acre	Dollars per acre	Pounds per acre	Dollars per cwt.	Dollars per cwt.
California					
almonds 4/	2 - 3	8.00 - 12.00	1,245	.60 - 1.00	36.25
cantaloups	1 - 2	4.00 - 8.00	12,700	.03 - .06	15.30
cherries	1 - 2	4.00 - 8.00	5,655	.07 - .14	36.80
peaches	1	4.00	21,398	.02	10.00
pears	1 - 2	4.00 - 8.00	18,747	.02 - .04	8.10
plums & prunes	1	4.00	8,923	.04	6.85
Washington					
apples	1/2 - 3/4	5.00 - 7.50	17,234	.03 - .04	10.60
cherries	1 - 2	10.00 - 20.00	6,480	.15 - .31	23.95
peaches	1	10.00	10,495	.10	9.10
pears	1 - 2	10.00 - 20.00	12,711	.08 - .16	6.75
plums & prunes	1	10.00	4,534	.22	5.80

1/ The cost assumes an increase in pollination fees of $4 per colony in California and $10 per colony in Washington above 1976 rental rates with termination of the Beekeeper Indemnity Payment Program.
2/ Most yields were computed from the 1969 Census of Agriculture, Volume V, part 6, Fruits, Nuts, Berries.
3/ Market prices were taken from Noncitrus Fruits & Nuts, 1975 Annual Summary, U.S. Department of Agriculture, Statistical Reporting Service, 1976.
4/ In-shell basis.

Bee pasturage which is relatively isolated from toxic pesticides cannot be developed in sufficient acreage to provide sanctuary for the thousands of colonies needed each year in the U.S. for pollination. An undertaking of this magnitude would cost Federal and State taxpayers millions of dollars to lease or purchase available land and plant the variety of crops needed to sustain a large number of bees. However, on a very limited scale, some beekeepers have purchased farmland for bee placement.

Unless Federal and State governments act to regulate and caution applicators of toxic pesticides, colony damage will continue to be a major problem for beekeepers. However, most government officials emphasize that farmers and spray applicators are already confronted with enough regulations which control the usage of toxic chemicals. Also, the current development of stronger and longer-lasting pesticides to combat insect and disease problems is creating an environment entirely unsuitable for honey bees in many parts of the U.S. These areas will find it harder to maintain the present level of bee population regardless of an Indemnity Program or higher honey and pollination prices. In fact, even with the present Indemnity Program, important beekeeping States like Arizona, California, Texas, Florida, and Georgia have shown virtually no gain in colony population in recent years.

Program Management and Potential Modifications

Operation and management of the Beekeeper Indemnity Payment Program has been a difficult task for ASCS. Management of the Indemnity Program In California and Washington, like many other States, has been divided between Federal and State regulatory agencies. In California, the division has been between county agriculture commissioners and local ASCS officials. Beekeepers

have expressed strong dissatisfaction with this arrangement because they have received differential treatment between counties in the assessment of colony damage. Beekeepers say, "a moderate loss in one county may not even qualify for indemnity payment in another county." The division in Washington has been between State bee inspectors and the local ASCS officials. This arrangement has also removed control of the program from ASCS and virtually given the State bee inspectors complete freedom in assessing damaged colonies.

In an attempt to provide more uniform inspections between counties and to minimize the chance for approving fraudulant claims, ASCS personnel have assumed total internal management of the Indemnity Program. In discussions with beekeepers in California and Washington during June 1976, they expressed satisfaction with this proposed administrative change.

Some beekeepers have suggested that a colony strength assessment is necessary at the time of registration to provide an equitable basis to measure the actual loss of bees and brood. Pesticide damage to strong colonies is more costly to a beekeeper than losses suffered by weak colonies even though both may receive the same amount of indemnity payment. The strength of a colony affects its ability to withstand and recover from exposure to pesticides and disease. Fruit and vegetable growers prefer strong colonies for pollination because they send out a large field force.

ASCS inspectors in Washington now require a minimum of 400 square inches of brood before July 1 and 600 square inches of brood after July 1 to qualify for any indemnity payment on a particular colony. The inspectors have indicated that this determination can be made with reasonable accuracy at the time of inspection for registration. It would seem reasonable that this guideline could be expanded to establish different amounts of coverage for

various strength counts.

Recording and monitoring the location of colonies has been difficult because of the necessity to move bees from one bee yard to another either to provide pollination services for various crops or to escape pesticide contamination. The practice of branding hives at registration is a possibility that has been used in several instances; however, this activity is time consuming and would generate prohibitive administrative costs. An alternative could be the random sampling of bee yards by ASCS inspectors to authenticate the number of colonies registered by each beekeeper. Beekeepers could also be required to notify local ASCS offices of any colony movement.

To reduce the government expenditure for indemnity claims, part of the cost could be shifted to beekeepers and crop producers and allocated via the market system. An option is to change the character of the current Indemnity Program from that of a general subsidy to a disaster program. This would simply require limiting payments to severely damaged and destroyed colonies.

During 1972-74, about 44 percent of the indemnity claims were for moderate damage (table 19). Elimination of these payments would have reduced the program outlay by about one-fourth or $1.8 million over the three year period. However, a weakness of this program change is that with the subjective nature of damage assessment, a portion of the moderate losses could be shifted into the severe category and actually increase total payments. The increase in total payments would occur, in fact, if over 50 percent of the moderately damaged colonies were actually inspected as being severely damaged—moderately damaged colonies currently receive $7.50 and severely damaged colonies receive $15.00. Consequently, a change in the present program to eliminate claims for moderate damage should be accompanied with rigid guidelines for classifying severely damaged and completely destroyed colonies.

APPENDIX A
TOXICITY OF PESTICIDES

TOXICITY OF PESTICIDES

Hundreds of pesticides have been tested as sprays or dusts to measure the relative degree of hazard to bees. Following are grouped the basic types and classes of pesticides and their potential effect on honey bees.

Insecticides

Insecticides affect bees as stomach poisons, as contact materials, and as fumigants. Arsenicals are typical stomach poisons; pyrethrum is a contact insecticide; and carbon disulfide, hydrogen cyanide, and paradichlorobenzene are examples of fumigants.

Botanicals.--Only a small number of insecticides are derived from plants. These sources include cube, derris, nicotine, pyrethrins, ryania, sabadilla, and tephrosia. The bulk of this material is used in household and garden spray. Consequently, it presents no hazards to pollinating insects because of its inaccessibility to bees or the relatively minute amounts utilized. Sabadilla dust is sometimes used on citrus crops where it can create a bee poisoning problem.

Occasionally, bees are poisoned by feeding on nectar and pollen of certain toxic plants. These include California buckeye, locoweed, and mountain laurel. However, reaction of bees to these plant poisons can usually be differentiated from those caused by most sprays.

Inorganics.--These pesticides include arsenicals, fluorides, mercury compounds, and sulfur. The limited use of the mercury compounds precludes their presenting a hazard to bees. Elemental sulfur alone or when combined with other insecticides in the field may present only a slight repelling action, although fumes from burning sulfur are highly toxic to bees. Fluorides are rarely used on a large scale and present no problem. Arsenicals

pose a serious threat to bees whenever they are contacted.

Organics.--The chlorinated hydrocarbons, organophosphates, and carbamates vary in their toxicity to bees from relatively nonhazardous to highly hazardous. The degree of toxicity depends upon the individual material or combination of materials.

Pathogens: bacteria, protozans, and viruses.--None of these that are currently recommended or that have been tested for biological control pose a hazard to bees (Cantwell, Lehnert, and Fowler, 1972).

Defoliants, Desiccants, and Herbicides

This class of materials has been shown to be nonhazardous to bees, except for their removal of the food source from the plant. However, Morton et al. (1972) reported that paraquat, MAA, MSMA, DSMA, hexaflurate, and cacodylic acid were extremely toxic when fed to newly emerged worker honey bees at 100 and 1,000 ppm concentrations. Although newly emerged bees do not forage away from the hive, they consume food collected by other bees.

Diluents, Synergists, and Activators

Information on the influence of these agents on the toxicity of the primary pesticides on honey bees is limited. Possibly different interpretations of the effects of certain pesticides may have been associated with the materials with which they were applied.

Fungicides

When applied as directed, the copper compounds, mercury compounds, pentachlorophenol, sulfur, and zineb have caused no damage to bees.

Other Agents

Hormones, attractants, and sex lures usually cause no trouble to bees. Occasionally, a few honey bees and bumble bees may be found in Japanese beetle traps. Research is being undertaken to develop biological agents for controlling harmful insects on crops. This would be welcomed by beekeepers as it could allow bees to forage with safety and effectively pollinate the crops. A listing of pesticides grouped according to relative toxicity to honey bees is shown in Appendix A, table 1.

TABLE 1.—*Relative toxicity of pesticides to honey bees as determined by laboratory and field tests in California, 1950-71 (Source: Anderson et al. 1971).*

GROUP 1—HIGHLY TOXIC: Severe losses may be expected if the following materials are used when bees are present at treatment time or within a day thereafter, except as indicated by footnotes.

- aldrin[2]
- arsenicals[1 2]
- Azodrin® (crotonamide)[1 2]
- Baygon®
- Baytex® (fenthion)
- BHC[2]
- Bidrin®[1 2]
- Bux® (RE-5353)
- Chlorthion®
- Cygon®, DE-FEND® (dimethoate)[2]
- Dasanit® (fensulfothion)
- DDVP (dichlorvos)
- diazinon[2]
- Dibrom® (naled)[2 3]
- dieldrin[1 2]
- Dimecron® (phosphamidon)[2]
- Dursban®[2]
- EPN[1 2]
- Ethyl Guthion® (azinphosethyl)[2]
- Famophos® (famphur)
- Furadan®[2]
- Gardona®[2]
- Guthion® (azinphosmethyl)[1 2]
- heptachlor[1 2]
- Imidan®
- Lannate® (methomyl)[2]
- lindane[2]
- malathion[2 4]
- Matacil®
- Mesurol®
- Metacide®[1]
- methyl parathion[1 2]
- Methyl Trithion®
- Mobam®
- Monitor®[2]
- parathion[1 2]
- Phosdrin® (mevinphos)[1 2 3]
- Sevin® (carbaryl.)[2]
- Sumithion®
- Temik® (aldacarb)[1 2 7]
- TEPP[1 2 3]
- Zectran®[2]
- Zinophos®

GROUP 2—MODERATELY TOXIC: These can be used around bees if dosage, timing, and method of application are correct, but should not be applied directly to exposed bees in the field or at the colonies.

- Abate®,[2] Biothion®
- Agritox®
- Banol®
- Carzol® (formetanate)[2]
- chlordane[2]
- Ciodrin®
- Co-Ral® (coumaphos)
- DDT[1 2]
- Di-Syston® (disulfoton)[1 6]
- endothion
- endrin[1 2]
- Korlan® (ronnel)
- Meta Systox® (methyl demeton)
- Meta-Systox R® (oxydemeton-methyl)
- mirex
- Perthane®[2]
- Phosalone®
- Phosvel®, Abor®[2]
- Pyramat®
- Systox® (demeton)[1 2]
- tartar emetic
- Thimet® (phorate)[1 2 6]
- Thiodan® (endosulfan)[2]
- Trithion® (carbophenothion)[2]

GROUP 3—RELATIVELY NONTOXIC: These can be used around bees with a minimum of injury.

INSECTICIDES

- Acaraben® (chlorobenzilate)
- Allethrin
- Aramite®
- *Bacillus thuringiensis*
- cryolite[2]
- Delnav® (dioxathion)[2]
- Dessin®
- Dilan®[2]
- Dimite® (DMC)
- DNOCHP (dinitrocyclo-hexyphenol)
- Dylox® (trichlorfon)[2]
- Eradex®
- Ethodan® (ethion)[1 2]
- Fundal®, Galecron® (chlorophenamidine)
- *Heliothis* virus
- Kelthane® (dicofol)[2]
- Kepone®
- methoxychlor[2]
- Mitox® (chlorbenside)
- Morestan®
- Morocide® (binapacryl)
- Murvesco® (fenson)
- Nemagon®[2]
- Neotran®[2]
- nicotine[2]
- Omite®
- OMPA (schradan)[1]
- Ovotran® (ovex)[2]
- Phostex®
- pyrethrin
- rotenone[2]
- Rhothane® (TDE)[1 2]
- ryania[2]
- sabadilla[2 5]
- Saphos® (menazon)
- Strobane®
- Sulphenone®
- Tedion® (tetradifon)
- toxaphene[1 2]

See footnotes at end of table.

TABLE 1.—Relative toxicity of pesticides to honey bees as determined by laboratory and field tests in California, 1950-71 (Source: Anderson et al. 1971)—Continued

FUNGICIDES

- Arasan® (thiram)
- bordeaux mixture[2]
- captan
- copper oxychloride sulfate
- copper 8-quinolinolate
- copper sulfate (monohydrated)[2]
- cuprous oxide
- Cyprex® (dodine)
- Dexon®
- dichlone
- Difolatan®
- Dithane® M-45 (folcid)
- Du-TER® (TPTH)
- Dyrene®
- Glyoxide® (glyodin)
- Karathane® (dinocap)
- Manzate® (maneb)
- Mylone®
- Parzate® (nabam)
- Phaltan (folpet)
- Polyram
- sulfur[2]
- Thynon (dithianon)
- Zerlate (ziram)

HERBICIDES

- AAtrex® (atrazine)
- amitrol
- Ammate® X (ammonium sulfamate)
- Banvel® (dicamba)[1]
- Benlate® (benomyl)
- Betanal® (phenmedipham)
- Caparol® (prometryne)
- Casoron® (dichlobenil)
- dalapon
- DEF®[8]
- diquat
- Eptam® (EPTC)
- Folex®[8] (merphos)
- Herbisan® (EXD)
- Hyvar® (bromacil)
- Igran® (terbutryne)
- IPC
- Karmex® (diuron)
- Kerb® (RH-315)
- Lasso® (alachlor)
- Lorox® (linuron)
- MCPA[1]
- Milogard® (propazine)
- monuron
- NPA
- paraquat
- picloram[1]
- Planavin®
- Princep® (simazine)
- Randox (CDAA)
- Sinbar (terbacil)
- Stam F-34 (propanil)[1]
- TOK (nitrofen)
- Trysben (2, 3, 6-TBA)[1]
- VCS-438
- Vegedex (CDEC)
- 2, 4-D[1 2]
- 2, 4-DB[1]
- 2, 4, 5-T[1 2]

[1] California State regulation requires permits for most uses of these materials; also for 2,4-D and 2,4,5-T as weed treatments but not as hormone sprays on citrus.

[2] These materials have been laboratory tested and field tested mainly on alfalfa, cotton, citrus, ladino clover, and sweet corn; all others are laboratory tested only.

[3] Dibrom®, Phosdrin®, and TEPP have such short residual activity that they kill only bees contacted at treatment time or shortly thereafter. These materials usually are safe to use when bees are not in flight; they are not safe to use around colonies.

[4] Malathion has been used on thousands of acres of blooming alfalfa without serious loss of bees. However, occasional heavy losses have occurred, particularly under high temperature conditions. If applied to alfalfa in bloom, it should be only as a spray, and treatment should be made during the night or early in the morning when bees are not foraging in the field. Undiluted technical malathion spray should not be used around bees.

[5] Sabadilla as a 20-percent dust, as it is sometimes used for stink bug control, may cause bee losses.

[6] Di-Syston® and other systemics used as a seed treatment have not caused bee losses.

[7] Temik®, although highly toxic to bees as a contact poison, is used only in granular form and extensive field usage has not resulted in bee losses.

[8] Defoliants.

APPENDIX B

STATE OF CALIFORNIA
PEST CONTROL REGULATIONS
FOR PROTECTION OF BEES

State of California
DEPARTMENT OF FOOD AND AGRICULTURE

APIARY INSPECTION

October 8, 1974

Apiary Law Changes Effective January 1, 1975

29121. (a) It is unlawful for any person that has relocated any colony of bees within the state from any apiary in which disease has been found within the preceding 60 days to fail to send a notice within five days of such relocation to the commissioner of the county in which the movement originated, and a second notice to the commissioner of the county of destination if the bees are moved from one county to another. The notice shall include a statement of all of the following:

(1) The number of colonies of bees moved.
(2) The number of colonies of bees left at the point of origin.
(3) The location of the point of origin and the point of destination.
(4) The name and address of the apiary operator.

(b) Each beekeeper who desires notice of any pesticide application shall report to the commissioner of the county in which his apiaries are located, on a form approved by the commissioner, of each location of apiaries for which notification is sought. Such report shall be mailed within the 72-hour period before locating or relocating the apiaries. If the beekeeper fails to submit such written report before locating or relocating his apiaries, he shall not be entitled to notification until receipt and processing of the written report is made by the commissioner. Such report shall be a condition to the recovery of damages for any injury to such apiary by reason of any pest control operation.

(c) The commissioner shall not be required to give notice to pesticide users until such written report by the beekeeper has been received and processed by him.

29154. The inspector, if he deems it necessary, may enter any premises and make an inspection of any apiary within his jurisdiction. He shall report his inspection and findings to the beekeeper in person or by mail within five days. If any disease is found in the apiary, the inspector making the inspection shall plainly mark the hives or combs which contain evidence of disease. If the inspector finds American foulbrood disease has infected more than two hives of 99 colonies or less, or more than 2 percent of colonies of 100 or more, he shall make a complete inspection of all hives in the apiary and the owner of the hives in the apiary shall pay the cost of the complete inspection.

29245. It is unlawful for any person to maintain an apiary on premises other than that of his residence unless the apiary is identified as follows:

(a) By a sign which is prominently displayed on the entrance side of the apiary, that states in black letters not less than one inch in height on a background of contrasting color the name of the owner or person in possession of the apiary, his address and telephone number, or if he has no telephone a statement to that effect.

(b) If the governing body of the county or city in which the apiary is located has provided by ordinance for the identification of apiaries, in the manner which is prescribed in the ordinance.

Section 29247 is repealed. (This is the section on identification numbers.)

29248. The owner of any apiary equipment may apply to the director for a serial number brand for use on apiary equipment which he owns. The application shall contain the name and address of the applicant and shall be accompanied by a fee of twenty-five dollars ($25).

29252. (a) If the purchaser does not have a registered brand number, he may use a brand acquired by purchase, if a bill of sale on such purchased brand number is forwarded by registered mail to the director accompanied by a transfer fee of twenty-five dollars ($25).

(b) If the purchaser has a previously registered brand number, he may have other brand numbers transferred to his name, without charge, but he shall destroy any and all branding irons or branding devices acquired by such transfer and notify the director of such destruction.

3096. Protection of Bees. (a) No person performing pest control shall apply any pesticide known to be harmful to bees on blossoming plants in which bees are working except under the following conditions:

(1) He shall inquire of the agricultural commissioner of the county in which the work is to be done if any beekeeper has requested in writing notice of such operations for apiaries located on the property to be treated or within one mile of such property.

(2) If he is so advised by the commissioner, he shall notify the beekeeper by collect telephone or collect telegraph message, or other expedient means provided by the beekeeper and at the beekeeper's expense, of the time and place the application is to be made, of the crop and acreage to be treated, and the identity and amount of the pesticide to be applied.

(3) He shall give the notice provided for in this section prior to application of the pesticide, allowing a reasonable time, not exceeding 48 hours, to move, cover, or otherwise protect the bees; provided, however, the commissioner in his discretion may reduce such time.

(4) He shall make any such application of pesticides only during the hours and under the conditions provided in the regulations and permit, if any, of the commissioner.

(b) Each beekeeper who desires notice as provided for in this section shall report to the commissioner of the county in which his apiaries are located, on a form approved by the commissioner, of each location of apiaries for which notification is sought. Said report shall be mailed within the 72-hour period before locating or relocating the apiaries. If the beekeeper fails to submit such written report before locating or relocating his apiaries, he shall not be entitled to notification provided in this section until receipt and processing of the written report is made by the commissioner.

(c) The commissioner shall not be required to give notice to pesticide users pursuant to this section until said written report by the beekeeper has been received and processed by him.

(d) The request for notification pursuant to paragraph (b) shall expire the following October 31.

APPENDIX C

BEEKEEPER PRODUCTION COST AND RETURNS

TABLE 1.—*Colonies per operation and investment costs per colony, by size of operation, Southwest and Midwest study areas, 1968*

Size of operation, number of operators, and range in size [1]	Colonies per operation	Investment per colony						
		Land	Buildings	Equipment				Total [2]
				Bees	Honey and wax	Shop	Power	
	Number	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Southwest								
Class I, 5 operators:								
Low	300	2.14	2.56	29.81	[3] 0	0.47	12.00	69.76
High	395	16.00	15.14	69.95	2.37	3.54	29.23	98.01
Average	349	6.88	6.93	40.41	1.22	1.52	23.10	80.06
Class II, 10 operators:								
Low	500	1.45	[3] 0	27.74	[3] 0	.19	0	43.70
High	900	6.56	37.80	62.68	9.06	2.95	17.50	99.04
Average	646	3.83	10.24	41.18	3.21	1.02	11.19	70.67
Class III, 21 operators:								
Low	1,000	.40	1.44	19.75	0.98	.18	4.00	34.66
High	2,500	9.36	14.83	54.31	5.83	2.18	16.38	81.91
Average	1,430	2.62	5.95	32.11	2.53	.87	8.55	52.63
Class IV, 5 operators:								
Low	3,000	.10	1.03	20.54	1.09	.64	4.20	36.85
High	5,500	3.00	8.00	51.87	6.24	1.13	12.70	74.54
Average	4,000	1.23	3.80	29.95	2.18	.79	7.50	45.45
Midwest								
Class I, 6 operators:								
Low	510	.41	3.18	28.19	1.44	.08	9.09	53.91
High	490	9.09	28.93	44.12	8.44	5.97	14.10	96.02
Average	374	2.79	12.49	36.03	4.32	1.47	12.05	69.15
Class II, 6 operators:								
Low	510	.29	16.31	38.05	1.74	.74	4.71	67.74
High	640	7.27	41.13	62.10	10.46	2.98	19.35	108.44
Average	576	1.72	24.21	47.17	4.89	1.34	10.34	89.67
Class III, 6 operators:								
Low	1,180	.12	12.11	29.47	1.51	.43	4.81	57.80
High	2,500	3.57	21.95	45.89	5.71	1.56	12.36	73.82
Average	1,559	1.22	15.03	38.75	3.91	.90	7.16	66.97

[1] Size of operation as follows: Class I, 300 to 499 colonies; Class II, 500 to 999; Class III, 1,000 to 2,999; Class IV, 5,000 to 5,999.
[2] Excludes value of live bees.
[3] Another beekeeper extracted all honey for this beekeeper.

Source: (Owens, Cleaver, and Schneider, 1973)

APPENDIX C--continued

Table 2.--Capital investment for 1,000 colonies, 1975

Item	Quantity	Price	Value: Total	Value: Per hive	Depreciation	Interest 8%
Land	2 acres	$1,500	$ 3,000	$ 3.00		$ 240
Warehouse, 2,400 sq. ft.		3.00	7,200	7.20	360	288
Well and pump			2,000	2.00	100	80
Automotive:						
Pick-up 1/2 ton	1		5,000			
Truck 1-1/2 ton	1		7,500			
Total			12,500	12.50	1,562	500
Hives:						
Bodies	2,000	3.00	6,000	6.00	600	
Supers	3,000	3.00	9,000	9.00	900	
Frames	45,000	.20	9,000	9.00	1,800	
Lids and bottoms	2,400[a]	1.50	3,600	3.60	360	
Excluders	1,100[b]	2.00	2,200	2.20	220	
Total			29,800	29.80	3,880	1,192
Bees			14,000	14.00		1,120
Warehouse equipment:						
Clamp truck	1		100			
Barrel truck	1		100			
Power saw	1		500			
Welder	1		250			
Nucs	250		2,250			
Platform scales	1		300			
Power drill	1		100			
Power sander	1		100			
Paint sprayer	1		500			
Shaking equipment			200			
Pollen traps	50	6.00	300			
Staple gun			250			
Bee blower			250			
Miscellaneous			300			
Total			5,000	5.00	500	200
Extraction equipment:						
Extractor	1		1,500			
Pumps	1		100			
Motors	2		150			
Spinner and motor			300			
Uncapper			2,500			
Tank, 2,500 gal.			400			
Steam generator			150			
Burner and propane tank			150			
Capping melter			600			
Miscellaneous			150			
Total			6,000	6.00	600	240
TOTAL INVESTMENT			$79,500	$79.50	$7,002	$3,860

a/ 20% extra
b/ 10% extra

Source: (Reed and Horel, 1976)

Table 3.-- INCOME AND EXPENSES FOR HONEY PRODUCTION

1,000 Hive Operation, 1975

	Quantity	Price	Total value 1,000 hives	Per hive
Income				
Honey	100,000 lb.	$ .30	$30,000	$30.00
Wax	1,000 lb.	1.00	1,000	1.00
Bees	600 lb.	3.50	2,100	2.10
Pollination	1,000 hives	3.55	3,550	3.55
TOTAL INCOME			36,650	36.65
Expense				
Labor	2,500 hrs.	3.00	7,500	7.50
Social Security, etc.		12%	900	.90
Feed - sugar	4,000 lb.	.20	800	.80
Queens and bees	270 packages[a]	14.00	3,780	3.78
Supplies				
Smokers			15	.02
Veils			35	.04
Hive tools			15	.02
Honey tins	1,670	1.80	3,006	3.00
Drugs and fumigants			200	.20
Foundations	2,250	.50	450	.45
Wax	375 lb.	1.00	375	.37
Hive repair			600	.60
Gas, oil, truck repair			3,000	3.00
Render wax @ 1/3 of wax	333 lb.	1.00	333	.33
Utilities			350	.35
Insurance			600	.60
Taxes			795	.80
Location rent			150	.15
Miscellaneous			900	.90
Interest on operating capital	6 months @ 9%		1,071	1.07
TOTAL CASH COST			24,875	24.88
Management 5% of $36,650			1,832	1.83
Depreciation			7,002	7.00
Interest on investment 8%			3,860	3.86
TOTAL EXPENSE			37,569	37.57
NET INCOME			<916>	<.92>

a/ Queen and 2 lbs. bees

Source: (Reed and Horel, 1976)

Table 4.--INCOME AND EXPENSES FOR PACKAGED BEE OPERATION

1,000 Hive Operation, 1975

	Quantity	Price	Total value 1,000 hives	Per hive
Income				
Honey	20,000 lb.	$ .30	$6,000	$ 6.00
Wax	1,000 lb.	1.00	1,000	1.00
Bees	8,000 lb.	3.50	28,000	28.00
Queens	4,000	7.00	28,000	28.00
Pollination	1,000 hives	4.60	4,600	4.60
TOTAL INCOME			67,600	67.60
Expenses				
Labor	4,500	3.25	14,625	14.62
Social Security, etc.		12%	1,755	1.75
Feed - sugar	985 lb.	.20	1,970	1.97
- candy			60	.06
Supplies				
Packages			1,500	1.50
Feeder cans			200	.20
Lath			100	.10
Smokers			15	.02
Veils			35	.04
Hive tools			15	.02
Honey tins	335	1.80	603	.60
Queen cages			200	.20
Pig tail			6	
Drugs and fumigants			200	.20
Foundations	2,250	.50	1,125	1.12
Wax	375 lb.	1.00	375	.38
Hive repair			600	.60
Gas, oil, truck repair			3,000	3.00
Render wax @ 1/3 of wax	333	1.00	333	.33
Utilities			350	.35
Insurance			600	.60
Taxes			795	.80
Location rent			150	.15
Miscellaneous			900	.90
Interest on operating capital	6 months @ 9%		1,328	1.33
TOTAL CASH COST			30,840	30.84
Management 5% of 67,600			3,380	3.38
Depreciation			7,002	7.00
Interest on investment			3,860	3.86
TOTAL EXPENSE			45,082	45.08
NET INCOME			22,518	22.52

Source: (Reed and Horel, 1976)

APPENDIX C --continued

Table 5.--INCOME AND EXPENSE FOR POLLINATION SERVICE

1,000 Hive Operation, 1975

	Quantity	Price	Total value 1,000 hives	Per hive
Income				
Honey	25,000 lb.	$ .30	$ 7,500	$ 7.50
Wax	1,000 lb.	1.00	1,000	1.00
Bees	800	3.50	2,800	2.80
Pollination	1,000 hives	10.70[a]/	10,700	10.70
TOTAL INCOME			22,000	22.00
Expenses				
Labor	2,500 hours	3.25	8,125	8.12
Social Security, etc.		12%	975	.97
Feed - sugar	2,000 lb.	.20	400	.40
Queens	1,000	7.00	7,000	7.00
Supplies				
Smokers	2		15	.02
Veils	10		35	.04
Hive tools	5		15	.02
Honey tins	420	1.80	756	.75
Drugs and fumigants			200	.20
Foundations	2,250	.50	1,125	1.12
Wax	375 lb.	1.00	375	.38
Hive repair			600	.60
Gas, oil, truck repairs			3,000	3.00
Render wax @ 1/3 of wax	333	1.00	333	.33
Utilities			350	.35
Insurance			600	.60
Taxes			795	.80
Location rent			150	.15
Miscellaneous			900	.90
Interest on operating capital	6 months @ 9%		1,159	1.16
TOTAL CASH COST			26,908	26.91
Management @ 5% of 22,000			1,100	1.10
Depreciation			7,002	7.00
Interest on investment @ 8%			3,860	3.86
TOTAL EXPENSE			38,870	38.87
NET INCOME			<16,870>	<16.87>

a/ Pollination income based on -

almonds	75% of hives @ 7.00	5.25
alfalfa, etc.	90% of hives @ 6.00	5.40
miscellaneous		.05
Total per hive		10.70

Source: (Reed and Horel, 1976)

Table 6.--INVESTMENT FOR 1,000, 2,000, AND 3,000 HIVE OPERATIONS, 1975

	1,000 hives			2,000 hives			3,000 hives		
	Total value	Depre- ciation	Interest	Total value	Depre- ciation	Interest	Total value	Depre- ciation	Interest
Land	$ 3,000	$	$ 240	$ 3,000	$	$ 240	$ 3,000	$	$ 240
Warehouse	7,200	360	288	12,000	600	480	14,400	720	576
Well & pump	2,000	100	80	2,000	100	80	2,000	100	80
Pickup	5,000			5,000			10,000		
Trucks	7,500	1,562	500	15,000	2,500	800	15,000	4,025	1,288
Forklift							7,200		
Hives	29,800	3,880	1,192	59,600	7,760	2,384	89,400	11,640	3,576
Bees	14,000		1,120	28,000		2,240	42,000		3,360
Warehouse & extracting equipment	11,000	1,100	440	16,800	1,680	672	24,300	2,430	972
Total	79,500	7,002	3,860	141,400	12,640	6,896	207,300	18,915	10,092
Per hive	79.50	7.00	3.86	70.70	6.32	3.45	69.10	6.31	3.36

Source: (Reed and Horel, 1976)

Table 7.--INCOME AND EXPENSE FOR POLLINATION SERVICE FOR 1,000, 2,000 AND 3,000 HIVE OPERATIONS 1975

	1,000 hives		2,000 hives		3,000 hives	
	Total	Per hive	Total	Per hive	Total	Per hive
	Dollars					
Income						
Honey	7,500	7.50	15,000	7.50	22,500	7.50
Wax	1,000	1.00	2,000	1.00	3,000	1.00
Bees	2,800	2.80	5,600	2.80	8,400	2.80
Pollination @ $10.70/hive	10,700	10.70	21,400	10.70	32,100	10.70
TOTAL INCOME	22,000	22.00	44,000	22.00	66,000	22.00
Expense						
Labor	8,125	8.12	12,185	6.09	15,845	5.28
Social Security, etc.	975	.97	1,462	.73	1,901	.63
Feed - sugar	400	.40	800	.40	1,200	.40
Queens	7,000	7.00	14,000	7.00	21,000	7.00
Supplies						
Smokers	15	.02	20	.01	25	.01
Veils	35	.04	50	.03	70	.02
Hive tools	15	.02	20	.01	25	.01
Honey tins	756	.75	1,512	.75	2,268	.76
Drugs & fumigants	200	.20	400	.20	600	.20
Foundations	1,125	1.12	2,250	1.13	3,375	1.13
Wax	375	.38	750	.38	1,125	.38
Hive repair	600	.60	1,200	.60	1,800	.60
Gas, oil, truck repairs	3,000	3.00	4,500	2.25	5,850	1.95
Render wax	333	.33	666	.33	1,000	.33
Utilities	350	.35	525	.26	700	.23
Insurance	600	.60	1,045	.52	1,475	.49
Taxes	795	.80	1,414	.70	2,073	.69
Location rent	150	.15	200	.10	250	.08
Miscellaneous	900	.90	1,350	.68	1,800	.60
Int. on operating capital	1,159	1.16	1,996	1.00	2,807	.94
TOTAL CASH COST	26,908	26.91	46,345	23.17	65,189	21.73
Management @ 5% of gross	1,100	1.10	2,200	1.10	3,300	1.10
Depreciation	7,002	7.00	12,640	6.32	18,915	6.31
Interest on investment	3,860	3.86	6,896	3.45	10,092	3.36
TOTAL EXPENSE	38,870	38.87	68,081	34.04	97,496	32.50
NET INCOME	〈16,870〉	〈16.87〉	〈24,081〉	〈12.04〉	〈31,496〉	〈10.50〉

Source: (Reed and Horel, 1976)

Table 8.--INCOME AND EXPENSE FOR POLLINATION SERVICE AT VARIOUS INCOMES PER HIVE

For 1,000 Hive Operation, 1975

	Pollination income per hive			
	$8.50	$10.50	$12.50	$14.50
Income				
Honey	$ 7,500	$ 7,500	$ 7,500	$ 7,500
Wax	1,000	1,000	1,000	1,000
Bees	2,800	2,800	2,800	2,800
Pollination	8,500	10,500	12,500	14,500
TOTAL INCOME	19,800	21,800	23,800	25,800
Expenses				
Labor	8,125	8,125	8,125	8,125
Social Security, etc.	975	975	975	975
Feed - sugar	400	400	400	400
Queens	7,000	7,000	7,000	7,000
Supplies				
Smokers	15	15	15	15
Veils	35	35	35	35
Hive tools	15	15	15	15
Honey tins	756	756	756	756
Drugs and fumigants	200	200	200	200
Foundations	1,125	1,125	1,125	1,125
Wax	375	375	375	375
Hive repair	600	600	600	600
Gas, oil, truck repairs	3,000	3,000	3,000	3,000
Rendering wax	333	333	333	333
Utilities	350	350	350	350
Insurance	600	600	600	600
Taxes	795	795	795	795
Location rent	150	150	150	150
Miscellaneous	900	900	900	900
Interest on operating capital	1,159	1,159	1,159	1,159
TOTAL CASH COST	26,908	26,908	26,908	26,908
Management @ 5% of gross	990	1,090	1,190	1,290
Depreciation	7,002	7,002	7,002	7,002
Interest on investment @ 8%	3,860	3,860	3,860	3,860
TOTAL EXPENSE	38,760	38,860	38,960	39,060
NET INCOME	〈18,960〉	〈17,060〉	〈15,160〉	〈13,260〉

Source: (Reed and Horel, 1976)

Table 9.-- INCOME AND EXPENSE FOR POLLINATION SERVICE AT VARIOUS INCOMES PER HIVE

For 2,000 Hive Operation, 1975

	Pollination income per hive			
	$8.50	$10.50	$12.50	$14.50
	Dollars			
Income				
Honey	15,000	15,000	15,000	15,000
Wax	2,000	2,000	2,000	2,000
Bees	5,600	5,600	5,600	5,600
Pollination	17,000	21,000	25,000	29,000
TOTAL INCOME	39,600	43,600	47,600	51,600
Expenses				
Labor	12,185	12,185	12,185	12,815
Social Security, etc.	1,462	1,462	1,462	1,462
Feed - sugar	800	800	800	800
Queens	14,000	14,000	14,000	14,000
Supplies				
Smokers	20	20	20	20
Veils	50	50	50	50
Hive tools	20	20	20	20
Honey tins	1,512	1,512	1,512	1,512
Drugs and fumigants	400	400	400	400
Foundations	2,250	2,250	2,250	2,250
Wax	750	750	750	750
Hive repair	1,200	1,200	1,200	1,200
Gas, oil, truck repairs	4,500	4,500	4,500	4,500
Render wax	666	666	666	666
Utilities	525	525	525	525
Insurance	1,045	1,045	1,045	1,045
Taxes	1,414	1,414	1,414	1,414
Location rent	200	200	200	200
Miscellaneous	1,350	1,350	1,350	1,350
Interest on operating capital	1,996	1,996	1,996	1,996
TOTAL CASH COST	46,345	46,345	46,345	46,345
Management @ 5% of gross	1,980	2,180	2,380	2,580
Depreciation	12,640	12,640	12,640	12,640
Interest on investment	6,896	6,896	6,896	6,896
TOTAL EXPENSE	67,861	68,061	68,261	68,461
NET INCOME	⟨28,261⟩	⟨24,461⟩	⟨20,661⟩	⟨16,861⟩

Source: (Reed and Horel, 1976)

Table 10.-- INCOME AND EXPENSE FOR POLLINATION SERVICE AT VARIOUS INCOMES PER HIVE

For 3,000 Hive Operation, 1975

	Pollination income per hive			
	$8.50	$10.50	$12.50	$14.50
	Dollars			
Income				
Honey	22,500	22,500	22,500	22,500
Wax	3,000	3,000	3,000	3,000
Bees	8,400	8,400	8,400	8,400
Pollination	25,500	31,500	37,500	43,500
TOTAL INCOME	59,400	65,400	71,400	77,400
Expense				
Labor	15,845	15,845	15,845	15,845
Social Security, etc.	1,901	1,901	1,901	1,901
Feed - sugar	1,200	1,200	1,200	1,200
Queens	21,000	21,000	21,000	21,000
Supplies				
Smokers	25	25	25	25
Veils	70	70	70	70
Hive tools	25	25	25	25
Honey tins	2,268	2,268	2,268	2,268
Drugs and fumigants	600	600	600	600
Foundations	3,375	3,375	3,375	3,375
Wax	1,125	1,125	1,125	1,125
Hive repair	1,800	1,800	1,800	1,800
Gas, oil, truck repairs	5,850	5,850	5,850	5,850
Render wax	1,000	1,000	1,000	1,000
Utilities	700	700	700	700
Insurance	1,475	1,475	1,475	1,475
Taxes	2,073	2,073	2,073	2,073
Location rent	250	250	250	250
Miscellaneous	1,800	1,800	1,800	1,800
Interest on operating capital	2,807	2,807	2,807	2,807
TOTAL CASH COST	65,189	65,189	65,189	65,189
Management 5% of gross income	2,970	3,270	3,570	3,870
Depreciation	18,915	18,915	18,915	18,915
Interest on investment	10,092	10,092	10,092	10,092
TOTAL EXPENSE	97,166	97,466	97,766	98,066
NET INCOME	<37,766>	<32,066>	<26,366>	<20,666>

Source: (Reed and Horel, 1976)

TABLE 11.—*Colonies per operation and annual cash costs, by size of operation, Southwest and Midwest study areas, 1968*

Size of operation, number of operators, and range in size[1]	Colonies per operation	Annual cash cost per colony: Maintenance and repair	Current operating expense	General cash business	Bee purchase	Paid labor	Power equipment	Total
	Number	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Southwest								
Class I, 5 operators:								
Low	300	0	0	0.09	0	0	3.86	5.89
High	395	.14	1.13	.45	1.26	1.78	6.05	8.47
Average	349	.07	.72	.19	.55	.78	5.04	7.35
Class II, 10 operators:								
Low	500	0	.04	.09	0	0	0	.83
High	900	2.44	2.34	1.36	2.59	5.73	6.46	12.26
Average	646	.47	.87	.63	.52	.89	4.15	7.53
Class III, 21 operators:								
Low	1,000	0	.21	.04	0	0	1.19	4.72
High	2,500	4.92	1.25	8.77	2.28	4.88	15.90	16.68
Average	1,430	.51	.76	.57	.51	2.12	3.48	7.95
Class IV, 5 operators:								
Low	3,000	0	.59	.03	0	2.86	1.98	7.08
High	5,500	.70	2.55	.63	.17	6.17	4.03	10.52
Average	4,000	.26	1.32	.49	.05	3.74	2.94	8.80
Midwest								
Class I, 6 operators:								
Low	310	.13	.57	.07	0.05	0	1.33	3.46
High	490	2.51	4.25	2.22	6.00	9.00	2.77	23.35
Average	374	.86	1.73	.70	1.93	2.17	2.14	9.53
Class II, 6 operators:								
Low	510	.01	.31	.50	0.10	0	1.04	4.04
High	640	1.05	2.26	3.08	1.82	.87	8.64	11.32
Average	576	.51	1.30	1.18	0.83	.19	3.11	7.12
Class III, 6 operators:								
Low	1,180	.15	1.39	.51	0.07	0	1.06	7.23
High	2,500	1.85	3.37	1.49	1.36	8.62	3.39	16.48
Average	1,559	.61	2.27	.91	.37	3.18	2.30	9.59

[1] See table 1, footnote 1, for explanation of size of operation.

Source: (Owens, Cleaver, and Schneider, 1973)

TABLE 12—*Annual costs per colony: Noncash, cash, and total, by size of operation, Southwest and Midwest study areas, 1968*

Size of operation, number of operators, and range in size[1]	Colonies per operation	Noncash costs: Depreciation	Noncash costs: Interest	Noncash costs: Unpaid labor	Noncash costs: Total	Cash Costs	Total costs	Change in bee inventory	Adjusted costs	Noncash costs as percentage of total costs
	Number	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Pct.*
Southwest										
Class I, 5 operators:										
Low	300	3.76	3.46	4.29	11.85	5.89	18.78	−3.51	21.56	71
High	395	8.00	4.34	13.76	25.04	8.47	30.93	+1.60	30.59	
Average	349	4.94	3.84	9.80	18.58	7.35	25.93	− .19	26.12	
Class II, 10 operators:										
Low	500	3.23	1.71	0	4.94	.83	5.77	−1.13	4.81	69
High	900	8.36	4.34	9.20	19.67	12.26	28.63	+2.27	28.10	
Average	646	5.31	3.45	7.06	15.82	7.53	23.35	+ .93	22.87	
Class III, 21 operators:										
Low	1,000	2.61	1.85	1.57	6.28	4.72	12.68	−1.91	9.95	61
High	2,500	6.23	3.53	7.58	17.61	16.68	23.51	+6.00	29.66	
Average	1,430	4.09	2.63	4.08	10.80	7.95	18.75	+ .93	17.82	
Class IV, 5 operators:										
Low	3,000	2.63	2.04	1.03	6.09	7.08	13.17	−1.71	12.62	45
High	5,500	6.15	3.52	1.70	11.32	10.52	21.31	+ .55	20.91	
Average	4.000	3.69	2.49	1.26	7.44	8.80	16.24	− .14	16.38	
Midwest										
Class I, 6 operators:										
Low	310	3.75	2.49	4.20	14.41	3.46	18.93	−1.78	18.29	65
High	490	6.98	4.64	14.11	22.06	23.35	39.16	+2.80	39.16	
Average	374	5.10	3.20	8.63	16.93	9.53	26.46	+ .53	25.93	
Class II, 6 operators:										
Low	510	5.52	2.95	4.57	13.41	4.04	17.46	− .76	17.04	72
High	640	8.54	4.69	11.07	20.73	11.32	32.05	+ .78	31.94	
Average	576	6.89	3.88	6.89	17.66	7.12	24.78	+ .22	24.56	
Class III, 6 operators:										
Low	1,180	4.56	2.90	1.42	9.12	7.23	18.57	− .11	17.98	56
High	2,550	5.83	3.39	6.90	14.09	16.48	25.60	+ .73	25.51	
Average	1,559	5.32	3.19	3.45	11.96	9.59	21.55	+ .33	21.22	

[1] See table 1, footnote 1, for explanation of size of operation.

Source: (Owens, Cleaver, and Schneider, 1973)

APPENDIX C--continued

TABLE 13—*Beekeeping production: Colonies per beekeeper, production of honey and beeswax per colony, and income per colony from various activities, Southwest and Midwest study areas, 1968*

Size of operation, number of operators, and range in size[1]	Colonies per operation	Production		Income from—					Total income	Average gross income[3]
		Honey	Beeswax	Honey	Beeswax	Polination[2]	Bee sales[2]	Other		
	No.	*Lbs.*	*Lbs.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Southwest										
Class 1, 5 operators:										
Low	300	0	0	0	0	0	0	0	10.50	--------
High	395	120	2.9	13.83	1.71	10.50	7.67	0	17.16	--------
Average	349	32.4	0.7	3.75	.43	5.37	2.07	0	11.63	4,652.00
Class II, 10 operators:										
Low	500	0	0	0	0	0	0	0	6.59	--------
High	900	147.5	3.3	17.82	1.81	16.84	2.75	0	24.63	--------
Average	646	55.1	1.1	6.69	.72	6.02	.28	0	13.79	10,342.50
Class III, 21 operators:										
Low	1,000	0	0	0	0	0	0	0	4.91	--------
High	2,500	144	2.4	17.28	1.51	14.55	18.46	0	26.82	--------
Average	1,430	35.7	0.7	4.34	.49	5.23	2.81	0	12.87	25,740.00
Class IV, 5 operators:										
Low	3,000	0	0	0	0	1.87	0	0	10.95	--------
High	5,500	85.7	1.4	10.61	.95	10.25	19.83	.30	21.70	--------
Average	4,400	33.5	.6	4.09	.40	5.40	5.78	.60	15.74	70,830.00
Midwest										
Class I, 6 operators:										
Low	310	30.3	.3	3.89	.20	0	0	0	4.10	--------
High	490	200	2.9	30.00	1.82	17.82	0	.48	31.13	--------
Average	374	95.3	1.4	13.89	.91	3.89	0	.07	18.76	7,504.00
Class II, 6 operators:										
Low	510	41.1	.4	4.93	.26	0	0	0	6.10	--------
High	640	102.4	2.2	15.35	1.43	0	0	.52	16.78	--------
Average	576	70.0	1.3	9.69	.84	0	0	.09	10.62	7,965.00
Class III, 6 operators:										
Low	1,180	53.9	.9	7.50	.63	0	0	0	8.65	--------
High	2,500	106.3	2.1	14.88	1.36	18.00	0	.30	16.23	--------
Average	1,559	72.2	1.5	10.52	1.01	1.42	0	.08	13.03	26,000.00

[1] See table 1, footnote 1 for explanation of size of operation.

[2] Number of beekeepers with income from polination and bee sales:

	Southwest Polination	Southwest Bee sales	Midwest Polination
Class I	4	2	1
Class II	8	1	0
Class III	17	7	8
Class IV	5	3	--

[3] Percentage gross income of Southwest beekeepers is to that of Midwest: Class I, 63 percent; Class II, 130 percent; Class III, 99 percent.

Source: (Owens, Cleaver, and Schneider, 1973)

Table 14.--Honey: Profit-and-loss experience of 118 U.S. producers on their beekeeping operations, by State or area, 1971-75

Year and reporting State or area	Honey and beeswax sold	Package bees and queens sold	Pollination fees	Other beekeeping income	Total beekeeping income	Total beekeeping expense	Net beekeeping profit or (loss) before income taxes	Ratio of net profit or (loss) before income taxes to total income	Honey produced	Total number of reported colonies
1971	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	Percent	1,000 pounds	
Arizona	66	5	23	2	96	124	(28)	(29.2)	376	11,788
California	537	1	675	61	1,274	1,019	255	20.0	2,505	42,206
Colorado, New Mexico, Utah, and Wyoming	192	-	-	-	192	127	65	33.9	835	10,814
Florida	415	-	7	-	422	365	57	13.5	1,046	8,370
Georgia	87	2	-	5	94	48	46	48.9	480	5,534
Idaho	134	-	8	27	169	97	72	42.6	664	15,145
Iowa, North Dakota, and South Dakota	1,096	-	7	19	1,122	678	444	39.6	4,268	48,418
Michigan	29	-	-	-	6	16	19	54.3	133	3,345
Minnesota	398	-	-	14	412	309	103	25.0	1,890	20,350
Montana	318	-	1	7	326	243	83	25.5	1,496	20,520
Nebraska	213	-	9	2	224	167	57	25.4	1,012	11,677
Oregon and Washington	95	-	78	2	175	129	46	26.3	496	9,694
Texas	110	106	-	-	216	147	69	31.9	573	9,443
All other reporting States	151	28	-	11	190	142	48	25.3	553	11,188
Total	3,841	142	808	156	4,947	3,611	1,336	27.0	16,327	228,492

Table 14.--Honey: Profit-and-loss experience of 118 U.S. producers on their beekeeping operations, by State or area, 1971-75--Continued

Year and reporting State or area	Honey and beeswax sold	Package bees and queens sold	Pollination fees	Other beekeeping income	Total beekeeping income	Total beekeeping expense	Net beekeeping profit or (loss) before income taxes	Ratio of net profit or (loss) before income taxes to total income	Honey produced	Total number of reported colonies
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	Percent	1,000 pounds	
1972										
Arizona	110	9	22	128	269	202	67	24.9	507	13,692
California	776	4	619	148	1,547	1,116	431	27.9	2,745	48,679
Colorado, New Mexico, Utah, and Wyoming	240	-	1	-	241	147	94	39.0	671	10,985
Florida	522	-	1	1	524	456	68	13.0	1,039	8,565
Georgia	119	2	-	15	136	49	87	64.0	365	6,500
Idaho	227	2	11	17	257	147	110	42.8	869	18,521
Iowa, North Dakota, and South Dakota	1,426	4	11	110	1,551	896	655	42.2	4,572	48,901
Michigan	95	-	-	2	97	103	(6)	(6.2)	275	7,893
Minnesota	536	-	-	18	554	341	213	38.4	2,076	19,956
Montana	528	-	-	7	535	310	225	42.1	2,928	23,007
Nebraska	250	-	2	31	283	218	65	23.0	1,415	12,018
Oregon and Washington	108	-	79	174	361	200	161	44.6	486	10,109
Texas	272	121	6	1	400	237	163	40.8	1,071	10,052
All other reporting States	197	35	-	17	249	176	73	29.3	472	11,722
Total	5,406	177	752	669	7,004	4,598	2,406	34.4	19,491	250,600

Table 14.--Honey: Profit-and-loss experience of 118 U.S. producers on their beekeeping operations, by State or area, 1971-75--Continued

Year and reporting State or area	Honey and beeswax sold	Package bees and queens sold	Pollination fees	Other beekeeping income	Total beekeeping income	Total beekeeping expense	Net beekeeping profit or (loss) before income taxes	Ratio of net profit or (loss) before income taxes to total income	Honey produced	Total number of reported colonies
1973	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	Percent	1,000 pounds	
Arizona	244	42	32	371	689	316	373	54.1	883	15,581
California	1,892	6	559	119	2,576	1,530	1,046	40.6	5,267	51,389
Colorado, New Mexico, Utah, and Wyoming	325	-	-	-	325	151	174	53.5	864	12,210
Florida	721	-	1	-	722	628	94	13.0	1,000	9,197
Georgia	186	5	-	4	195	73	122	62.6	582	6,950
Idaho	402	-	12	21	435	214	221	50.8	1,131	21,602
Iowa, North Dakota, and South Dakota	2,117	9	17	63	2,206	1,292	914	41.4	5,625	51,458
Michigan	258	-	6	4	268	186	82	30.6	602	9,448
Minnesota	794	-	-	31	825	436	389	47.2	2,578	21,788
Montana	978	2	-	9	989	514	475	48.0	2,403	24,024
Nebraska	500	-	18	24	542	454	88	16.2	1,251	15,122
Oregon and Washington	417	-	114	61	592	432	160	27.0	720	11,452
Texas	304	157	14	3	478	277	201	42.1	604	10,515
All other reporting States	220	64	-	13	297	228	69	23.2	520	12,159
Total	9,358	285	773	723	11,139	6,731	4,408	39.6	24,030	272,895

Table 14.--Honey: Profit-and-loss experience of 118 U.S. producers on their beekeeping operations, by State or area, 1971-75--Continued

Year and reporting State or area	Honey and beeswax sold	Package bees and queens sold	Pollination fees	Other beekeeping income	Total beekeeping income	Total beekeeping expense	Net beekeeping profit or (loss) before income taxes	Ratio of net profit or (loss) before income taxes to total income	Honey produced	Total number of reported colonies
1974	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	Percent	1,000 pounds	
Arizona	310	-	44	194	548	392	156	28.5	532	13,068
California	1,474	15	707	238	2,434	1,761	673	27.7	3,673	55,905
Colorado, New Mexico, Utah, and Wyoming	393	2	1	-	396	267	129	32.6	959	12,695
Florida	513	-	1	-	514	439	75	14.6	813	8,641
Georgia	192	11	-	8	211	89	122	57.8	394	7,168
Idaho	582	-	19	21	622	350	272	43.7	1,387	21,896
Iowa, North Dakota, and South Dakota	1,775	16	22	45	1,858	1,461	397	21.4	3,771	54,388
Michigan	286	-	9	8	303	212	91	30.0	388	9,955
Minnesota	802	-	-	36	838	532	306	36.5	1,620	21,910
Montana	919	-	-	22	941	629	312	33.2	2,058	23,230
Nebraska	606	-	8	5	619	477	142	22.9	1,561	16,702
Oregon and Washington	535	-	198	65	798	658	140	17.5	688	15,707
Texas	316	206	5	5	532	374	158	29.7	708	11,742
All other reporting States	321	90	-	18	429	313	116	27.0	428	13,116
Total	9,024	340	1,014	665	11,043	7,954	3,089	28.0	18,980	283,123

Table 14.--Honey: Profit-and-loss experience of 118 U.S. producers on their beekeeping operations, by State or area, 1971-75--Continued

Year and reporting State or area	Honey and beeswax sold	Package bees and queens sold	Pollination fees	Other beekeeping income	Total beekeeping income	Total beekeeping expense	Net beekeeping profit or (loss) before income taxes	Ratio of net profit or (loss) before income taxes to total income	Honey produced	Total number of reported colonies
1975	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	Percent	1,000 pounds	
Arizona	221	1	48	51	321	316	5	1.6	541	13,556
California	1,927	38	837	173	2,975	2,082	893	30.0	3,925	57,279
Colorado, New Mexico, Utah, and Wyoming	421	-	-	-	421	310	111	26.4	911	13,268
Florida	595	-	2	-	597	523	74	12.4	741	8,605
Georgia	203	11	-	10	224	126	98	43.8	554	7,655
Idaho	531	-	20	19	570	383	187	32.8	927	22,444
Iowa, North Dakota, and South Dakota	2,242	26	34	100	2,402	1,522	880	36.6	4,854	58,880
Michigan	233	-	18	12	263	217	46	17.5	413	9,203
Minnesota	771	1	-	75	847	623	224	26.4	1,931	22,186
Montana	1,057	-	-	27	1,084	790	294	27.1	2,390	24,620
Nebraska	651	-	14	8	673	534	139	20.7	833	17,215
Oregon and Washington	418	1	193	130	742	506	236	31.8	681	15,520
Texas	341	262	5	4	612	456	156	25.5	783	12,882
All other reporting States	257	104	-	34	395	325	70	17.7	398	13.070
Total	9,868	444	1,171	643	12,126	8,713	3,413	28.1	19,882	296,383

Source: Compiled by the U.S. International Trade Commission from data submitted by U.S. honey producers.

Table 15.--Honey: Profit-and-loss experience of 118 U.S. producers on their beekeeping operations, by colony size, 1971-75

Year and colony size	Honey and beeswax sold	Package bees and queens sold	Pollination fees	Other beekeeping income	Total beekeeping income	Total beekeeping expense	Net beekeeping profit or (loss) before income taxes	Ratio of net profit or (loss) before income taxes to total income	Honey produced	Total number of reported colonies
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	Percent	1,000 pounds	
1971:										
300 to 899	122	-	19	17	158	111	47	29.7	559	10,658
900 to 1,549	424	-	87	15	526	349	177	33.7	1,820	23,887
1,550 to 2,699	1,025	106	79	21	1,231	847	384	31.2	4,022	48,438
2,700 and over	2,270	36	623	103	3,032	2,304	728	24.0	9,926	145,509
Total	3,841	142	808	156	4,947	3,611	1,336	27.0	16,327	228,492
1972:										
300 to 899	171	-	31	22	224	151	73	32.6	615	11,410
900 to 1,549	603	4	75	85	767	402	365	47.6	2,240	25,831
1,550 to 2,699	1,319	122	79	113	1,633	1,110	523	32.0	4,601	51,047
2,700 and over	3,313	51	567	449	4,380	2,935	1,445	33.0	12,035	162,312
Total	5,406	177	752	669	7,004	4,598	2,406	34.4	19,491	250,600
1973:										
300 to 899	364	-	27	28	419	224	195	46.5	976	12,076
900 to 1,549	881	4	110	38	1,033	586	447	43.3	2,169	30,122
1,550 to 2,699	2,209	162	123	55	2,549	1,661	888	34.8	5,084	57,740
2,700 and over	5,904	119	513	602	7,138	4,260	2,878	40.3	15,801	172,957
Total	9,358	285	773	723	11,139	6,731	4,408	39.6	24,030	272,895

Table 15.--Honey: Profit-and-loss experience of 118 U.S. producers on their beekeeping operations, by colony size, 1971-75--Continued

Year and colony size	Honey and beeswax sold	Package bees and queens sold	Pollination fees	Other beekeeping income	Total beekeeping income	Total beekeeping expense	Net beekeeping profit or (loss) before income taxes	Ratio of net profit or (loss) before income taxes to total income	Honey produced	Total number of reported colonies
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	Percent	1,000 pounds	
1974:										
300 to 899	391	-	44	24	459	288	171	37.3	805	13,030
900 to 1,549	903	2	156	81	1,142	728	414	36.3	1,827	31,754
1,550 to 2,699	2,072	217	183	51	2,523	1,813	710	28.1	4,360	58,796
2,700 and over	5,658	121	631	509	6,919	5,125	1,794	25.9	11,988	182,543
Total	9,024	340	1,014	665	11,043	7,954	3,039	28.0	18,980	283,123
1975:										
300 to 899	376	-	68	33	477	346	131	27.5	865	13,410
900 to 1,549	954	10	156	86	1,206	776	430	35.7	1,993	31,595
1,550 to 2,699	2,118	276	196	172	2,762	2,031	731	26.5	3,700	60,409
2,700 and over	6,420	158	751	352	7,681	5,560	2,121	27.6	13,324	190,969
Total	9,868	444	1,171	643	12,126	8,713	3,413	28.1	19,882	296,383

Source: Compiled by the U.S. International Trade Commission from data submitted by U.S. honey producers.

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