Evaluation of the Mexican-American Screwworm Eradication Program in Mexico

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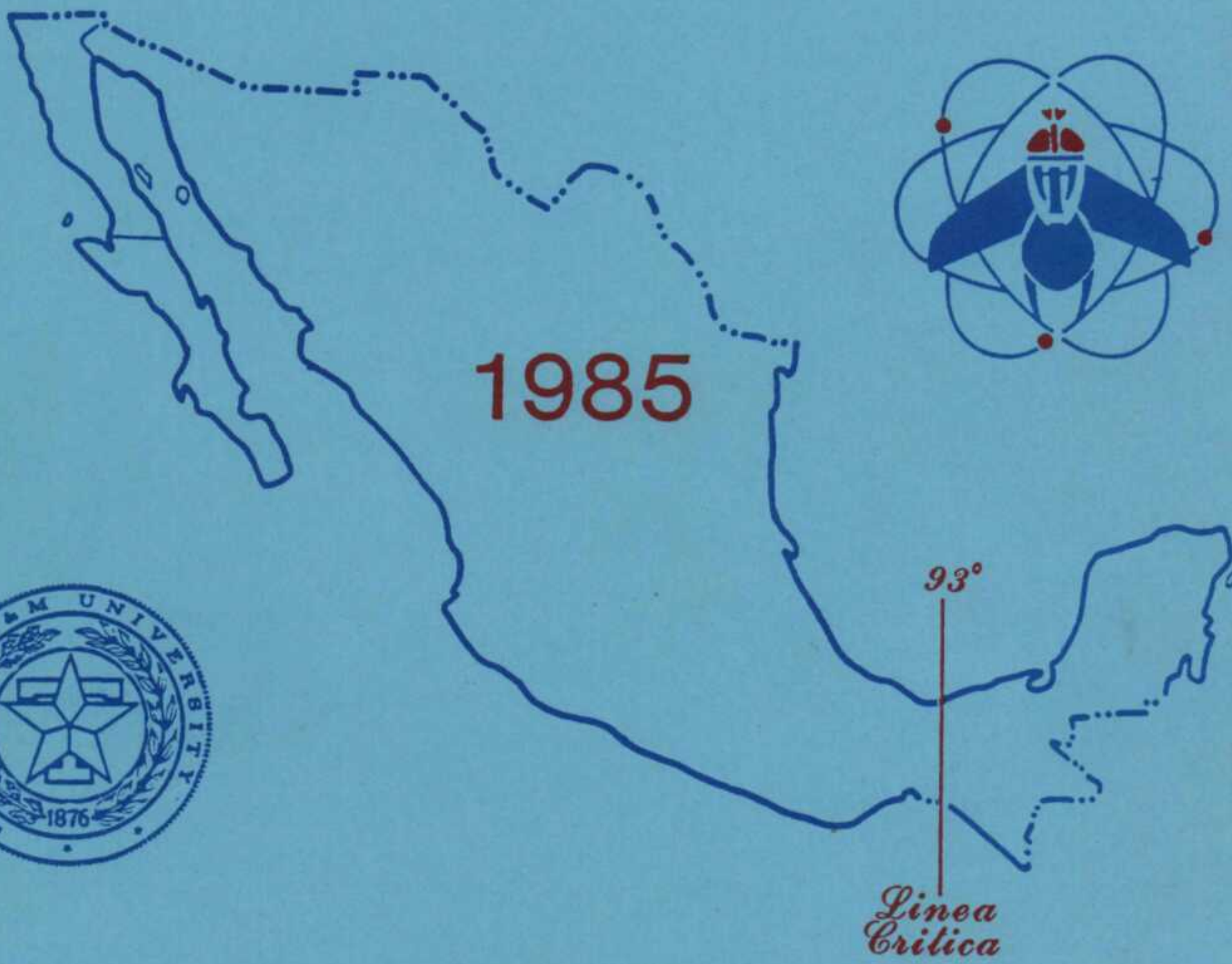

VOLUME I

ECONOMIC IMPACT FROM SCREWWORM ERADICATION IN MEXICO

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VOLUME I

ECONOMIC IMPACT FROM SCREWWORM ERADICATION IN MEXICO

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Several members of the staff at Texas A&M University gave assistance to this project. Dr. Cliff Hoelscher, Extension Entomologist, has our deep appreciation for securing contacts and liason with the Animal and Plant Health Inspection Service and the Mexican American Screwworm Commission. Luis Romero and Teofilo Ozuna participated in questionnaire preparation, drawing the sample, and training the enumerators. Professor Emeritus Clive Harston provided some of the brightest moments of the training seminar.

The field employees of the Mexican-American Screwworm Commission that actually conducted the personal interviews with Mexican livestock producers were the most crucial element in this undertaking. They took on this new endeavor with great care and enthusiasm. The successful completion of this study is due in great measure to them.

EXECUTIVE SUMMARY

Economic Impact From Screwworm Eradication In Mexico

The Screwworm, *Cochliomyia hominivorax*, is a flesh-feeding parasite that attacks warm blooded animals including humans. This pest has caused livestock producers to sustain monetary losses as a result of animal mortalities, decreased weight gains, and additional labor costs, additional veterinarian services, additional expense for medicine and insecticides. A strategy has been developed for eradicating the screwworm by releasing sufficient sterile screwworm flies to mate with the wild fly population. Screwworms have now been eradicated from all of North America except the Yucatan Peninsula. The purpose of this study was to quantify benefits of screwworm eradication in Mexico.

Two questionnaires were developed to obtain information about the impact of the Screwworm on livestock producers in Mexico. One was administered in the part of the country where the pest had been eradicated. The other was administered in the infested Yucatan Peninsula. Both survey instruments were designed to obtain information on the impact of the screwworm on producers' variable costs and production. Sections on cattle, swine, sheep, goats, horses, and work animals were included in both questionnaires. There were 2004 questionnaires received from the area of Mexico from which screwworms

had been eradicated and 77 from the Yucatan Peninsula.

The impact of the screwworm was estimated on a per head basis. These per head estimates were expanded to the total inventories of the various livestock categories in Mexico to obtain estimates of total benefits. The largest components of reduction in producers' variable cost attributed to the screwworm eradication were reductions in labor needed and in days necessary to produce an animal for sale. All estimates of benefits were made with and without the reduction in labor since Mexico has surplus labor. On a per head basis swine producers experienced the greatest benefit from screwworm eradication. Larger cattle numbers, however, made cow-calf owners the largest total benefactors from Mexico's eradication program.

The government costs of the program were available from the Mexican-American Screwworm Commission. Both costs and benefits were discounted to their 1984 values at discount rates of 3%, 6%, and 8.625%. Total benefits were calculated with and without the reduction in labor needed by producers which was attributed to Screwworm eradication.

Twelve benefit-cost ratios were estimated given alternative scenarios. The ratios ranged from 2 to 4.5. This indicates that the eradication program in Mexico provided cost effective savings to the country.

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CHAPTER I

INTRODUCTION

The screwworm, Cochliomyia hominivorax, is a flesh-feeding parasite that attacks warm blooded animals including humans. It was once found throughout the Americas. In the 1950's a strategy was developed for eradicating the screwworm by releasing sufficient sterile adult screwworm flies to mate with the wild fly population. Eradication of the pest began in the Southeastern United States in 1957 and in the Southwestern United States in 1962. Presently the parasite has also been eliminated from Puerto Rico, the Virgin Islands, the continental United States, and all of Mexico except the Yucatan Peninsula. Central America remains an infested area (Rawlins et al, 1983).

This pest has caused livestock producers to sustain monetary losses as a result of animal mortalities, decreased weight gains, additional labor costs, additional veterinarian services, medicine, and insecticides, and damaged hides. Losses incurred by the livestock industry have had a multiplier effect that has damaged the economies of areas where C. hominivorax has been found (Davis and Prater, 1973).

The benefits from the eradication effort that have accrued to

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livestock producers had not been carefully quantified before this study. However, the proposal to extend the campaign into the Yucatan Peninsula and Central America made it important to estimate the economic effects of the program on Mexico (APHIS, 1985). Future eradication campaigns would demand a substantial contribution of resources from all of the countries involved. Economic justification is needed before those resources are committed. Quantification of the screwworm eradication campaign's economic effects on Mexico would give an idea of the economic effects other areas might experience if they undertake screwworm eradication campaigns.

Objectives of the Study

Following are the specific objectives of this study. They address the economic impacts of the eradication program in Mexico and of extending the campaign to the Darian Gap in Panama.

1. To quantify mortalities, weight loss, and other related physical effects of the screwworm on livestock.
2. To estimate the economic implications of screwworm eradication by major livestock category in Mexico.
    a. Develop estimates on an average annual basis for cattle, sheep, goats, swine, horses, and work animals.
    b. Calculate the present value of the stream of estimated annual benefits and costs into perpetuity.

3. To estimate the expected benefits for each additional region where the screwworm might be eradicated.
   a. Estimate the benefits on an average annual basis.
   b. Estimate the present value of the stream of annual benefits into perpetuity.
4. To estimate benefit-cost ratios for the Mexican eradication effort and the potential benefits of extending the eradication campaign southward.

Review of Previous Studies

There have been four previous studies estimating to some extent the impact of the screwworm eradication program. The first of these studies was done in 1973 by the Texas Agricultural Extension Service (Davis and Prater, 1973). This study estimated that livestock mortality caused by the screwworm cost producers $121.7 million in 1973 and had a multiplier effect of 3.5. According to the study, the reduction in the 'red meat' supply caused by screwworms cost consumers $146.4 million in 1973 and also had a multiplier effect of 3.5.

A second study was conducted by the Oklahoma State Department of Agriculture in 1974 (Goodwin, 1974). This study, utilizing the consumer surplus methodology, estimated that the screwworm eradication program resulted in a total savings of $1 billion to consumers in 1972. Consumers benefited from an additional 1.8 pounds of beef per capita that year as a result of the program. A benefit-cost ratio of 113:1

was estimated by the Oklahoma study.

The Texas Agricultural Extension Service and the Southwest Screwworm Eradication Laboratory conducted a livestock producer survey in 1977 to estimate losses of livestock caused by the 1976 screwworm outbreak in Texas (Cocke, 1981). This study estimated a loss of livestock production valued from $113.7 to $150.5 million in 1976. Considering the economic multiplier effect, the Texas economy suffered losses of $283 to $375 million during that year as a result of the screwworm. The study also estimated that from 1962 through 1976 the benefit of the eradication program to livestock producers was more than $1 billion.

The last study concerning the economic impact of the screwworm eradication program was completed by the Instituto Interamericano de Ciencias Agricolas in 1982 (IICA, 1982). That study evaluated the economic implications of extending the screwworm eradication program into Central America as far south as Panama. The study estimated it would cost $300 million to extend the fly barrier to the Darian Gap over a 6 year period. This study used judgement estimates of the effects of screwworm infestation such as increased mortality rates, weight loss, and increased insecticide cost per head. Using these judgement estimates an average loss per animal in Mexico was calculated and extended to Central America and Panama. Equivalent present value and benefit-cost ratios were projected for an extended program.

Results from all of the studies indicated the exceptional success and benefits attributable to the Screwworm Eradication Program. Unfortunately, all of the studies had limited resources and depended primarily on secondary data which limited the studies' value to decision makers.

The following chapter reviews the history of the screwworm eradication program in North America. Economic theory which was used in the analysis of the screwworm eradication effort in Mexico is presented in Chapter III. The fourth chapter details the procedures used in this study. Chapter V presents the physical effects of screwworm eradication as estimated in this study. The estimated economic impacts of screwworm eradication are presented in Chapter VI. A summary of the entire study is given in the seventh chapter along with a discussion of the limitations of this study.

CHAPTER II

A HISTORY OF THE ERADICATION PROGRAM

Several innovations and discoveries have made the eradication of *Cochliomyia hominivorax* possible. Elimination of such a widespread pest has involved not only the adoption of those innovations by individuals, but also their adoption by governments. International cooperation has been necessary and will be increasingly vital if eradication is to spread throughout the Americas.

Research in Screwworm Control

Early research into innovations that might help control the screwworm was hampered by lack of knowledge about the pest's taxonomy. At the start of the twentieth century the livestock industry in the southwestern United States was being heavily impacted by screwworms. Producers asked the U.S. Department of Agriculture for assistance. In 1913 the Department of Agriculture sent a team to the Southwest to carry out a study of the screwworm problem and make recommendations. Although state agricultural experiment stations had issued publications concerning the problem before, this was the beginning of the U.S. Department of Agriculture's active participation in screwworm control. The research team recommended several management practices which included the following: burning all carcasses, using meatbaited fly traps, not castrating or dehorning animals during times when there was high screwworm activity, and using benzol to kill larvae in wounds. In several ways these recommendations were not compatible with the cattlemen's accustomed practices. Burning carcasses was labor intensive and could cause range fires. The fly traps were hard to maintain. These control practices were later proven unreliable.

County agents of the Texas Agricultural Extension Service became involved in trying to disseminate the innovations proposed by the Department of Agriculture team. The county agent from Menard County, Mr. Walker Nesbet, was able to convince many ranchers in his area to implement the team's suggestions. In 1929 the U.S. Department of Agriculture's former Bureau of Entomology and Plant Quarantine established a research station at Menard in an attempt to facilitate the program. The Department of Agriculture provided funds for extending the fly trapping program to an area of over 70 square miles. After the trapping program had been in progress for almost three years, a survey determined that it was ineffective in reducing screwworm populations in the surrounding areas. This failure of fly trapping to produce results did not cause producers to lose confidence in government efforts to control the screwworm.

Another innovation produced at the new station, Smear 62, was widely accepted. This was a compound for killing larvae and repelling flies. Several hundred gallons of this preparation were given to ranchers in Arizona and Texas for their evaluation. It was soon being produced commercially. The relative advantage of this compound over old treatments caused it to be accepted without an extensive promotional campaign. It seemed for a while that this new preparation might be the key to screwworm control. One unforeseen problem with application of this new technology was that there were not enough experienced cowboys to apply it.

One employee of the Menard station, Emory C. Cushing, upon realizing that fly traps were not the answer to screwworm control, decided that some important piece of information about the pest's biology was missing. He decided to pursue graduate studies at the University of Liverpool's School of Tropical Medicine in England. Until that time it had been assumed that all the larvae infesting cattle were *Cochliomyia macellaria*, or common blowflies. Mr. Cushing established however, that there was a distinct species which he called *Cochliomyia americana*. Specialists later changed the name to *Cochliomyia hominivorax*. *C. hominivorax*, the true screwworm, infests only live tissue. As wounds enlarged by screwworms become infected and the surrounding tissues begin to decay, common blowflies are attracted and lay their eggs. It was later determined that the true screwworm was relatively few in number compared to the common blowfly. This discovery by Emory Cushing gave later researchers the background needed to develop methods which would make possible the eradication of the screwworm.

In the early 1930's, the Southwest was in the midst of the depression and the dustbowl. Cattle were shipped to the Southeast so that they could utilize the forage in that area. These cattle carried the screwworm with them. Producers in the Southeast were unaccustomed to dealing with the screwworm and infestations in that area soon increased to epidemic proportions.

The U.S. Department of Agriculture reacted by establishing another experiment station for screwworm research in Valdosta, Georgia and participating in an extension campaign in the Southeast. This educational campaign promoted management practices that had been developed in the Southwest. The extension effort worked. The incidence of infestation was reduced dramatically in a few years. Although more of the United States' livestock producers were now affected by *C. hominivorax*, one benefit did come from the extension of this parasite's range to the Southeast. The Department of Agriculture, in part due to the attention received by the spread of infestation, increased the amount of research being done on screwworm control (Scruggs, 1975).

E. F. Knipling, working at the Menard station in the years immediately prior to World War II, developed the new ideas which would make it possible to eradicate the screwworm. He had observed that the female of that species mated only once. This observation made him realize that the naturally small native screwworm population might be overwhelmed by laboratory produced sterile males. Knipling's theory was met with skepticism by other entomologists. World War II stopped work on his ideas. Although war and unrest can halt development and diffusion of science, the research into atomic power conducted during

World War II would later prove useful to the entomologists researching ways to eradicate the screwworm.

After the war, a new research facility was established at Kerrville, Texas. R. C. Bushland started to work on the sterile fly theory. His experiments with chemical sterilants failed. In 1950 Bushland became aware of the work of Dr. H. J. Muller on the use of x-rays to produce sterility in fruit flies. Even though work was slowed by a lack of funds, Bushland had established by 1953 that radiation could be used to produce sterile screwworm flies (Scruggs, 1975).

The Diffusion of the Screwworm Eradication Program

Laboratory tests had suggested that screwworm eradication was possible. Proof was now needed before these ideas could be disseminated. The U.S. Department of Agriculture first attempted screwworm eradication on Sanibel Island, which is west of Fort Myers, Florida. Releasing sterile flies on that island reduced, but did not eliminate, the native population of C hominivorax. The U.S. Department of Agriculture scientists theorized that the failure to remove C. hominivorax completely from Sanibel Island was due to the migration of flies from nearby Florida. The results of the Sanibel test were inconclusive. Scientists felt that more proof of the feasibility of eradication was needed before they could try to start an eradication program. Another test was conducted on the Island of Curacao, 40 miles north of Venezuela, in the summer of 1954. The screwworm was completely eliminated from that island.

The U.S. Department of Agriculture's Agricultural Research Service had decided that its Animal Disease Eradication Division (later called the Animal Health Division) would be responsible for any large scale eradication effort. Florida producer groups such as the Florida Cattlemen's Association had heard of the research in screwworm eradication. They now began to pressure the U.S. government to start an eradication program in the Southeastern United States. Producers and producer groups were to play a vital role in the U.S. eradication effort from that time. Dissemination of the eradication program in the U.S. was greatly facililtated by livestock producers' desire to rid themselves of a costly pest.

Lack of funds slowed the implementation of the program in Florida. The U.S. Department of Agriculture wanted the state to match the funds that were to be provided by the Federal government. Intense lobbying efforts by livestock producers convinced the Florida legislature to appropriate the needed funds. The legislature also implemented a tax on livestock sold at auction markets. The money collected was to be used for the eradication effort. With this beginning, U.S. producers would provide millions of dollars for the eradication effort over the next several years.

By 1959 the eradication program had been implemented in all of the Southeast. The first barrier, or demarcation line between infested and uninfested areas, was established along the Mississippi River.

Producers in the Southwestern United States began to wonder if eradication might not be feasible in their area of the country. Lyndon Baines Johnson, at that time majority leader of the U.S. Senate, also became interested in the eradication effort. He pushed the U.S. Department of Agriculture to determine whether or not the sterile fly method would work in Texas and the rest of the Southwest. The method had proven successful in the Southeast but the Southwest presented new problems. The land area was larger and cattle coming from Mexico might cause reinfestation.

Senator Johnson conferred with U.S. President Eisenhower and Mexican President Lopez Mateo about extending the eradication program. There was now a possibility of implementing the U.S. Department of Agriculture scientists' discoveries internationally. The Republican administration of President Eisenhower, however, was emphasizing fiscal restraint. Very intense political pressure from ranchers and livestock organizations was to prove necessary before eradication was attempted in the Southwest.

Congress indicated that producers would have to provide half of the funds if a program were to be started. A non-profit organization, called the Southwest Animal Health Research Foundation (SWAHRF), was formed to collect funds. In contrast to the Florida campaign, funds were to be collected directly from producers. The first chairman of the foundation was Charles G. Scruggs editor of <u>Progressive Farmer</u> magazine (Scruggs, 1975).

SWAHRF, the newly formed foundation, decided that the fund raising effort should mostly be conducted on a county basis. County agents and vocational agricultural teachers sought out influential livestock producers and formed county screwworm committees. The county committees conducted county wide meetings of livestock producers. A list of all producers in each county was compiled and people were assigned to visit each producer. In this way almost everyone who would benefit from the eradication effort could be asked to contribute. The effort to involve those who would benefit from the program was successful. SWAHRF was able to collect 3 million dollars from livestock producers.

As eradication proceeded in the Southwest, a new barrier zone was formed along the border between Mexico and the U.S. By 1966 the Southwest was virtually free of screwworms. The new barrier, however, was very expensive to maintain. There was a continual threat of reinfestation from livestock brought in from Mexico. Those working in the eradication program realized that eliminating screwworms from that neighboring country would give the U.S. a larger margin of safety. They also felt that the U.S. should pay for 72 percent of the program since Mexico had limited funds and the U.S. would benefit greatly from a Mexican eradication effort. This funding plan encountered opposition in the U.S. Senate. That opposition was to halt continuation of the program in Mexico until 1972. During that year money was appropriated to initiate the Mexican program. A joint Mexican-United States

Screwworm Eradication Commission was formed. Screwworms have now been eliminated in Mexico as far south as the Isthmus of Tehuantepec. Figure 1 shows how the eradication effort has moved the critical line south through North America.

The Permanence of Screwworm Control

As long as the screwworm exists in the Western Hemisphere there will be a danger of reinfestation in areas where the sterile male technique has been used. Twenty-two years after they had been eliminated from the island of Curacao, screwworms reappeared. It was suspected that cattle imported from Colombia might have been infested. The inhabitants of the island had largely forgotten how to deal with the parasite. There was an atmosphere of hysteria. It was necessary to mount a program to reeducate the people of Curacao about managing the pest (Tannahill and Snow). What happened in Curacao could happen in any region which has had an eradication campaign. Eradication can never be called truly permanent until *Cochliomyia hominivorax* has vanished completely from the Americas.

The Possibility of the Eradication Program Being Expanded

Twenty-six years have passed since it was demonstrated that screwworm eradication is feasible in a large land mass. Even though Mexico and the United States have been largely cleared of the pest, it is still encountered in many regions of the Americas. It is found in

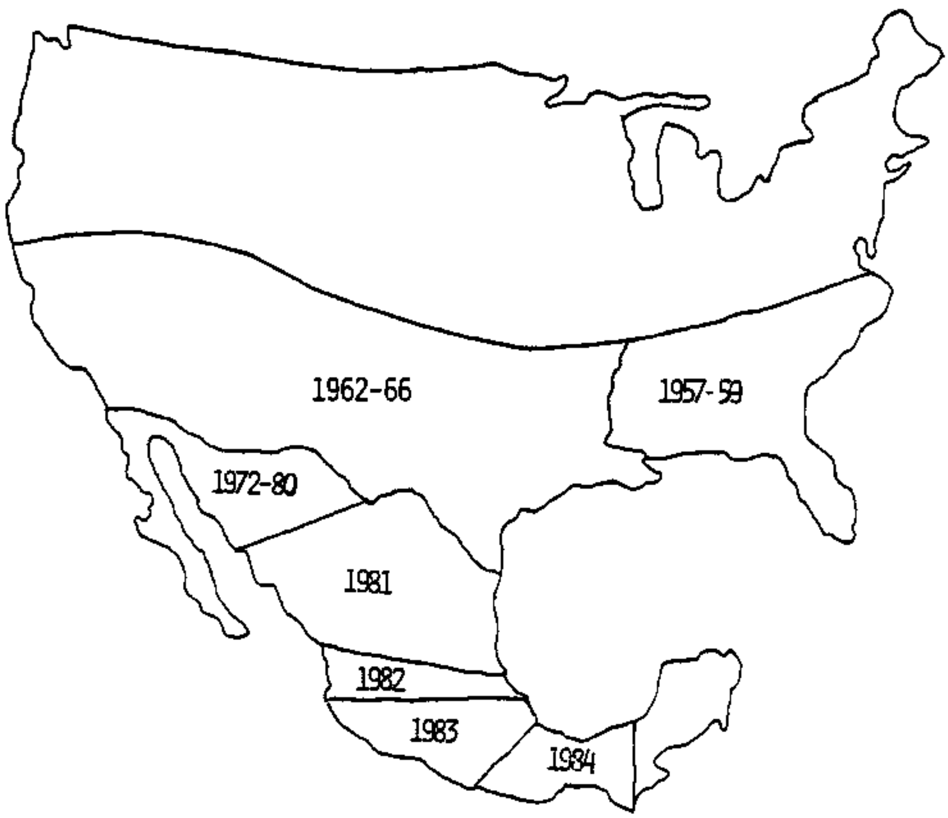

Figure 1. The progress of screwworm eradication in North America

South America as far south as Southern Brazil and Northern Chile. *C. hominivorax* is endemic in Central America and parts of the Caribbean. The next area to which the institutions and people dedicated to screwworm eradication might turn their attention is the total elimination of the parasite from the Americas. A program has been proposed for Central America. Researchers have also theorized that the sterile fly method would work well on the islands of Trinidad and Tobago and in at least parts of Surinam and Guyana (Rawlins and Others, 1983). A high degree of international cooperation would be necessary if those proposed programs were to be successful. If *C. hominivorax* were to be eliminated from Jamaica, for example, that country might face a continual threat of reinfestation from the eastern tip of Cuba (Rawlins and Sang, 1984).

Strong economic justification would be necessary before a group of countries undertake a project as demanding as screwworm eradication. Governments or individuals would have to commit substantial resources. A study such as this can provide decision makers with results that will help them decide whether or not to provide the resources needed for screwworm eradication.

CHAPTER III

THEORETICAL CONCEPTS

The theoretical concepts of producers' and consumers' surplus offer an approach to evaluating the economic impact of a change in technology. The eradication of the screwworm in Mexico is an example of a change in technology which is thought to cause increased livestock production in that country and a reduction in producers' unit costs. Those changes have effects on the welfare of producers and consumers. The economic concepts of producers' and consumers' surplus will be used to estimate the economic impacts of the screwworm eradication program.

Supply and Demand

A supply curve is a schedule of the different quantities of a good that producers are willing to place on the market as the good's price varies. This curve is usually positively sloped indicating that as the market price rises, producers will supply more of the good. Assuming that producers are profit maximizers they will continue to increase production until their marginal cost, the cost to them of increasing output one unit, is equal to their marginal revenue, the revenue which they can obtain by selling one more unit. A producer's supply curve is the same as his marginal cost curve over the part of the range of the marginal cost curve where marginal cost is above average variable cost.

A demand curve is a schedule of the quantity of a good that consumers are willing to take from the market at alternative prices. The slope of a demand curve is normally negative. This indicates that as a good's price rises, consumers will take less of that good.

When the demand and supply curves of a good are expressed as graphs and plotted together they have a single point of intersection. That point is where the demand for the good and the supply of the good are equal. In a competitive market the intersection of the two curves identifies the market price of the commodity and how much of the commodity will be produced and sold. The price and quantity identified by the two curves' intersection are known as the equilibrium price and quantity. Figure 2 illustrates the supply and demand curves of a good. The line labeled S is the supply curve and the one labeled D is the demand curve. Equilibrium price and quantity are labeled respectively as p* and q*. A thorough discussion of the concepts of supply and demand is found in Browning.

Consumers' and Producers' Surplus

The demand curve illustrates that the consumer is willing to pay progressively less for each additional unit of a good that he purchases. A consumer's willingness to pay is the price that he will pay for any given additional unit of a good. This is a measure of the marginal value or marginal benefit of that unit to the consumer. Intersection of the supply and demand curves, however, determines the price per unit of the good. For each unit purchased, the

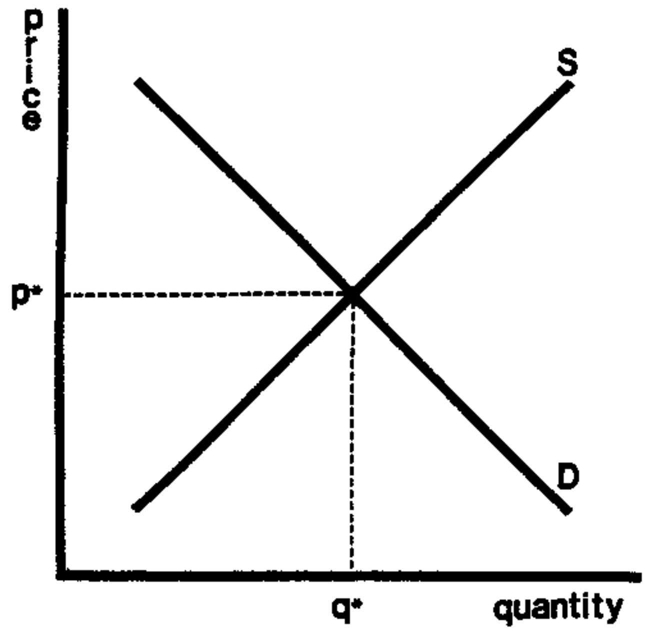

Figure 2. The supply and demand curves of a good

difference between the consumer's willingness to pay, which is illustrated by the demand curve, and the actual price of the good is the net benefit or surplus received by the consumer. The sum of the net benefits for each of the units bought is defined as consumers' surplus. Consumers' surplus is illustrated graphically as the area between the demand curve and the market price line. In Figure 3 the supply and demand curves from Figure 2 have been reproduced. In this graph the dot shaded triangular area, abp*, is consumers' surplus.

The supply curve shows that producers increase output of a good in response to an increasing price for that good. This is due to the positive relationship between costs of production and the level of production. The price associated with each sequential unit of output

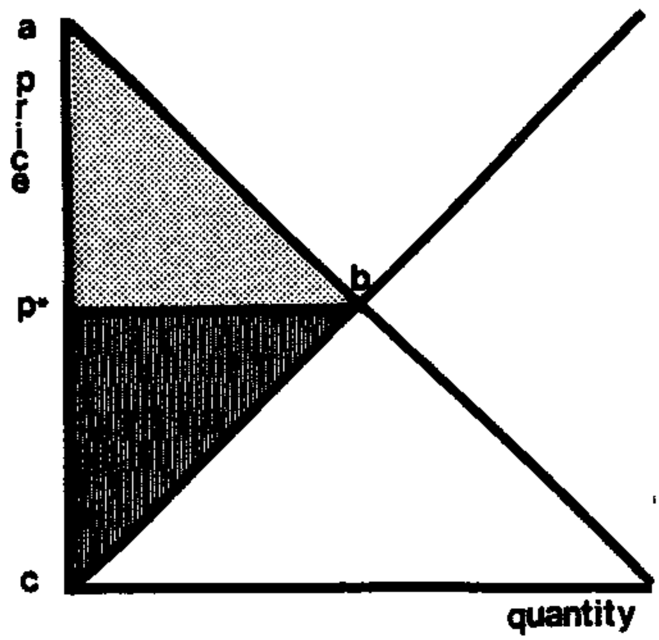

Figure 3. Producers' and consumers' surplus

on the supply curve is the price at which the producer would be willing to produce that next single unit of output. The price which will be obtained for all the units produced, however, is determined by the intersection of the demand and supply curves. Producers' surplus is the difference between the market price of a unit and the price at which the producer would have been willing to produce that unit (e.g. the supply curve). This return above the variable cost of production is also called economic rent. The sum of the returns above variable cost from all the units produced is the total producers' surplus. Producers' surplus is represented graphically in Figure 3 as the area between cbp* the supply curve and the price line. Just, Hueth, and

Schmitz give a detailed discussion of producers' and consumers' surplus.

Measuring the Social Benefits of Public Programs

A public program such as screwworm eradication can be expected to cause an increase in the supply of livestock. Graphically this increase would be represented as a rightward movement of the supply curve. A shift in supply causes a change in total consumers' surplus, total producers' surplus, and the distribution between the two. A hypothetical increase in supply is illustrated in Figure 4. In this figure S_1 is the original supply curve for livestock and S_2 is the new supply curve after eradication of the screwworm. Although S_2 has been depicted as parallel to S_1, the exact nature of the shift in supply caused by the eradication program is not known.

An ideal economic evaluation of a program that causes a supply shift would measure the changes in consumers' and producers' surplus separately to identify benefits and costs by group. Producers' and consumers' surplus are the net benefits of each group and are thus appropriate for use in constructing a benefit-cost ratio. In Figure 4 the increase in supply causes the price to drop from p1 to p2. The quantity supplied by producers has risen from q1 to q2. Consumers' surplus increases by the area p1acp2 in response to the increased supply and lower price. Due to the decrease in price, producers experience a decrease in their surplus of area p1abp2. The increase in

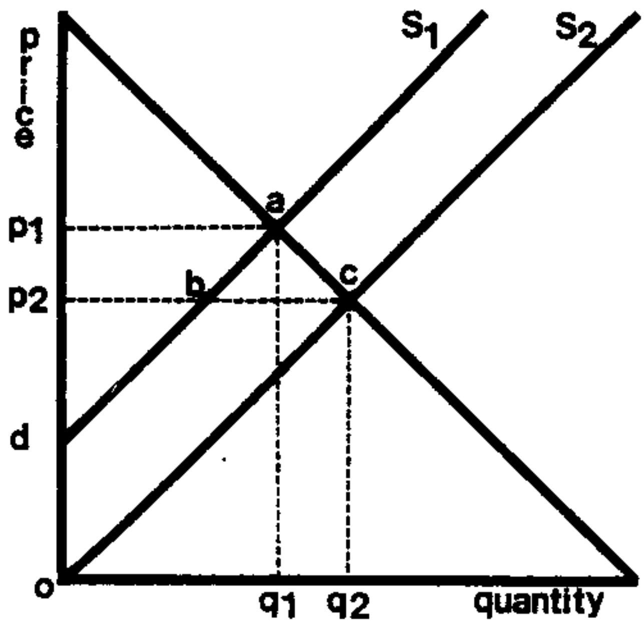

Figure 4. An increase in supply and its effect on surpluses

quantity produced increases producer's surplus by the area bcod so the net change in producers' surplus is bcod minus plabp2.

Up to this point the discussion of consumers' and producers' surplus has been based on a freely operating market where prices are allowed to fluctuate without constraints. In Mexico, prices for many types of basic commodities are regulated by the government. When price controls are in effect, market data from which demand curves can be derived is not available. Without knowledge of the demand curve, consumer surplus cannot be calculated. Thus conditions dictate that the impact of the screwworm eradication program in Mexico be gauged in terms of producers' surplus. The effect on consumers' surplus can be hypothesized but not evaluated quantitatively.

Figure 5 shows a producer's marginal cost curve, MC, and average variable cost curve, AVC. In this graph it has been assumed that the producer faces a government established price, pg. The price line in this case also represents the producer's marginal revenue for each unit sold. Assuming that the producer is a profit maximizer the amount he will produce is determined by the intersection of the marginal cost curve and the price line. Marginal cost will be equal to marginal revenue at the point of intersection of the marginal cost and marginal revenue curves. In Figure 5 the profit maximizing level of output is quantity q.

Producers' surplus can be thought of as the difference in total revenue and total variable costs. The total variable costs of production can be arrived at by multiplying the producer's average variable cost per unit by the quantity of units produced. Using this method in Figure 5 total variable costs are cbqo and total revenue is pgaqo. The area pgabc, the difference between total variable costs and total revenue, is producers' surplus. This area will be the same as pgao. In the following discussion producers' surplus is illustrated as the difference in total revenue and total variable costs or pgabc.

Economic Evaluation of the Eradication of the Screwworm in Mexico

It is hypothesized that the major effects of screwworm eradication in Mexico include a lowering of producers' production costs and an increase in livestock output. Decreased expenses for medicine, labor,

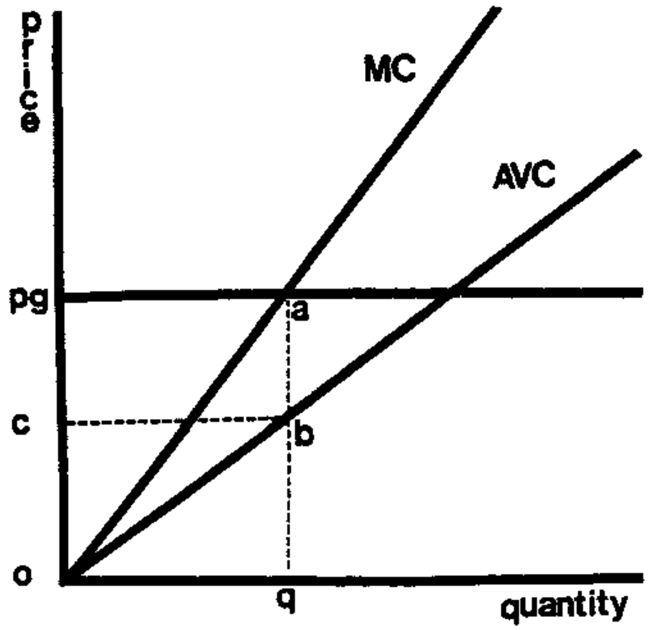

Figure 5. Producers' surplus and the variable cost curve

veterinarian services, and other variable costs are expected to cause a decline in production costs. Reduced weight loss and death loss would cause an increase in production.

In Figure 6 producers' average cost and marginal cost curves before eradication are labeled MC1 and AVC1, respectively. The hypothesized shift in producers' costs due to screwworm eradication is illustrated in the graph by the post screwworm cost curves MC2 and AVC2. Producers' surplus, originally pgadc using the before eradication average variable cost curve, becomes pgbhf using the average variable cost curve after eradication. Thus in this hypothetical situation screwworm eradication increased producers' surplus by the area abhfcd.

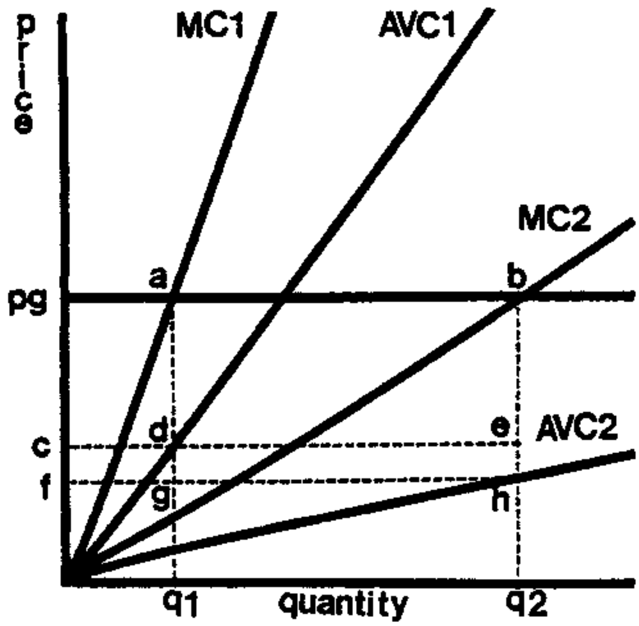

Figure 6. The economic impact of screwworm eradication in Mexico

In Figure 6 the decline in the average variable cost of production incurred by the producer is the change from c to f, given no demand shifts during the eradication period. From a survey of Mexican livestock producers, the reduction in average variable costs of production is quantifiable. Therefore, this area of reduced average costs, cehf, will be estimated in this study.

The estimated increase in total revenues in this diagram is the rectangle abq2q1. That rectangle is the product of the extra quantity produced (that can be attributed to the eradication of the screwworm) and the price, pg, received by the producer. An estimate can also be made of this area by using secondary data and data obtained from livestock producers. However, the area ghq2q1 is not a valid part of producers' surplus and thus overestimates net benefits. This area is actually the increase in the producer's variable costs that results from the additional production made possible by eradicating screwworms from Mexico.

The two main effects of eradication measured via results of the livestock survey overlap by the area dehg. This overlap along with the invalid part of the increase in total revenue, ghq2q1, seriously complicate an effort to completely measure producers' surplus. However, methodology was developed for measuring producers' surplus using the survey data and additional secondary data. This measurement was made only for the cow-calf section of the study. The methodology developed for measuring total producers' surplus is detailed in the Procedures Section. For all other livestock categories, the increase in producers' surplus measured in this study is the region cehf only.

In this study the effect of screwworm eradication on the variable costs of Mexican livestock producers was considered to be the major economic impact of the eradication program. The reduction in price and increase in supply of livestock products would be expected to significantly increase consumers' surplus. This study did not evaluate benefits to the consumer which resulted in a conservative estimate of the economic impact of the screwworm eradication program in Mexico.

CHAPTER IV

PROCEDURES

Estimating the economic impact of the eradication of the screwworm in Mexico involved several steps. These included separating the country into zones, designing survey instruments, drawing a sample of livestock producers, training enumerators, surveying selected producers and analyzing the data from the questionnaires.

Study Area Delineation

Mexico was divided into nine zones to facilitate this analysis. This was accomplished with the close cooperation of Dr. James E. Novy, head of the Mexican-American Screwworm Commission. Mexico's Federal District and state of Tlaxcala were not included in any zone since they have not been infested with screwworms in recent history.

The division of Mexico into zones was accomplished by grouping states from which the screwworm had been eradicated in the same year. Screwworm eradication in Mexico started in the North and progressed towards the South. The screwworm was eliminated from parts of Mexico bordering the United States up to seven years before it was eliminated in the Isthmus of Tehuantepec. Eight zones were formed from the area of Mexico from which screwworms had been eradicated prior to the time of this study. The three states in Mexico where screwworms were still present when the study was conducted; Campeche, Yucatan, and Quintana

Roo, were placed into a single separate zone.

Preparation of the Questionnaires

Two questionnaires were developed to provide base data for estimating the economic impact of the screwworm on Mexican Livestock producers, or alternatively, the benefits of eradication. In each of the two survey instruments questions were included about ten livestock categories; cow-calf, feeder cattle, feedlots, dairy cattle, swine, sheep, goats, horses, poultry, and work animals. One of the questionnaires was designed to be administered in the area of Mexico from which screwworms had been eradicated (eradicated area), the other was to be administered in the zone where screwworms were still present at the time of the study (infested area).

Both questionnaires asked for information in two general categories; the impacts of the screwworm on livestock production costs and producers' revenues. The expenses of producers in zones 1-8 for labor, insecticides, medicines, feed, veterinarian services, and equipment were expected to have been decreased by the elimination of the screwworm. Producers' revenues in those zones were expected to have been augmented since the eradication campaign should have decreased their death losses, increased their animals' birth rates, and diminished loss of sale weight stemming from screwworm attack.[1]

[1]The theory chapter discusses conditions in Mexico that influence the relationship between price received by livestock producers and changing output levels

Producers in zone 9 were expected to still be experiencing extra costs and revenue losses due to the presence of screwworms. In addition to gathering data about effects of the screwworm both questionnaires included questions about each livestock operation such as the number of animals owned.

Although the same questionnaire was used in zones 1-8, producers were asked to respond about production and cost effects of the screwworm for a different year in each zone. The year to be responded about in each zone was the last year when the screwworm had presented a serious problem. Data about 1984 were collected with the zone 9, or infested area, questionnaire. The states in each zone and the year about which producers were asked to respond in that zone are shown in Table 1.

Both of the survey instruments were designed to be administered by field employees of the Mexican-American Screwworm Commission. Those commission employees were experienced in working with livestock producers in rural Mexico. Many of them had been stationed in the areas where they conducted interviews. This facilitated their effectiveness in locating the producers and completing the survey.

The questionnaires were pretested several times in the United States and in Mexico. Based on the pretests, modifications were incorporated and the questionnaires finalized and printed. A copy of the eradicated area questionnaire is included in Appendix A.

Table 1. Division of Mexico Into Zones for Screwworm Eradication Impact Study

Zone	State	Year[a]
1	Baja California Norte Sonora Chihuahua	1978
2	Baja California Sur	1977
3	Coahuila Nuevo Leon Tamaulipas	1976
4	Sinaloa Durango Zacatecas San Luis Potosi	1979
5	Nayarit Jalisco Aguas Calientes Guanajuato Hidalgo Queretaro	1980
6	Michoacan Colima Mexico Morelos Veracruz Puebla	1981
7	Guerrero	1982
8	Tabasco Chiapas Oaxaca	1983
9	Campeche Yucatan Quintana Roo	1984

[a]This is the last year screwworms were a problem in a zone, producers were asked about the impacts of the screwworm on their livestock in this year.

Sample

Membership lists of the Mexican National Livestock Producers' Confederation (CNG), which is headquartered in Mexico City, were used as the base for drawing the sample of producers to be surveyed. The CNG's lists were the only extensive, centralized lists of Mexican livestock producers available. The CNG is an umbrella organization for regional unions which are located throughout the country. Each union is made up of local associations. The membership rolls of local associations are sent to the central CNG office in Mexico City where they are grouped by state.

Before drawing the sample the percentage of the CNG's members that were located in each of the study zones was calculated. This required that all of the association membership lists first be sorted by zone. For purposes of drawing the sample all the association lists from a zone were considered to constitute one continuous list. Any list that did not include its members' addresses was not considered for use in drawing the sample. The number of producers belonging to the Confederation in each study zone was then tabulated. A total of 294,638 livestock producers were counted in the nine study zones. The percentage of the CNG's membership found in each zone was calculated by:

(1) $\%PROD_i = PROD_i \,/\, 294{,}638 \qquad (i=1,..,9)$

where:

$\%PROD_i$ = percentage of CNG's producers in zone i

$PROD_i$ = number of CNG's producers in zone i

Dr. Rudolf Freund, a statistician at Texas A&M University, indicated that approximately 500 Mexican livestock owners would constitute an adequate sample size for the country of Mexico. However, a target sample size of 2,500 was selected due to the anticipated problem of inadequate addresses and difficult transportation in many areas of rural Mexico making it difficult to contact many of the producers on the Confederation's lists. To assure having sufficient names to provide a sample of 2,500 producers, a total of 5,000 names was drawn from the lists of members.

The number of names to be drawn from each study area zone was calculated by:

(2) $NAME_i = \%PROD_i * 5{,}000 \quad (i=1,...,9)$

where:

$NAME_i$ = number of names to be drawn from zone i

To remove any drawing bias, a set number of producers' names was skipped between names selected from each zone's list. The interval of producer names to be skipped was determined by:

(3) $INTR = 294{,}638 / 5{,}000$

where:

INTR = interval of names to be skipped when drawing names

The first name on each zone's list was drawn and then 294,638 / 5,000, or 59, names were skipped before the next name was drawn.

The names and addresses picked in this manner were copied and later typed for distribution to the enumerators. Each enumerator was given only the names of the producers selected from the area which he was assigned to survey. Table 2 presents the number of producers from each study area zone that were scheduled to be interviewed.

Table 2. Sample Size per Study Area Zone

Zone	Number of Interviews
1	230
2	23
3	86
4	625
5	626
6	714
7	18
8	157
9	23
Total	2,500

The list given to each enumerator contained twice as many names as that individual was assigned to interview. To maintain unbiased selection criteria, each of the enumerators was instructed to use the odd numbered names on their list. If the person they were to interview could not be located the interviewer was instructed to choose the even numbered name immediately below the one originally chosen. In cases where the second person chosen also could not be located, the enumerator was told to use the even numbered name immediately above the original name chosen. At any time when ten consecutive names could not be located, the enumerators were instructed to contact the research team at Texas A&M University for alternative instructions.

Enumerator Training

To minimize confusion and assure consistent data, a two day training workshop was conducted in June 1985 at Veracruz, Mexico for the Mexican-American Screwworm Commission employees who would be conducting the personal enumeration of livestock producers in Mexico. Agricultural Economists with extensive experience in survey based research conducted the training. A major objective of that training session was to educate the enumerators about the need to use a scientific methodology and to be completely impartial when conducting the personal interviews with producers.

The purpose of each question and all the procedures to be used, such as how to replace a person that could not be located, were explained to the enumerators in detail during this seminar. They were also given background information about the purpose of the study and how the people they were to interview had been selected. On several occasions during the seminar the enumerators participated in practice sessions relating to completing questionnaires.

Each enumerator was given a copy of a manual that contained instructions and examples relative to completing the survey instrument. It was designed to serve as a reference for the enumerators when they were working in the field. A copy of the enumerator's manual is included in Appendix B.

Survey Process

In June 1985 interviews with the selected Mexican livestock producers began. The personal interview phase was planned to be completed by November, 1985. However an outbreak of screwworms in northeast Mexico and an earthquake in Mexico City slowed the survey's progress and lead to a shutoff date for enumeration of May 15, 1986.

Each week the enumerators reviewed each of the questionnaires they had completed to assure that they were correctly completed. The questionnaires were then sealed in a large envelope. The envelope was signed, dated and given to the enumerator's supervisor. The supervisor sent the questionnaires, still in their sealed envelopes, to a second supervisor who lived close to the Mexican-United States border. He crossed the border each week and sent all the questionnaires by bus to Texas A&M University.

Upon arriving at A&M University each of the questionnaires was checked for completeness and catalogued. Any questionnaires from which data had been omitted were returned to the enumerators for completion. Each enumerator's performance was monitored continuously in order to insure that each individual was correctly completing the survey instruments. When it was noted that an enumerator was having difficulty, he or his supervisor was contacted by phone and given instructions.

Site Visits

Two site visits were made to Mexico by the research team from Texas A&M University. The first of those trips was to the state of Sonora in the eradicated zone. The second was to the state of Campeche in the infested region.

The purpose of those two visits was to meet with individual Mexican cattlemen and local associations of the National Cattleman's Confederation. That was accomplished by visits to representative ranches and meetings with producer panels. Meeting with producer panels enabled the researchers to contact a large number of livestock producers representing all scales of livestock production.

All the Mexican livestock producers contacted were asked about past and present impacts of the screwworm on their operations. Researchers could then compare those responses to the data collected from the questionnaires. This allowed the researchers to check for any enumerator bias.

Analysis of the Data

Data recorded on the questionnaires were transferred to computer tapes by employees of the Texas Agricultural Extension Service.

Separate data sets were prepared for the eradicated and infested areas. All data entered on the tapes were checked to insure that they had been accurately copied from the questionnaires. These data provided the basis for computer analysis of the expected economic impact of the screwworm on Mexican livestock producers. Almost no data were collected on the effects of the screwworm on poultry production. Therefore only the other nine livestock categories were analyzed.

The impacts of the screwworm such as animal deaths and increased costs were estimated separately for the eradicated and infested areas. Estimation procedures for the impact of the screwworm in the two areas differed only in the data sets used. The additional costs and reduced production attributed to screwworm infestation in the eradicated area of Mexico can be expected to have continued if the pest had not been eliminated. Benefits from the eradication program gained by producers in that area can thus be considered as the impacts they reported for the last year that screwworms had effected their operations. Data from the infested area detailed the 1984 increase in costs and decrease in livestock production due to the screwworm. That data indicated what the benefits to producers would be if the screwworm were eradicated from the Yucatan Peninsula.

The procedures used to analyze the cow-calf data are presented here. They were used as a model for the other livestock categories and are therefore representative of the methods used for analysis of all livestock categories.

Adjustment of Reported Screwworm Related Costs

Over the years about which producers in the eradicated area were asked there was severe inflation in Mexico. Monetary data reported on the questionnaires had to be adjusted to a common base before being analyzed. All peso values reported on the eradicated area questionnaires were converted to their 1984 equivalents using price indices available from the Department of Economic Research, Bank of Mexico. These indices are presented in Table 3. Costs for medicines and insecticides were adjusted using the chemical index. All other costs of production reported on the questionnaires were adjusted using the agricultural index. This procedure accounted for the effect of inflation and put all values for all years on a 1984 basis. However, it did not account for the time value of money. No adjustment was necessary for peso figures reported from the infested area since producers in that area were responding to questions about 1984.

All peso figures from the eradicated area were converted to 1984 pesos using the following equation:

(4) $VAL84 = VALYR_j * (PI84 / PIYR_j) \quad (j=1976,...,1983)$

where:

$VAL84$ = value of reported figure in 1984 pesos

$VALYR_j$ = value reported in the questionnaire for year j

$PI84$ = 1984 price index value

$PIYR_j$ = price index value for year j

Table 3. Price Indices Used to Adjust Reported Peso Values to a 1984 Base

Year	Zone	Agricultural Index	Chemical Index
1976	3	70.8	68.7
1977	2	85.7	88.6
1978	1	100.0	100.0
1979	4	118.0	111.9
1980	5	151.7	139.1
1981	6	196.4	173.5
1982	7	164.8	270.4
1983	8	494.6	643.1
1984		812.1	1,109.4

Source: Department of Economic Research, Bank of Mexico.

Estimating the Impact of the Screwworm

Estimation of the screwworm's impacts on a livestock category was done on the basis of one designated type of animal from that category. Determination of the screwworm's impacts on a per animal basis was necessitated by the number of years spanned by the survey and the limited data for Mexican livestock inventories. The animal used as the basis for calculation in a category will hereafter be called that category's expansion animal. In each livestock category, except for the work animals, stockers, and feeders, the expansion animals were female breeding animals. The expansion animals selected for the work animals, stockers, and feeders were respectively, adult work animals, stocker cattle and feeder cattle. The procedures used to estimate screwworm impacts are presented for the cow-calf category only since the same procedures were followed for all categories. All the impacts of the screwworm were calculated on an annual basis.

Death Losses

The first step in estimating screwworm induced death losses in the cow-calf category was to quantify the total number of breeding cows (TBC) owned by the producers that had been sampled. The numbers of cows, calves, and bulls killed by screwworms in Mexico on a per expansion animal basis was then calculated by:

(5) $BCK = TBCK / TBC$

(6) $CK = TCK / TBC$

(7) $BK = TBK / TBC$

where:

BCK = breeding cows killed per breeding cow from survey

TBCK = total breeding cows killed by screwworms from survey

TBC = total number of breeding cows from survey

CK = calves killed by screwworms per breeding cow from survey

TCK = total calves killed by screwworms from survey

BK = bulls killed by screwworms per breeding cow from survey

TBK = total bulls killed by screwworms from survey

Number of Calves Whose Development Was Affected by Screwworms

For estimating several of the effects of the screwworm it was first necessary to determine the number of calves whose development was affected by screwworms annually. To accomplish this each surveyed producer's annual calf crop was established by:

(8) $CC = BC * CR$

where:

CC = total annual calf crop per questionnaire

BC = number of breeding cows reported on the questionnaire

CR = calving rate reported on questionnaire

The number of calves by questionnaire that were infected by screwworms was:

(9) $IC = CC * IFR$

where:

IC = total number of calves infected by screwworms per producer

IFR = infestation rate reported by the producer

For those producers where some calves were reported killed by screwworms, the total number of surviving calves whose development was affected by the infestation was calculated by:

(10) $CA = IC - CKBS$

where:

CA = number of calves per questionnaire whose development was affected by screwworms

CKBS = number of calves per producer killed by screwworms

In those observations where some calves were attacked by the screwworm but none died as a result of those attacks, CA was considered to be equal to IC. Any questionnaire that reported a number of calves killed by screwworm greater than the total number of calves in the herd (CC) was discarded.

Extra Production Days

The growth of calves infested with screwworms was often slowed. Producers incurred extra cost due to the additional production days that were necessary before their animals could be sold. The number of extra days of production time per producer caused by screwworm infestation was determined by:

(11) EXDAYS = CA * INC

where:

EXDAYS = extra days of production time per producer made necessary by screwworm

INC = increase in production time per affected animal

The additional cost to each producer of the extra production time was calculated by:

(12) COST = EXDAYS * PESOS

where:

COST = cost for additional days of production time

PESOS = cost of maintaining a calf per day as reported by the producer

This cost was extrapolated from the producer level to the eradicated area of Mexico on a per expansion animal (breeding cow) basis as follows:

(13) COSTHD = TCOST / TBC

where:

COSTHD = extra cost per breeding animal across Mexico (eradicated area) in 1984 pesos of increased production time made necessary by screwworm attack

TCOST = sum of costs to all surveyed producers in Mexico (eradicated area) in 1984 pesos of additional production days made necessay by screwworm infestation in calves

Sale Weight Loss

Some calves lost weight as a result of screwworm attack. The amount of sale weight loss caused by screwworm per surveyed producer was calculated by:

(14) KCHANGE = CA * KILOS

where:

KCHANGE = total sale weight loss of calves in kilograms per questionnaire

KILOS = number of kilograms of sale weight lost by a calf affected by screwworms as reported by the producer

As for increased production days due to screwworm, the amount of sale weight lost per breeding cow over all of the eradicated area of Mexico was estimated by:

(15) KLH = TKCHANGE / TBC

where:

KLH = kilograms of sale weight lost per breeding animal across Mexico (eradicated area)

TKCHANGE = sum of all kilograms of sale weight lost by the producers surveyed in Mexico (eradicated area)

Additional Variable Costs

Costs stemming from screwworm infestation for medicine, insecticides, veterinarian services, confinement of animals, and equipment were reported on the questionnaires as totals for the farm or ranch. These were evaluated by dividing the total cost in 1984 Pesos incurred over all the surveyed producers in the eradicated area of Mexico by the total number of female breeding animals as shown below:

(16) MED = TOTMED / TBC

(17) INS = TOTINS / TBC

(18) VET = TOTVET / TBC

(19) CON = TOTCON / TBC

(20) EQU = TOTEQU / TBC

where:

MED = cost per breeding animal in Mexico for medicine used to treat screwworm

TOTMED = sum of all costs incurred by surveyed producers for medicine to treat screwworm

INS = cost per breeding animal in Mexico for insecticide used to prevent screwworm

TOTINS = sum of all costs incurred by surveyed producers for insecticides used to prevent screwworm

VET = cost per breeding animal in Mexico for payments to veterinarians for treating animals infested by screwworms

TOTVET = sum of all cost incurred by surveyed producers for payments to veterinarians for treating animals infested by screwworms

CON = cost per breeding animal in Mexico of confining cattle in order to prevent screwworm attack or treat infested animals

TOTCON = sum of all costs incurred by surveyed producers for confinement of cattle that had been attacked by screwworms or were threatened by screwworm

EQU = cost per breeding animal in Mexico of additional equipment made necessary by the presence of screwworms

TOTEQU = sum of all costs incurred by surveyed producers for additional equipment made necessary by the presence of screwworms

All of the above per expansion animal estimates of the impact of the screwworm were later used for making more aggregated estimates of the screwworm's impact.

Expansion Animal Inventories

To estimate the economic implications of the Mexican eradication program and the expected benefits of a Central American screwworm eradication campaign, expansion animal inventories were required for both regions. For Mexico it was necessary to determine the number of expansion animals per study zone in each of the livestock categories included in the study for the years 1976 through 1984. Since yearly data published by the U.S. Foreign Agricultural Service indicated that livestock inventories had not fluctuated greatly in Mexico from 1981 through 1984, the 1984 inventories were adopted for those four years. Stable inventories from 1976 through 1980 suggested that 1980 inventories were applicable for 1976 through 1980. Central American expansion animal inventories were needed only for 1984.

Mexico

Secondary data collected in Mexico was not sufficiently detailed to give all the needed data on expansion animal inventories for the years 1976 and 1984. A procedure using the available secondary data and estimates by livestock specialists was developed to estimate the annual inventories of expansion animals by zone.

Statistics that were available about Mexican livestock numbers in 1984 are given in Table 4. Additional unpublished data from the United States Foreign Agricultural Service that gave further information on the composition of the 1984 cattle herd is given in Table 5.

Inventory data reported in Table 5 included the numbers of 1984 expansion animals in the cow-calf and dairy categories and made possible the estimation of the number of expansion animals in 1984 in the stocker and feeder categories. After the beef cows, dairy cows, and the calf crop reported in Table 5 were subtracted from the total cattle reported for 1984 by the U.S. Foreign Agricultural Service, 12,991,000 head remained. Livestock specialists at Texas A&M University estimated that a number of cows which was equal to 15 percent of the total beef and dairy cows, or 1,935,400 cows, would be used as heifer replacements in the dairy and beef herds. Those

Table 4. Mexican Livestock Inventory Data for 1984

Category	1000's of head of cattle
(1) cattle	33,917
(2) hogs	13,137
(3) sheep	6,400
(4) goats	10,380
(5) horses	5,640
(6) mules	3,619
(7) donkeys	2,818

Source: Categories 1-2, Foreign Agricultural Service, Foreign Agricultural Circulars, 1984. Categories 3-4, Food and Agricultural Organization of the United Nations, Monthly Bulletin of Statistics, Feb. 1985. Categories 5-7, FAO, FAO Production Yearbook, 1984.

Table 5. Partial Breakdown of 1984 Mexican Cattle Herd as Given by FAS

Category	1000's of head of cattle
Dairy cows	1,783
Beef cows	11,120
Calf crop	8,023

Source: Unpublished estimates, Foreign Agricultural Service, Mexico City

replacement heifers were also subtracted from the 12,991,000 head. With approximately one bull for each 20 cows in the cow-calf and dairy herds, 645,150 bulls were also subtracted. The 10,410,400 head left were divided evenly among stocker and feeder cattle giving 5,205,000 head in each of those categories.

The next step was to allocate the total expansion animals in the four cattle categories into the study's survey zones. That allocation was done by using the survey data to estimate each Mexican state's percentage of the total expansion animals in each cattle category. The equation is as follows:

(21) $\%ST_{mk} = \# STATE_{mk} / TOTEXP_m$ (k=1,..,30) (m=1,..,4)

where:

$\%ST_{mk}$ = percent of expansion animals of category m owned by surveyed producers in state k

$\#STATE_{mk}$ = number of expansion animals in category m owned by surveyed livestock producers in state k

TOTEXP = total number of expansion animals in category m owned by surveyed producers in all states

The k's in (21) refer to the states in Table 1 and the m's refer to the four cattle categories included in this study. Table 6 presents the total number of expansion animals from each cattle category that were owned by livestock producers surveyed in the eradicated area of Mexico.

Table 6. Total Numbers of Expansion Animals Owned by Surveyed Producers in Screwworm Free Zones

Category	Total Number of Expansion Animals in Survey
Stocker	14,513
Feeder	16,311
Beef Cow	81,066
Dairy Cow	9,583

Using the percentage of expansion animals in each of the four cattle categories in each state, the total number of expansion animals of each category in each state was calculated by:

(22) $STTOT_{mk} = \%ST_{mk} * NATOT_m$ (k=1,..,30) (m=1,..,4)

where:

$STTOT_{mk}$ = estimated number of expansion animals of category m in state k

$NATOT_m$ = total number of expansion animals in category m in the eradicated area of Mexico as determined from secondary data

The k's and m's in (22) have the same significance they have in (21). To determine how many expansion animals of each cattle category were found in the study's zones, the number of expansion animals in the states corresponding to each zone were summed.

For the swine category, an unpublished U.S. Foreign Agricultural Service report indicated that there were 905,000 sows in Mexico in 1984. Published data from Mexico's Sector Agricola Recursos Hidraulicos (SARH), Direccion General De Economia Agricola, allowed the calculation of the percentage of the swine herd found in each Mexican state. The number of sows per state was then calculated by:

(23) $SOWSST_k = \%SWNST * 905{,}000 \quad (k=1,..,30)$

where:

$SOWSST_k$ = number of sows in state k

$\%SWNST_k$ = % of swine herd in state k as determined by data from SARH

The k's in (23) are the states in Table 1. The sows per study zone were determined by summing the number of sows from the states corresponding to each zone.

In the other categories; sheep, goats, horses, and work animals;

estimates of the number of expansion animals were not available. The United Nations Food and Agriculture Organization, U.S. Foreign Agricultural Service, and Mexico's Sector Agricola Recursos Hidraulicos data reported only total herd size. It was necessary to utilize survey data to estimate the number of expansion animals in each of those categories. This was accomplished for each each of those categories by:

(24) $EXPAN_m = TOTHERD_m * PEREXPSURVEY_m \quad (m=6,...,9)$

where:

$EXPAN_m$ = number of animals in category m of the type to be used as expansion animals.

$TOTHERD_m$ = Total herdsize in Mexico of category m

$PEREXPSURVEY_m$ = percentage of animals in category m of the type to be used as expansion animals that were owned by surveyed producers

In (24) the m's refer to all the livestock categories other than cow-calf and swine.

For the sheep, goat, horse, and work animal categories, Sector Agricola Recursos Hidraulicos data from 1979 or 1980 were available which allowed the calculation of the percentage of the total herd in each state. These percentages were used to calculate the number of expansion animals per study zone in each of the four categories by the same procedure utilized for the swine. Before separating the horses into classifications by zone, the total reported horse herd had to be divided among horses for sale and work horses. Horses of each type were quantified for surveyed producers. The percentages determined in the survey were assumed to be representative of Mexico and were used to divide the total horse herd reported by the United Nations Food and Agricultural Organization into work animals and animals for sale. The total number of work animals in Mexico could then be determined by summing the numbers of work horses, mules, and burros.

Expansion animal numbers for 1976-1980 were estimated the same way as those for 1981 through 1984 for all livestock categories except the swine category. Inventory numbers that were available for the year 1980 are given in Table 7.

Table 7. Mexican Herd Sizes in 1980

Category	Herd Size
(1) Cattle	29,500
(2) Hogs	12,800
(3) Sheep	6,482
(4) Goats	9,638
(5) Horses	6,300
(6) Mules	3,109
(7) Donkeys	3,233

Sources: Categories 1-4, U.S. Foreign Agricultural Service, Foreign Agricultural Circulars 1980. Categories 5-7, United Nations Food and Agriculture Organization, FAO Production Yearbook, 1982.

As in the case of 1984, unpublished U.S. Foreign Agricultural Service data from 1980 were available that facilitated distributing the total cattle number into the four cattle categories included in the study. These data are given in Table 8.

Table 8. Partial Breakdown of 1980 Mexican Cattle Herd as Given by the FAS

Category	1000's of head
Dairy Cows	2,627
Beef Cows	10,615
Calf Crop	8,315

Source: Unpublished estimates, U.S. Foreign Agricultural Service, Mexico City

No FAS figure for sows was available in 1980 as was the case for 1984. Therefore, the percentage of sows owned by surveyed producers was used as the basis for estimating the total number of sows to be allocated among zones. The number of expansion animals per year from 1976-84 that lived in zones from which the screwworm had been eradicated is given in Appendix C.

Central America

Expansion animal inventories from Central America were needed only for 1984. The available data on livestock inventories in Central America for 1984 is presented in Table 9.

The only U.S. Foreign Agricultural Service data available about the breakdown of the cattle category in Central America was from Costa Rica and pertained to the year 1984. Those data indicated that 5 percent of the herd were dairy cows, 36 percent of the herd were cows in the cow-calf category, and 15 percent of the total herd was made up of the calf crop. The same procedure that was employed with the cattle

Table 9. 1984 Livestock Inventories in Central America

Category	Herd Size
Cattle	12,047,000
Swine	2,572,000
Sheep	678,000
Goats	130,000
Horses	914,000
Mules	187,000
Donkeys	42,000

Source: United Nations Food and Agriculture Organization, *Production Yearbook*, 1984.

inventory in Mexico was used to find what proportion should be allocated to the feeder and stocker sections. The percentages found in Costa Rica were considered representative of the rest of Central America due to a lack of reliable secondary data for other countries in that region.

The number of expansion animals in Central America for the livestock categories other than the cattle categories were estimated by:

(25) $CAEXPAN84_m = CAHERD_m * PEREXPSURVEY_m \quad (m=5,..,9)$

where:

$CAEXPAN84_m$ = number of expansion animals of category m in Central America in 1984

$CAHERD_m$ = total herd size of category m in Central America in 1984

There were no estimates of the percentage of each livestock category that was comprised of expansion animals for Central America. Therefore the estimates of those percentages derived from the Mexican study, ($PEREXPSURVEY_m$), were used. Horses in Central America were divided into work horses and horses for sale by using the percentages in each category from the Mexican survey. The total number of work animals in Central America was calculated by summing the number of work horse, mules, and burros, in that region.

Program Costs

The costs of the Mexican-American Screwworm Commission for the years 1977 to 1983 were adjusted for inflation and converted to 1984 dollars. In a separate step, the time value of money was incorporated by compounding pre 1984 values and discounting post 1984 values to derive a 1984 present value. Similar steps were conducted for benefits of screwworm eradication so that the estimated present value of costs and benefits could be compared.

Inflation Adjustment

Annual budgets for the Mexican American Screwworm Commission were available for the years 1977 to 1985. The amount spent by the Commission in the 1986 U.S. Fiscal year was supplied by Bill Sudlow of the U.S. Animal and Plant Health Inspection Service in a July 21, 1986 telephone interview. Yearly dollar expenditures from 1977 to 1984 as given in the budgets were adjusted for inflation and converted to a

1984 dollar basis using the United States Consumer Price Index reported in the 1986 edition of the Economic Report of the President. The methodology used for inflating the expenditures prior to 1984 was the same as that presented in equation (4) except for the price index used. The 1985 and 1986 expenditures were not seriously affected by inflation and were thus not adjusted. Table 10 gives the annual expenditures of the Mexican-American Commisson for 1977 to 1986 in 1984 dollars.

Table 10. Mexican-American Screwworm Eradication Commission Annual Expenditures by U.S. Fiscal Year in 1984 Dollars

Year	Annual Expenditure ($1000 U.S.)
1977	21,768.4
1978	23,881.8
1979	22,793.0
1980	22,697.2
1981	35,883.9
1982	43,992.0
1983	44,308.8
1984	38,861.0
1985	31,854.0
1986	31,589.0

Present Value Calculation

The effect of inflation was removed by using the price index to adjust values. However, the time value of money or the real interest rate remained. Thus, all values were estimated on a 1984 present value basis via compounding and discounting procedures.

The 1984 present value of each of the Commission's yearly expenditures from 1977 to 1983 was calculated by:

(26) $FUTVAL_{jr} = EXP_j * (1 + r)^n \quad (j=1977,\ldots,1983) \quad (r=3\%,\ 6\%,\ 8.625\%)$

where:

$FUTVAL_{jr}$ = the value of the expenditure in year j in 1984 present value terms calculated at discount rate r

EXP_j = the Commission's expenditure in year j as given in Table 10.

r = the discount rate used (a proxy for the real rate of interest)

n = the number of years between year j and 1984

Three different interest rates; 3%, 6%, and 8.625%, were used in each conversion of annual benefits and costs to 1984 present value terms. At the time of this study, 8.625% was the interest rate used for evaluation of resource projects by the United States Federal Government (telephone interview, Economics Branch, SCS, Fort Worth, 7/16/86). However, this discount rate includes an inflation component and represents a very high long term real rate of interest. The expenditure for 1984 was used without adjustment.

The 1985 expenditure was discounted to 1984 by:

(27) $PV85_r = \frac{EXP85}{(1+r)}$

where:

$PV85_r$ = value of 1985 expenditure discounted to 1984 using interest rate r

EXP85 = the Commission's expenditure in 1985

r = rate of interest (3%, 6%, 8.625%)

The amount budgeted for 1986 was assumed to continue to perpetuity. The present value of this stream of expenditures was calculated in 1984 terms by:

$$(28) \quad PERPEXP86r = \frac{EXP86}{r}$$

where:

$PERPEXP86_r$ = present value in 1984 basis of the budgeted amount for 1986, using discount rate r

EXP86 = Commissions's 1986 budget figure

r = the discount rate used (3%, 6%, 8.625%)

However, since the analysis established 1984 as the base year for presentation economics, 1985 was counted twice. Once as reported on the Commission's budget and once when using the 1986 budget figure which was assumed to continue to perpetuity. It was necessary to eliminate this double counting by taking the 1986 expenditure value and discounting one year by using the procedure given in equation (27). That amount was then subtracted from the total calculated in equation (28).

The total cost of the eradication effort in 1984 present value terms at each of the three discount rates was then determined by:

$$(29)\quad PROGCOST84_r = FUTVAL_{jr} + PV85_r + ADJPERP_r$$

$$(j=1973,..,1983)\ (r,=3\%,\ 6\%,\ 8.625\%)$$

where:

$PROGCOST84_r$ = the cost of the program in 1984 present value terms using discount rate r

$ADJPERP_r$ = $PERPEXP86_r$ adjusted for the double-counting of the 1985 expenditure

Program Benefits - Eradicated Region

Benefits of screwworm eradication were estimated separately for the eradicated region of Mexico, the infested region of Mexico, and Central America. This section focuses on the estimation of the benefits of the eradication program in the eradicated region of Mexico. The change in producers' surplus due to screwworm eradication was more completly estimated for cow-calf producers than for other livestock producers. A serious lack of reliable producer budget data preempted any complete estimate of the change in producers' surplus in the other livestock categories. In all categories other than cow-calf, the reduction in producer's variable costs due to eradication was used as the estimate of change (increase) in producers' surplus due to screwworm eradication.

Non Cow-Calf Categories

This study was designed to quantify the effects of the screwworm eradication effort on seven of the costs associated with producing livestock; medicine, insecticides, veterinarian services, labor, equipment, confinement of animals, and extra days of production made necessary by screwworm infestation. In Mexico unemployment is relatively high. Due to this unemployment factor, two estimates of the effects of screwworm eradication on per expansion animal costs were made, one that included the decrease in labor needed due to screwworm eradication and one that did not. Decision makers could thus use the total that they felt was a truer representation of the benfits of the program to Mexico.

The total annual benefit accruing to all categories other than the cow-calf category was calculated as follows:

(30) $TOTBEN_{mj} = EXPANBEN_{mj} * SWCOSTEXP_m \qquad (j=1977,\ldots,1983) \; (m=2,\ldots,9)$

where:

$TOTBEN_{mj}$ = total benefit accruing to livestock category m in year j

$EXPANBEN_{mj}$ = total amount of expansion animals in category m found in study zones from which the screwworm had been eradicated by year j

$SWCOSTEXP_m$ = extra cost per expansion animal that would have been experienced had screwworms still been present

$SWCOSTEXP_m$ is a summation of medicine, insecticide, veterinarian services, equipment, confinement, extra days of production, and extra labor caused by screwworms. It was calculated once with the labor component and once without the labor component. Two estimates of the total annual monetary benefit per category from screwworm eradication were thus produced.

Cow-Calf

For the cow-calf category a more encompassing estimate of the change in producers' surplus due to screwworm eradication was made. As in the other livestock categories, the impact of the screwworm per expansion animal on the variable cost of producers was first calculated. That estimate of the benefits to producers from eradication, however, does not totally include their benefit from the greater level of output made possible by the elimination of the screwworm. That net increase in producers' revenue from eradication not captured in other estimates is the area abed in Figure 6 as discussed in Chapter 3. Estimation of this area involved determining the total cost of producing the increased output and then deleting preeradication costs of production as well as the lower costs of production due to eradication to avoid double counting. Enterprise budgets for cow-calf operations in Mexico were employed to make possible an estimation of this added benefit.

The impact of the screwworm on the variable cost of producing a kilo of calf was arrived at by:

(31) IMPKILO = IMPHEAD / KILCAFCOW

where:

IMPKILO = extra variable cost of producing a kilo of calf due to screwworm infestation

IMPHEAD = extra variable cost per breeding cow due to screwworm as determined from the survey

KILOCAFCOW = average kilograms of calf produced per cow pre-eradication as determined from the survey

The annual number of kilos of calves that would have been produced if the screwworm had still been present was arrived at by:

(32) $TOTKILOSPRE_j = BENCOWS_j * KILCAFCOW \quad (j=1977,..,1984)$

where:

$TOTKILOSPRE_j$ = total kilos of calves that would have been produced in year j by cows in zones where the screwworm had been eradicated if the screwworm had still been present

$BENCOWS_j$ = total number of breeding cows benefitting from screwworm eradication in year j

$TOTKILOSPRE_j$ is equivalent to Q1 in Figure 6.

The average number of kilos of calf produced per cow after the eradication campaign was:

(33) KILOSPOST = KILOCAFCOW + KILDEATH + KILLOST

where:

KILOSPOST = average number of kilos of calf produced per cow, post eradication

KILDEATH = national average of kilos of calf per breeding cow that were lost due to screwworm induced calf deaths, determined from survey

KILLOST = national average of kilos per breeding cow of sale weight of calves that was lost due to screwworm infestation

The annual number of kilos of calf produced by cows located in zones from which the screwworm had been eradicated was:

(34) $TOTKILOSPOST_j = KILOSPOST * BENCOWS_j \quad (j=1977,...,1983)$

where:

$TOTKILOSPOST_j$ = total kilos of calf produce in year j by cows in zones where the screwworm had been eradicated

$TOTKILOSPOST_j$ is the point Q2 in Figure 6.

The change in the quantity of kilos of calves produced from 1977 to 1983 by cows in areas where the screwworm had been eradicated was:

(35) $KILOSCHA_j = TOTKILOSPOST_j - TOTKILOSPRE_j \quad (j=1977,..,1983)$

where:

$KILOSCHA_j$ = change in kilos of calves produced in year j due to screwworm eradication

$KILOSCHA_j$ is equivalent to Q2 - Q1 in Figure 5.

The annual variable cost savings to cow-calf producers from screwworm eradication were:

(36) $CHAVC_j = TOTKILOSPOST_j * IMPKILO \quad (j=1977,..,1983)$

where:

$CHAVC_j$ = total reduction in variable cost in year j due to screwworm eradication

The annual change in producers' total revenue due to screwworm eradication was:

(37) $TRCHA_j = KILOSCHA_j * PRICEKILO \quad (j=1977,..,1983)$

where:

$TRCHA_j$ = change in total revenue of producer in year j due to screwworm eradication

PRICEKILO = average price per kilo of calf received by cow-calf operators in 1984 pesos, taken from survey data

The increase in producers' total revenue due to eradication cannot be counted as a valid increase in producers' surplus. A methodology was developed to estimate what part of the increase in total revenue was a net benefit to producers. To implement that methodology it was necessary to obtain budgetary data for Mexican cow-calf operations. The Mexican equivalent of the U.S. Department of Agriculture, Sector Agricola Recursos Hidraulicos (SARH), supplied cow-calf budget data for tropical areas of Mexico such as the states of Tampico, Veracruz, and Jalisco. Sector Agricola Recursos Hidraulicos indicated that the budget they furnished was as typical of Mexican cow-calf operations as any budget available. The budget they supplied however was based on high level management.

Several items included in the budget from Sector Agricola Recursos Hidraulico were adjusted to better reflect a typical cow-calf operation. Sector Agricola Recursos Hidraulicos had included variable costs for some types of cattle which are not normally included in a cow-calf operation. The variable costs for cattle other than cows, calves, bulls, and replacement heifers; the normal components of a cow-calf herd; amounted to 23.5 percent of the total variable cost. This 23.5 percent of the variable cost was removed from the total variable cost included in the budget.

Sector Agricola Recursos Hidraulicos had also included interest costs calculated at a 58 percent annual rate. This high interest rate reflected the high rate of inflation in Mexico. Since inflation had been removed from all economic estimates in this study only 10 percent of the total cost of interest reported by SARH was retained. This brought the interest cost more in line with the real rate of interest.

Once the budget had been adjusted to reflect a typical cow-calf operation, the annual variable cost per cow and the variable cost per kilogram of calf produced were calculated. The budget Sector Agricola Recursos Hidraulicos supplied was for November, 1985 so the variable costs determined from that budget had to be adjusted to 1984 pesos. The per kilo variable cost figure was analogous to the post eradication variable cost figure defined by the point f in Figure 6. To arrive at the pre-eradication average variable cost, analogous to point c in Figure 6, it was necessary to add the additional per kilo variable cost caused by the screwworm that had been determined in equation (34) to the per kilo variable cost determined from the Sector Agricola Recursos Hidraulicos budget. A summary of the cow-calf budget provided by Sector Agricola Recursos Hidraulicos, after adjustment, is given in Table 11.

Once point c was known, that part of the annual increase in total revenue stemming from screwworm eradication that was extraneous to the increase in producers' surplus, deq2q1 in Figure 6, was determined as follows:

(38) $EXTR_j = KILOSCHA_j * c \quad (j=1977,..,1983)$

where:

$EXTR_j$ = portion of the increase in total revenue in year j that was extraneous to the increase in producers' surplus

Table 11. Sample Budget for Mexican Cow-Calf Operations[a]

Maintenance of infrastructure	1,761
Maintenance of pastures	2,742
Medicine and minerals	1,175
Miscellaneous	284
Replacement of bulls	1,095
Labor	2,695
Interest	502

[a]All monetary figures reported in 1984 dollars per 100 breeding cows.

c = pre-eradication variable cost per kilo of calf produced

The net annual increase in total revenue was:

(39) $NETCHATR_j = TRCHA_j - EXTR_j$ $(j=1977,..,1983)$

where:

$NETCHATR_j$ = net change in cow-calf producers' total revenue due to screwworm eradication

The total annual increase in the producers' surplus of owners of cattle in the cow-calf category that was attributed to screwworm eradication was then determined by:

(40) $CHAPS_j = NETCHATR_j + CHAVC_j$ $(j=1977,..,1983)$

where:

$CHAPS_j$ = increase in producers' surplus of owners of cattle in the cow-calf category in year j

$CHAVC_j$, the benefit due to the reduction in costs of production due to eradication, was estimated earlier. The value of $CHAVC_j$ corresponds to the area cefh in Figure 6.

Conversion of Benefits to 1984 Present Value Terms

To reflect the time value of money the annual benefits experienced by each livestock category from 1977 through 1983 expressed in 1984 present value terms were calculated by:

$$(41) \quad VALBEN84_{mjr} = BEN_{mj} * (1 + r)^n \quad \begin{array}{l}(j=1977,..,1983)\\(m=1,..,9)\end{array}$$

where:

$VALBEN84_{mjr}$ = the value of the estimated benefit by category m in year j compounded to 1984 terms at interest rate r

r = the interest rate used (r=3%, 6%, 8.625%)

Ben_{mj} = benefits estimated by livestock category m in year j in 1984 pesos

n = the number of years between year j and 1984

The value of the benefit as estimated for the year 1984 was considered to be the level of benefit that would continue to perpetuity. Thus, the present value on a 1984 basis of the benefits from 1985 to perpetuity was calculated as:

$$(42) \quad BENPERP_{mr} = \frac{BEN84_m}{r} \quad (m=1,..,9)$$

where:

$BENPERP_{mr}$ = estimated present value of benefits from 1985 to perpetuity for each category calculated at interest rate r

$BEN84_m$ = estimated benefits for category m in 1984

r = discount rate used (3%, 6%, 8.625%)

The estimated total benefit of each category in 1984 present value terms by discount rate was:

(43) $TOTBENCAT_{mr} = VALBEN84_{mjr} + BEN84_{m} + BENPERP_{mr}$

(m=1,..,9) (r,=3%, 6%, 8.625%) (j=1977,..,1983)

where:

$TOTBENCAT_{mr}$ = total benefit estimated for category m from eradication in 1984 present value terms calculated at discount rate r

In this way, the present value of benefits were estimated for each livestock category. Total benefits of screwworm eradication involved summing across the nine livestock categories.

Total Benefits From Screwworm Eradication

The 1984 present value of estimated total benefits from screwworm eradication is the sum of each category's benefits in 1984 present value terms. Table 12 shows the elements of each of the twelve estimates of the 1984 present value of total benefits to Mexican livestock producers from screwworm eradication that were used in this study.

Estimation of Benefit-Cost Ratios

The present value of total benefits livestock producers gained from the elimination of the screwworm were divided by the total costs of the Mexican-American screwworm eradication program to produce benefit-cost ratios. For each estimate, the same discount rate was

Table 12. Elements of Estimations of Total Benefits From Screwworm Eradication

estimate #	labor component of each category's decrease in VC included	net increase in producers TR from cow-calf category included	discount rate used to convert benefits to 1984 present value
1	yes	no	3%
2	yes	yes	3%
3	no	no	3%
4	no	yes	3%
5	yes	no	6%
6	yes	yes	6%
7	no	no	6%
8	no	yes	6%
9	yes	no	8.625%
10	yes	yes	8.625%
11	no	no	8.625%
12	no	no	8.625%

used for both annual benefits and annual costs to compute the present values. Twelve benefit-cost ratios for the Mexican screwworm eradication effort were thus calculated.

Expected Program Benefits - Infested Regions

A screwworm eradication campaign has been initiated in the Yucatan Peninsula and proposed for Central America. Benefits which livestock producers in those two areas would be expected to experience from eradication were estimated. Estimation of total benefits was based on 1984 livestock inventories, 1984 benefits per animal, and other known variables. The benefits that livestock owners in the Yucatan Peninsula and Central America would have experienced in 1984 from the absence of the screwworm were considered to continue to perpetuity.

For both Central America and the Yucatan Peninsula, twelve estimates of the benefits of eradication were calculated. Six of the estimates utilized the decreased variable cost per expansion animal as estimated for the eradicated area of Mexico, calculated both with and without the labor component. The other six estimates were based on the estimated extra variable cost caused by the screwworm per expansion animal in the infested study zone 9, again calculated both with and without the labor component. No estimation of potential benefits for the two areas was made which included the net increase in the revenues of cow-calf operations as estimated for the eradicated area of Mexico.

In each case the benefit per expansion animal in a category was multiplied by the number of 1984 expansion animals in that category. Then the benefits accruing to each category were summed to give the total 1984 benefit. Table 13 shows the elements used in each of the twelve estimates of the potential benefits to livestock producers in the Yucatan Peninsula and Central America from screwworm eradication.

Table 13. Elements of the Estimations of the Potential Benefits to Livestock Producers in the Yucatan Peninsula and Central America From Screwworm Eradication

est #	source of screwworm eradication impact	labor included in benefits	discount rate
1	eradicated area	yes	3%
2	eradicated area	no	3%
3	infested area	yes	3%
4	infested area	no	3%
5	eradicated area	yes	6%
6	eradicated area	no	6%
7	infested area	yes	6%
8	infested area	no	6%
9	eradicated area	yes	8.625%
10	eradicated area	no	8.625%
11	infested area	yes	8.625%
12	infested area	no	8.625%

Each of the twelve estimates of eradication benefits for the Yucatan Peninsula and Central America were converted to 1984 present value terms by the present value formula:

(44) $$BENEFIT_{ar} = \frac{TOTBEN84_a}{r} \quad (a=1,..,12)$$ (see Table 13)

where:

$BENEFIT_{ar}$ = present value of potential benefits from 1984 to perpetuity as calculated from estimation a using discount rate r

$TOTBEN84_a$ = estimations of the potential annual benefits of eradication as given in Table 13

r = discount rate used (3%, 6%, 8.625%)

Summary

Thus, the impact of eradicating the screwworm was estimated in physical terms and expanded to a monetary value. The monetary benefits were calculated to a present value basis as were program costs to evaluate economic implications. The physical impacts of eradication and economic implications are discussed in separate chapters.

CHAPTER V

PHYSICAL IMPLICATIONS OF SCREWWORM ERADICATION

The results reported herein are based on analysis of 2,004 producer questionnaires from the eradicated zones in Mexico and 77 questionnaires from the infested region or 2,081 usable questionnaires from a sample of 2,500. Cow-calf operations experienced the greatest benefit from screwworm eradication. Producers surveyed in all nine study zones owned a total of 90,203 beef cows. This represents about 1 percent of the 1984 inventory of beef cows reported in Mexico by the U.S. Foreign Agricultural Service. This chapter focuses on the physical impacts of the screwworm including; death losses, extra days necessary to produce an animal for sale, weight losses, extra labor, milk loss, and working time loss of infested work animals. Some of the physical impacts, when converted to monetary terms by applying appropriate cost or price data, constitute an important part of the economic impact of the screwworm estimated in this study. The physical impacts of the screwworm are first discussed on a per animal or disaggregated basis. The total physical impact of the screwworm is then examined separately for both the eradicated region and infested region.

Per Animal Impacts

A reduction in the milk output of dairy cows and milk goats was an important physical effect of the screwworm in Mexico. Dairy producers in zones 1-8 reported that screwworm eradication had increased their yearly milk production by 9,610 liters for every 1,000 dairy cows. In zone 9, no loss of milk production due to screwworm infestation was reported for 1984 by dairy cow owners. Producers in both the eradicated and infested areas of Mexico indicated that the screwworm had not affected the production of goat milk.

Work animals could sometimes not be used for a period of time after they were infected by screwworms. Producers in the eradicated area of Mexico reported that they had gained 598 annual hours of work per 1,000 adult work animals as a result of those animals no longer being infected by screwworms. In study zone 9, producers said that they had lost 493 hours of working time per 1,000 adult work animals in 1984 due to screwworms. Work animals often are a principal power source for lower income farmers and ranchers. The loss of the work of those animals due to screwworm infestation could be detrimental to the welfare of a family.

Table 14 presents several other annual physical benefits of screwworm eradication in the eradicated area of Mexico; the decrease in death losses, the decrease in the number of days necessary to produce an animal for sale, the decrease in weight losses, and the decrease in labor needed by producers. Each of those estimates is reported on the basis of 1,000 expansion animals. For example, the decrease in death loss for calves in the cow-calf category, 15.8, means that for every

Table 14. Estimated Annual Physical Benefits From Screwworm Eradication per 1,000 Expansion Animals[a] in the Screwworm Free Region

Livestock Category	Reduction In Death Loss (hd.)	Reduction In Extra Feeding Days (Days)	Reduction In Weight Loss On Sale Animals (kg)	Reduction In Extra Labor Days (Days)
Cow-Calf		2,522	1,196	492
Cows	4.8			
Calves	15.8			
Bulls	0.6			
Stocker	1.3	63	1,059	141
Feeder	.4	21	530	50
Dairy		1,808	806	1,091
Cows	5.5			
Calves	8.7			
Bulls	0.0			
Sheep		365	79	211
Ewes	8.3			
Lambs	6.0			
Rams	6.3			
Goats		1,000	66	132
Nannies	27.9			
Kids	41.5			
Billies	19.6			
Swine		5,180	2,176	1,342
Sows	5.7			
Pigs	52.7			
Boars	30.2			
Horses		N/A	N/A	263
Mares	2.4			
Ponies	6.0			
Stallions	2.4			
Geldings	1.2			
Draft[b]		N/A	N/A	598
Mules	1.0			
Horses	3.2			
Burros	15.1			

[a]Female breeding animals except for stockers, feeders, horses, and draft animals where expansion animals are adult animals.
[b]Male and female animals of all age groups.

1,000 breeding cows 15.8 less calves died per year as a result of the eradication of the screwworm. The estimates in Table 14 may be interpreted as the annual physical benefits per 1,000 expansion animals from the screwworm eradication effort in Mexico.

Table 14 indicates that the reduction in death losses of offspring was larger than the reduction in death losses of adult males or adult females in each livestock category except for sheep. The small size of young animals makes them more likely to die from screwworm infestation than adults. The greatest single reduction in death loss was for pigs at 52.7 per 1,000 sows. Sows can have two litters of pigs per year so screwworms had more opportunities to attack young pigs. The second greatest reduction in death loss in the eradicated area was for kids at 41.5 per 1,000 nannies. Screwworm eradication had little effect on death losses for stockers, feeders, mules and horses. However, even infrequent death losses of animals could be particularly devastating to poor farmers with small holdings of livestock.

Of all the categories, swine operations had the greatest reduction in the number of days necessary to produce animals for sale, 5,180 per 1,000 sows. Cow-calf operations had the second greatest decrease in production time, 2,522 days per 1,000 cows. No questions were included in the survey instrument on the effects of screwworm eradication on the time necessary to produce horses or draft animals.

The reduction in sale weight loss attributable to screwworm eradication followed a pattern similar to the reduction in death loss.

The greatest reduction in sale weight loss was for swine at 2,176 kilograms per 1,000 sows. That was followed by a decrease in beef lost of 1,196 kilograms per 1,000 beef cows and 1,059 kilograms per 1,000 stockers. Feeder cattle and dairy cows also sustained large sale weight losses.

The greatest reduction in labor needed for production in the eradicated area was for the swine category at 1,342 days per 1,000 sows. The second greatest reduction in labor needed in the eradicated area was for dairy farms. Screwworm eradication allowed dairy producers to use 1,091 less days of labor per 1,000 dairy cows. Dairy cows must be in good physical condition to produce well. Any pest such as the screwworm that could weaken dairy cows would have to be carefully guarded against. Such extra care is labor intensive and could explain why the elimination of the screwworm decreased the need for labor in dairy operations more than in other categories.

Table 15 shows physical impacts of the screwworm for the infested region of Mexico, study zone 9. The impacts presented in Table 15 are the actual physical impacts of the screwworm in 1984, per 1,000 expansion animals, as reported by producers in the states of Quintana Roo, Campeche, and Yucatan. The data in Table 15 can be interpreted as the annual physical benefits that would accrue to producers in the infested area of Mexico if they no longer had to contend with the screwworm.

For the infested region, death losses were greatest for pigs and

Table 15. Estimated Annual Physical Impacts of the Screwworm per 1,000 Expansion Animals[a] in the Screwworm Infested Area of Mexico

Livestock Category	Death Loss (hd.)	Extra Feeding Days (Days)	Weight Loss On Sale Animals (kg)	Extra Labor Days (Days)
Cow-Calf		3,995	2,330	98
Cows	1.2			
Calves	9.9			
Bulls	0.1			
Stocker	.3	15	490	85
Feeder	no data obtained in this category			
Dairy		0	0	414
Cows	0.0			
Calves	10.3			
Bulls	0.0			
Sheep		678	251	42
Ewes	5.4			
Lambs	105.4			
Rams	2.7			
Goats		0	0	250
Nannies	0.0			
Kids	83.3			
Billies	0.0			
Swine		9,600	605	261
Sows	0.0			
Pigs	400.0			
Boars	0.0			
Horses		N/A	N/A	400
Mares	0.0			
Ponies	0.0			
Stallions	0.0			
Geldings	0.0			
Draft[b]		N/A	N/A	493
Mules	0.0			
Horses	4.6			
Burros	0.0			

[a]Female breeding animals except for stockers, feeders, horses, and draft animals where expansion animals are adult animals.
[b]Male and female animals of all age groups.

second greatest for lambs. High numbers of extra production days caused by the screwworm were reported for both the swine and cow-calf categories. The loss of sale weight reported per 1,000 beef cows, 2,330 kilograms, was the greatest single loss of sale weight reported for either the eradicated or infested area. The highest amount of extra labor needed in the eradicated area was for work animals followed by dairy cows.

Generally, the estimated physical impacts of the screwworm per 1,000 expansion animals were much greater for the eradicated zone than the infested zone. Exceptions include death losses of lambs, kids, and pigs. Sale weight losses for cow-calf and sheep operations were also much larger in the infested zone than in the eradicated zone. A comparison of the physical impacts of the screwworm in the eradicated and infested areas of Mexico suggests that the impacts of the screwworm on each region are unique. The difference in impacts is, in part, due to the difference in cultural practices in the two regions. Intense heat in the Yucatan Peninsula makes it necessary to pen cattle in that region during the part of the day when temperatures are highest. The daily rounding up of the cattle provides handlers a chance to observe all of their animals. Early detection of screwworm infestation is thus facilitated. In many areas of the eradicated region of Mexico cattle are only periodically rounded up which makes it more difficult to detect screwworm infested animals. This variance in impact between the two regions implies that extrapolation from the impacts experienced in any particular region must be done with caution.

Total Regional Impacts

Table 16 gives the estimated total annual physical benefits received from screwworm eradication for each livestock category in the eradicated area of Mexico. The values in Table 16 were calculated by multiplying the per expansion animal physical benefits of a category as estimated from the eradicated area questionnaire by the total number of expansion animals in that category in zones 1-8 in 1984. In this study, the level of benefits experienced in 1984 was projected to continue to perpetuity.

The data in Table 16 demonstrate that the livestock category with the highest physical impact on a per animal basis is not necessarily the most important on an aggregate basis. This is explained by the diversity among livestock categories in the number of expansion animals and total inventory.

In the eradicated area, kids, the offspring of goats, had the greatest total reduction in death loss due to screwworm eradication; 192.6 thousand annually. The death loss reduction for calves in the cow-calf category, 158.2 thousand, was the second highest annual decrease in death losses due to screwworm eradication. Even though pigs had the highest reduction in death loss per 1,000 expansion animals, the relatively small number of sows in Mexico in 1984 caused pigs to experience only the sixth highest reduction in total death loss

Table 16. Total Annual Estimated Physical Benefits Received From Screwworm Eradication in the Screwworm Free Area of Mexico

Livestock Category	Reduction In Death Loss (hd.)	Reduction In Extra Feeding Days (Days)	Reduction In Weight Loss On Sale Animals (kg)	Reduction In Extra Labor Days (Days)
	-----------	000	-----------	
Cow-Calf		25,245	11,971	4,921
Cows	48.1			
Calves	158.2			
Bulls	6.0			
Stocker	5.2	251	4,197	559
Feeder	2.1	110	2,742	259
Dairy		3,041	1,356	1,836
Cows	9.3			
Calves	14.6			
Bulls	0.0			
Sheep		1,338	288	774
Ewes	30.4			
Lambs	22.0			
Rams	23.1			
Goats		4,640	306	612
Nannies	129.5			
Kids	192.6			
Billies	91.0			
Swine		4,495	1,888	1,164
Sows	4.9			
Pigs	45.3			
Boars	26.2			
Horses		N/A	N/A	170
Mares	1.6			
Ponies	3.9			
Stallions	1.6			
Geldings	0.8			
Draft[a]		N/A	N/A	5,530
Mules	3.7			
Horses	8.7			
Burros	43.0			

[a]Males and females of all ages.

due to screwworm eradication.

The total reduction in days necessary to produce animals for sale for cow-calf operations, 25.2 million per year, was the greatest across all livestock categories. The cow-calf category had the largest number of expansion animals and the second highest reduction per 1,000 expansion animals in the number of days necessary for production. The goats category had the second highest reduction in the number of days necessary to produce animals for sale, 4.6 million per year. Although swine had the highest reduction in production time per 1,000 animals, the relatively small number of sows meant that the swine category had only the third highest decrease in the number of days necessary for production.

The annual total reduction in sale weight loss for cow-calf operations, 12.0 million kilograms, was more than twice as great as the second highest total reduction, 4.2 million kilograms per year for stockers. Feeder cattle had the third highest reduction in sale weight loss, 2.7 million kilograms. Thus, screwworm eradication increased the amount of beef placed on the market far more than any other type of meat.

The highest reduction in labor needed for a livestock category was for work animals, 5.5 million days annually. Cow-calf operations had the second greatest benefit from eradication in the area of reduction in labor. Their total reduction in extra days of labor for production, 4.9 million days per year, was more than twice as great as the third highest reduction, 1.8 million days annually for dairy operations.

Overall, the greatest total physical benefit from screwworm eradication was obtained by owners of cow-calf operations. In many cases other livestock categories had greater benefits per 1,000 animals. The large number of beef cows in Mexico in 1984, however, resulted in a greater proportion of the total benefits accruing to cow-calf owners than owners of livestock in other categories.

Table 17 presents the total estimated 1984 physical impacts of the screwworm per livestock category in Study Zone 9 of Mexico. The values in Table 17 were arrived at by multiplying the per expansion animal physical effects of the screwworm for a category as calculated from the eradicated area questionnaire by the number of expansion animals in that category in the Yucatan Peninsula in 1984.

Due to the much smaller inventories of expansion animals in the Yucatan Peninsula as compared to the eradicated area of Mexico, each total physical impact of the screwworm for the infested zone was smaller than the total impact in the eradicated zone. The highest total death loss in the infested region was for calves in cow-calf operations at 10.4 thousand head. The second highest death loss in 1984 in zone 9 was for pigs at 8.4 thousand. Cow-calf operations had the greatest extra production days and largest sale weight loss caused by screwworm infestation. Stocker and cow-calf operations both required about 103 thousand days of extra labor in 1984 due to the screwworm.

Table 17. Total Estimated Physical Impact of the Screwworm in The Screwworm Infested Region of Mexico, 1984

Livestock Category	Death Loss (hd.)	Extra Feeding Days (Days)	Weight Loss On Sale Animals (kg)	Extra Labor Days (Days)
		---000---		
Cow-Calf		4,209	2,456	103
Cows	1,265			
Calves	10,433			
Bulls	105			
Stocker	365	19	596	103
Feeder	no data obtained in this category			
Dairy		0	0	38
Cows	0			
Calves	950			
Bulls	0			
Sheep		9	3	.6
Ewes	76			
Lambs	1,432			
Rams	38			
Goats		0	0	1
Nannies	0			
Kids	330			
Billies	0			
Swine		201	13	5
Sows	0			
Pigs	8,356			
Boars	0			
Horses		N/A	N/A	15
Mares	0			
Ponies	0			
Stallions	0			
Geldings	0			
Draft[a]		N/A	N/A	194
Mules	0			
Horses	1,003			
Burros	0			

[a]Males and females of all ages.

Several of the physical impacts reported in this chapter for the eradicated zone were not converted to economic terms for inclusion in the estimation of the program's benefit-cost ratios. Reduced death loss and reduced sale weight loss were converted to monetary terms for only the cow-calf category. No attempt was made to express the lost work time of work animals in monetary terms.

Chapter VI

THE ECONOMIC IMPACTS OF SCREWWORM ERADICATION

The economic feasibility of a social program may be evaluated by determining that program's benefit-cost, or B-C, ratio. These ratios are formed by dividing the present value of a stream of benefits derived from a program by the present value of all present and future costs of that program. For a social investment such as screwworm eradication, benefit-cost ratios help to guide policymakers and provide an economic evaluation of the investment for the public. This chapter addresses the costs and the estimated economic benefits of the screwworm eradication program in Mexico, and the expected economic benefits if the screwworm is eradicated in the Yucatan Peninsula and Central America.

All monetary values in this chapter are reported in 1984 constant dollars. The average exchange rate for 1984 as reported by the Bank of Mexico was 185 pesos per dollar. All annual values were adjusted to a 1984 dollar basis and then discounting and compounding procedures were applied to account for the time value of money.

Eradication Program Costs

Several steps were necessary before the annual costs of the Mexican screwworm eradication campaign could be obtained in 1984 present value terms. First, budgetary data supplied by the Mexican-

American Screwworm Commission were used to determine the annual expenditures for the program from 1977 to 1985. The annual expenditures were then adjusted to 1984 constant dollars to correct for inflation. A projection of the program's future costs was made by assuming that the level of expenditure in 1985 would continue to perpetuity. Table 18 presents the annual costs of screwworm eradication in Mexico both in nominal terms and with values adjusted for inflation.

Table 18. Annual Costs of the Mexican Screwworm Eradication Program in 1984 Dollars

Year	Annual Nominal Expenditure ($1000 U.S.)	Annual Expenditure Adjusted For Inflation ($1000 1984)
1977	12,700	21,768
1978	15,000	23,882
1979	15,928	22,793
1980	18,006	22,697
1981	31,420	35,884
1982	40,881	43,992
1983	42,500	44,309
1984	38,861	38,861
1985	31,854	31,854[a]

[a]Low inflation from 1984 to 1985 made it unnecessary to adjust the expenditure for 1985.

Even though annual expenditures for the program increased steadily in nominal terms from 1977 until 1983, adjustment for inflation showed that spending in real terms decreased in several of those years. As shown in Table 18, nominal expenditures for screwworm eradication in Mexico rose each year from the initial level of $12.7 million in 1977 until reaching $42.5 million in 1983. The nominal expenditures then declined to $38.9 million in 1984 and $31.9 million in 1985. The annual expenditures adjusted for inflation remained at about the same level from 1978 through 1980. As larger areas of treatment were included in the program, expenditures increased to almost $36 million in 1981 and rose to a high of $44.3 million in 1983. Expenditures dropped thereafter as eradication approached completion and maintenance of the barrier made up most of the necessary cost (Table 18).

The 1977-1985 annual expenditures as expressed in 1984 dollars and the estimated expenditures into perpetuity were converted to 1984 present value terms by applying compounding and discounting procedures to account for the time value of money or the real interest rate. The real interest rate is the market rate of interest less inflation. The present value on a 1984 basis of the Mexican screwworm eradication program's costs are given in Table 19.

As indicated in Table 19, as progressively higher discount rates are used, the estimated present value of annual expenditures are higher for years prior to 1986. For example, in 1977 the present value of expenditures was $26.7 million with a 3% discount rate, $32.7 million with 6%, and $38.8 million when a 8.625% discount rate was

Table 19. Annual Costs of the Mexican-American Screwworm Eradication Program in 1984 Present Value Terms at Alternative Discount Rates in Thousand Dollars

	Discount Rate		
Year	3%	6%	8.625%
1977	26,772.4	32,731.6	38,845.0
1978	28,516.1	33,876.8	39,232.5
1979	26,423.3	30,502.2	34,470.7
1980	25,545.9	28,654.7	31,600.3
1981	39,211.3	42,738.3	45,992.7
1982	46,671.1	49,429.4	51,907.9
1983	45,638.0	46,967.3	48,130.4
1984	38,861.0	38,861.0	38,861.0
1985	30,926.0	30,050.9	29,324.7
1986 to Perp	1,052,966.7	496,682.4	337,168.5
Total	1,330,863.2	830,494.7	695,533.8

employed. Conversely, for projected future expenditures (1986 to perpetuity) the opposite relationship exists between present value of expenditures and the magnitude of the discount rate. As the discount rate increases from 3% to 8.625%, the present value of projected expenditures falls from just over one billion dollars to about $337 million (Table 19).

Screwworm Impact on Producers' Costs

The costs of production examined in this study were variable costs, or costs that are related to the level of production. An example of a variable cost of livestock production would be feed for animals. Increasing the number of animals produced would require additional feed. A producers' costs would increase since he would either have to buy or produce the extra feed needed. Fixed costs of production, those costs that do not vary with production levels, are not analyzed.

In the eradicated zones, the decrease in producer's costs that was attributed to screwworm eradication was counted as the primary benefit of the eradication campaign. The increase in cost due to screwworm infestation that producers in the Yucatan Peninsula reported for 1984 was considered to be the level of annual benefits that would accrue to them if the screwworm were eliminated from that area. Stated another way, the potential annual benefit from an eradication campaign in the Yucatan Peninsula would be equal to the portion of livestock producers' costs in that area in 1984 that was attributable to the presence of the screwworm. Per animal impacts of the screwworm on the costs of producers in the eradicated and infested regions of Mexico were also used as estimates of the per animal benefits Central American livestock producers might gain if the screwworm were eradicated from their countries.

Impact on Variable Costs in the Eradicated Region

Table 20 gives the reductions in producers' variable costs that were attributed to screwworm eradication in zones 1-8, the screwworm

Table 20. Estimated Reduced Variable Costs Attributable to Screwworm Eradication, Eradicated Area[a], 1984 Dollars per 1000 Expansion Animals.[b]

	Livestock Category								
Item	Cow-Calf	Dairy[c]	Swine	Sheep	Goats	Stoc.	Feed.	Horse	Work
Med.	500.9	1201.5	717.9	62.1	0.7	277.7	120.5	286.6	320.4
Vet.	35.9	142.3	433.8	0.0	0.0	24.4	15.9	0.0	67.4
Ins.	664.5	784.3	737.8	112.9	21.4	380.2	235.1	644.3	105.5
Con.	139.4	938.5	846.9	4.0	1.6	49.8	129.2	0.0	128.8
Equip	218.5	24.1	1.8	13.4	0.0	94.2	71.4	0.0	0.0
Extra Days	2192.8	2730.8	4277.7	17.2	1664.8	1052.0	400.9	N/A	N/A
Labor	2198.1	4869.8	5986.8	958.9	589.7	629.9	233.4	1161.6	44.7
Total With Labor	5950.1	10691.3	13002.7	1168.5	2278.2	2508.2	1206.4	2092.5	666.8
Total Without Labor	3752.0	5821.5	7015.9	209.6	1688.5	1878.3	973.0	930.9	622.1

[a]The eradicated region is essentially all of Mexico except for the Yucatan Peninsula.
[b]Female breeding animals except for stockers, feeders, horses, and draft animals where expansion animals are adult animals.
[c]Dairy herd owners also reported an extra $505,247.9 worth of milk production due to the eradication campaign.

free region of Mexico. The data in Table 20 may be interpreted as the annual monetary benefits of the eradication campaign to producers in those zones. For example, the cow-calf column shows that for every 1,000 beef cows in the sample, screwworm eradication lowered costs for medicine by an average of $500.90. The other estimated annual savings per 1,000 beef cows in the cow-calf column were $35.90 for veterinarian services, $644.50 for insecticides, $139.40 for confinement of animals, $218.50 for equipment, $2,192.80 for extra days required for production, and $2,198.10 for labor.

In Table 20, the total decrease in the costs of production for each livestock category was calculated both with and without the reduction in the cost for labor. The reduction in the labor needed for production was not considered an unequivocal benefit for Mexico since that country has a labor surplus. Although producers' variable costs were lowered since they needed less labor, unemployment within the country may have been worsened since alternative employment may not be available. Most livestock categories had a significantly lower reduction in cost (or benefit from eradication) when the decrease in labor cost was excluded. The total decrease in variable costs excluding labor for the swine category ($7,015.9 per 1,000 sows) is only 54 percent of the total with labor, $13,002.7. The cost reduction per 1,000 cows for the cow-calf category, excluding labor, was $3,752. That cost reduction was 37 percent lower than the total including labor, $5,950.1. Hence, excluding labor cost savings significantly lowers the estimated total annual benefits of eradication to livestock producers. Table 20 shows that for cow-calf, dairy, swine, sheep, and horse operations, labor was the variable cost that was reduced most by screwworm eradication. Labor accounted for the second largest reduction in cost for all other livestock categories except for work animals. These cost reductions reflected the fact that livestock production in Mexico is a labor intensive activity (Table 20).

The length of time required to raise an animal infested with screwworms to sale weight was reported to be longer than for animals never bothered by the screwworm. These extra days of production increased variable costs to livestock producers. The decrease in costs from no longer experiencing extra production days for animals attacked by screwworms is presented in the "Extra Days" row of Table 20. For producers of stockers, feeder cattle, and goats, the reduction in days necessary for production was the single largest cost savings.

There were also relatively large reductions in the variable costs for medicine, insecticides, and confinement as a result of screwworm eradication (Table 20). In all livestock categories, except for dairy and work animals, the reduction in insecticide cost was greater than the reduction in the cost for medicines for treating cases of screwworm attack. During the eradication campaign, the Screwworm Commission gave producers medicine for treating animals attacked by screwworms. This could mean that the reduction in the cost for medicine reported in Table 20 does not capture all medicine costs incurred by producers prior to the eradication campaign. If so the average reduction in medicine costs may be underestimated.

The data in Table 20 indicate that the reduction in costs for veterinarian services and equipment were the least from the program for most classes of livestock. Veterinarian services are often provided to Mexican collective farms without charge by the Mexican government. The reduction in cost for the services of veterinarians due to screwworm eradication may have been understated since livestock producers often did not have to pay for those services. Also most owners of small holdings of livestock in Mexico have insufficient capital to allow them to invest in equipment for caring for their animals. This may partially explain the relatively small reduction in variable cost for equipment due to the eradication campaign.

Figure 7 shows each livestock category's percentage of the total benefits from screwworm eradication for the eradicated zone of Mexico. The pie chart in the top of Figure 7 includes labor reduction as a benefit while the pie chart on the bottom of Figure 7 does not. The areas of the two pie charts in Figure 7 are proportional thus illustrating how total benefits diminish when the reduction in labor needed is excluded from total benefits.

With labor cost savings included, owners of cow-calf operations gained the largest percentage of benefits, 47.9 percent, while owners of dairy operations gained the second largest percentage of the benefits from screwworm eradication, 16.5 percent. Owners of draft

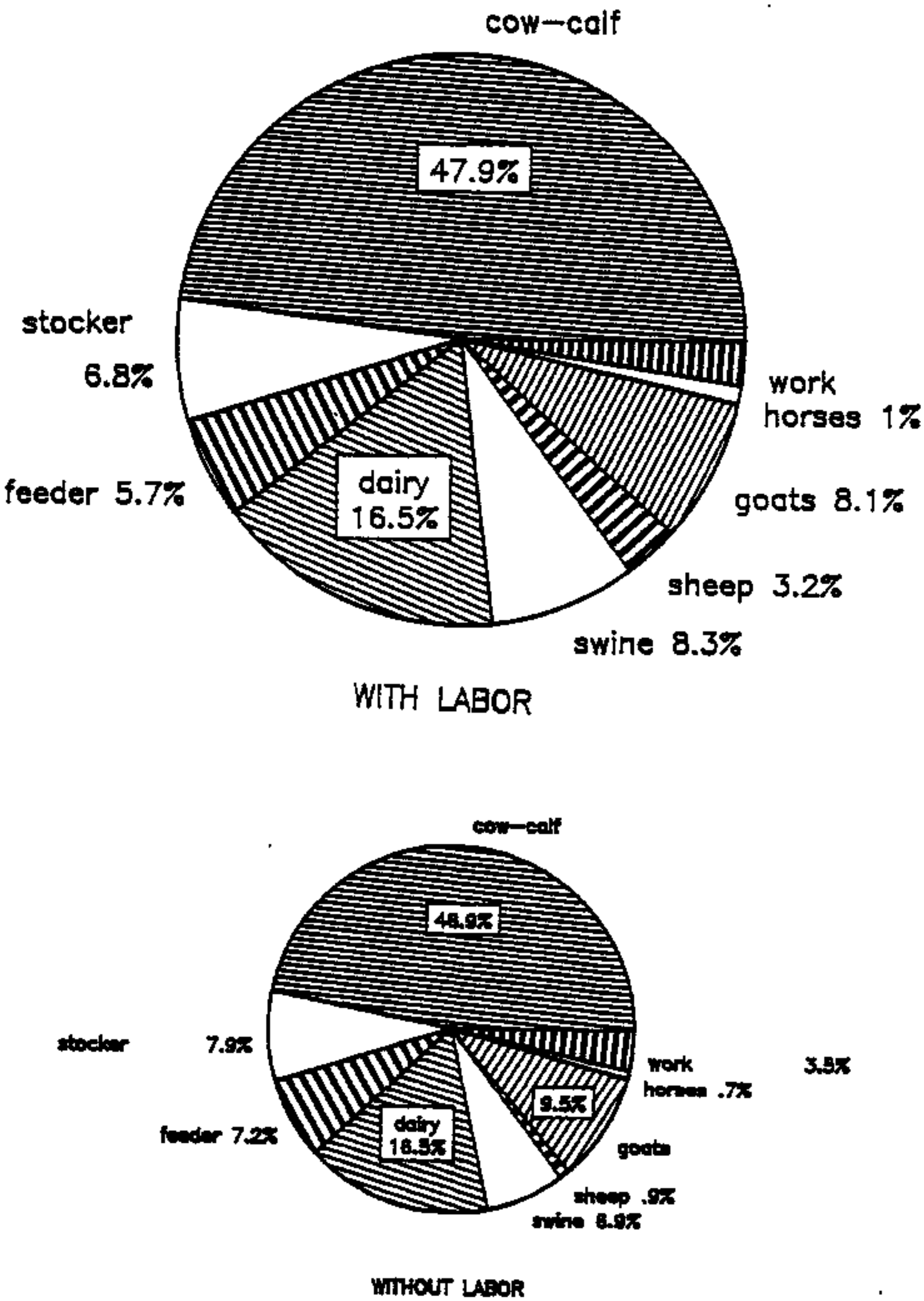

Figure 7. Percentage of total benefits by livestock category for the eradicated zone of Mexico

animals and horses for sale received only 2.4 percent and 1 percent respectively of the total benefits.

The lower pie chart in Figure 7 demonstrates that the relative percentages of the benefits gained by owners of the livestock categories included in this study changed little when labor cost savings was not considered to be a benefit. Cow-calf operations were still the largest beneficiaries with 46.9 percent of the benefits and dairy operations were second with 16.5 percent of the total benefits. The smallest percentage of the benefits, .7 percent, went to owners of sale horses when labor savings was not counted as a benefit.

Impact on Variable Cost in the Infested Region

Table 21 presents the increase in producers' variable costs attributed to screwworms in study Zone 9, the region of Mexico where the screwworm was still found at the time of this study. The values in Table 21 are the estimated average annual expenditures per 1,000 head that producers in Mexico's infested area made to combat the screwworm. These also may be interpreted as the potential annual monetary benefits that would be experienced by producers if they no longer had to contend with screwworm infestation. For example, the dairy column of Table 21 shows that in the infested area of Mexico in 1984 dairy producers averaged the following variable costs per 1,000 dairy cows because of the presence of the screwworm: \$29.2 for medicine, \$931.9 for insecticides, and \$1,787.0 for labor. Average total variable cost per

Table 21. Potential Benefits of Screwworm Eradication Infested Area[a], 1984 Dollars per 1,000 Expansion Animals.[b]

	Livestock Category								
Item	Cow-Calf	Dairy[c]	Swine	Sheep	Goats	Stoc.	Feed.	Horses	Work
Med.	537.3	29.2	2458.4	230.3	0.0	181.1	----	4324.3	398.4
Vet.	21.1	0.0	0.0	0.0	0.0	0.0	----	0.0	0.0
Ins.	78.9	931.9	8.6	4.3	0.0	75.7	----	0.0	0.0
Con.	11.9	0.0	0.0	0.0	0.0	0.0	----	0.0	0.0
Equ.	19.5	0.0	0.0	0.0	0.0	0.0	----	0.0	23.2
Extra Days	1050.0	0.0	5607.7	211.6	0.0	94.6	----	N/A	N/A
Labor	400.0	1787.0	1161.6	178.7	1116.9	400.0	----	1787.0	447.0
Total With Labor	2118.7	2748.1	9236.3	624.9	1116.9	751.4	----	6111.3	868.6
Total No Labor	1718.7	961.1	8074.7	446.2	0.0	351.4	----	4324.4	421.6

[a]Infested area of Mexico in 1984 was the Yucatan Peninnsula.
[b]Female breeding animals except for stockers, feeders, horses, and draft animals where expansion animals are adult animals.
[c]No impact on milk production was reported by producers in Zone 9.

1,000 dairy cows due to the screwworm was $2,748.1 when labor was included and $961.1 when labor was not included. Hence, Table 21 provides estimates of the costs incurred by dairy producers in 1984 that could be avoided if the screwworm were eradicated in the Yucatan Peninsula. As such, those costs represent the potential benefits of screwworm eradication to dairy producers in the Yucatan.

The potential benefits from screwworm eradication in the infested region of Mexico presented in Table 21 followed a pattern similar to the benefits experienced in the eradicated region (Table 20). Labor savings were the first or second highest potential benefit for all livestock categories other than sheep. There were also important potential reductions in producer's variable costs for medicine and insecticides. In the infested region of Mexico, as in the eradicated region, the screwworm had little impact on producers' use of veterinarian services and equipment.

The total potential benefits per 1,000 expansion animals in the Yucatan Peninsula, labor included, were lower than the estimated benefits from eradication for each livestock category except work animals. In the case of swine, the estimated total benefits per 1,000 sows, including labor, in the eradicated region of Mexico was $13,002.7 (Table 20). The potential benefit per 1,000 sows in the Yucatan Peninsula from screwworm eradication (Table 21), $9,236.3, was $3,776 lower than the benefit reported in the eradicated region. When labor reduction was excluded, the potential benefit for each livestock category in the infested region was still less than the corresponding benefit in the eradicated region for all categories except for swine, sheep, and horses. Hence, the greatest reported impact of the screwworm on producers' costs was in the eradicated region.

Pie charts which detail each livestock category's reduction in variable costs (Table 20) are found in Appendix D. Those charts give the percentage that each component of the reduction in variable costs (medicine, etc.) make up of a category's total reduction in variable cost due to screwworm eradication.

Benefits of Screwworm Eradication in the Eradicated Region

The computation of the 1984 present value of benefits involved the same basic steps as the computation of the program's costs in 1984 present value terms. First annual benefits, composed of the benefits to producers of all the livestock categories included in this study, were estimated and adjusted for inflation to 1984 terms. Annual benefits were calculated both with and without the reduction in labor and with and without the estimated increase in the value of output of cow-calf producers attributed to screwworm eradication. Future benefits were projected by assuming that the level of benefits experienced in 1984 would continue in all future years.

Table 22 presents the estimated annual benefits of screwworm eradication to Mexican livestock producers from 1977 to 1984 in constant 1984 dollars. The first column of annual benefits in Table 22 includes the decrease in total variable costs for all livestock categories. The second column of benefits includes the decrease in variable costs excluding labor savings. Neither of the first two columns of benefits include the net value of increased output of cow-calf producers attributed to screwworm eradication. These increases in

Table 22. Annual Benefits of Screwworm Eradication in Mexico[a] in Thousands of 1984 Dollars

Year	Benefits Labor Included	Benefits Labor Excluded	Net Value Of Increased Output
1977	12,159.3	8,530.2	1,695.2
1978	12,521.8	8,780.0	1,744.0
1979	31,761.3	20,943.4	7,519.0
1980	67,401.4	43,841.5	16,684.7
1981	84,257.1	54,478.0	19,813.3
1982	111,820.5	71,870.5	23,445.7
1983	114,236.6	73,446.4	23,869.6
1984	131,480.7	84,571.6	26,778.8

[a]At the time of this study the Yucatan Peninsula was still infested with screwworms and is not included in these values.

net revenues are presented in the column labeled "Net Value of Increased Output".

Annual benefits labor included, annual benefits labor excluded, and the increase in producers' net revenues showed slight increases in each of the years of the eradication program. Year to year increases were largest in years when large areas were added to the eradicated zone. From 1983 to 1984 annual benefits, including labor, increased from $114.2 million to $131.5 million, a total increase of 13 percent. During 1984 three additional states, Tabasco, Chiapas, and Oaxaca, were added to the screwworm free zone. In the period from 1977 to 1978, annual benefits, including labor, increased from $12.2 million to $12.5 million, an increase of only 3 percent. During 1978 only the relatively small state of Baja California Sur was added to the eradicated area of Mexico.

The data in Table 22 point out the importance of the labor and net revenue components of total benefits to producers. The estimated total benefit to Mexico in 1984 including labor, $131.5 million is 36 percent higher than the estimated total benefit excluding labor, $84.6 million. The net value of the increased output of cow-calf producers in 1984, $26.8 million, was about one-fifth the estimated benefits from reduced costs including labor in 1984 (Table 22). Annual estimated benefits from screwworm eradication might have been substantially higher if sufficient secondary data had been available to allow an accurate estimation of the net value of increased output for all the livestock categories included in the study.

To account for the time value of money or real interest rate, a 1984 present value was estimated for screwworm eradication using three discount rates, 3%, 6%, and 8.625%. Table 23 presents the estimation of the yearly benefits from screwworm eradication calculated at the 6% discount rate. These are the total benefits to producers of all the livestock categories included in the survey. The first column of estimates in Table 23 includes the present value of benefits to producers from reduced costs, including labor, due to eradication. The second column of Table 23 shows the estimated present value of benefits

Table 23. Estimated 1984 Present Value of Annual Benefits by Year of Screwworm Eradication in Mexico[a] (Thousands of 1984 Dollars) Using a 6% Discount Rate

	reduced costs including labor	reduced costs excluding labor	net value of increased output
1977	18,283.1	12,826.3	2,549.0
1978	17,762.4	12,454.5	2,473.9
1979	42,503.8	28,027.1	10,062.3
1980	85,092.7	55,348.9	21,064.0
1981	100,351.5	64,884.2	23,597.9
1982	125,641.5	80,753.7	26,343.6
1983	121,090.8	77,853.2	25,301.8
1984	131,480.8	84,571.6	26,778.8
1985 to Perp	2,191,345.3	1,409,527.0	446,313.3

[a]At the time of this study the Yucatan Peninsula was still infested with screwworms and is not included in these values.

to producers from reduced costs excluding labor. Column three of Table 23 shows the yearly estimated increase in the net revenues of cow-calf operations. The data in Table 23 are the benefits in the form needed for the calculation of benefit-cost ratios.

Benefits expressed in 1984 present value terms in Table 23 decreased from 1977 to 1978 and 1982 to 1983. In both of those periods only relatively small areas were added to the eradicated zone. The change in total benefits for those years, when adjusted for inflation and the real rate of interest (time value of money), were thus smaller than the change in total benefits for the previous years.

Each of the benefit-cost (B-C) ratios computed for the screwworm eradication program were derived by dividing the present value of program benefits by the present value of program costs. As indicated, three different levels of benefits were considered. Thus, a total of 12 B-C ratios were estimated. Differences in the ratios depends upon the magnitude of the discount rate selected and the types of benefits included in the estimation. Table 24 shows the benefit-cost ratios of the program at three levels of discount rate and including only the reductions in costs to livestock producers as benefits.

Table 24. Benefit-Cost Ratios for the Screwworm Eradication Program in Mexico, Net Increase in Total Revenue Excluded

Scenario	Discount Rate	Present Value Of: Benefits[a]	Costs[a]	B/C
With Labor:	3%	4,985,122,252	1,330,863,168	3.7
Without Labor:	3%	3,209,650,324	1,330,863,168	2.4
With Labor:	6%	2,833,551,732	830,494,653	3.4
Without Labor:	6%	1,826,246,272	830,494,653	2.2
With Labor:	8.625%	2,204,060,872	695,533,776	3.2
Without Labor:	8.625%	1,421,878,420	695,533,776	2.0

[a] Present value using indicated discount rate, 1984 constant dollars.

The B-C ratios in Table 24 range from a high of 3.7 when labor cost reduction is included as a benefit and the 3% discount rate is used to a low of 2.0 when labor cost reduction was not considered as a national benefit and the 8.625% discount rated was used. The 3.7 B-C ratio means that each dollar invested in the screwworm eradication program will generate an estimated $3.7 of benefits to the country of Mexico. All the other estimates of B-C ratios obtained in this study may be interpreted in a similar manner. Decision makers may use the B-C ratio estimated with the discount rate they feel is most appropriate. However, all the benefits and costs used in this study were adjusted to remove the influences of inflation on future benefits and costs. That is, future benefits derived from current investments are valued in constant dollars and, therefore reflect real income gains. This means that a real rate of interest (reflecting no component of anticipated inflation) may be the appropriate discount rate. This method favors use of the lower discount rates of 3% or 6%.

The discount rate used and the decision whether or not to include labor reduction as a benefit influences the magnitude of the B-C ratios in Table 24. The B-C ratio calculated with the 3% discount rate and excluding labor as a benefit, 2.4, was nine percent higher than the B-C ratio, 2.2, which utilized the present values of benefits and costs calculated at a 6% discount rate and excluded labor as a benefit. The B-C ratio using benefits excluding labor and the 3% discount rate was 17 percent higher than the B-C of 2.0 which was obtained by using benefits excluding labor and the 8.625% discount rate. This range of ratios provides more information than a single estimate based on one set of assumptions. Even in the most conservative case the present value of benefits is twice that of costs (Table 24).

Table 25 presents the B-C ratios for the screwworm eradication campaign which utilized the estimates of benefits that include the increase in net revenues of cow-calf operations due to screwworm eradication. Other than the inclusion of this net revenue increase as a benefit, the B-C ratios in Table 25 were calculated exactly as those in Table 24.

Table 25. Benefit-Cost Ratios for the Screwworm Eradication Program in Mexico[a], Net Increase in Total Revenue Included

Scenario	Discount Rate	Present Value of: Benefits[b]	Costs[b]	B/C
With Labor:	3%	6,007,300,234	1,330,863,168	4.5
Without Labor:	3%	4,231,828,305	1,330,863,168	3.2
With Labor:	6%	3,418,036,375	830,494,653	4.1
Without Labor:	6%	2,410,730,916	830,494,653	2.4
With Labor:	8.625%	2,660,797,141	695,533,776	3.8
Without Labor:	8.625%	1,878,614,688	695,533,776	2.7

[a]At the time of this study the Yucatan Peninsula was still infested with screwworms and is not included in these values.
[b]Present value using indicated discount rate, 1984 basis.

As expected, the B-C ratios estimated with the inclusion of the increase in net revenues of cow-calf producers as a benefit were larger than the B-C ratios using the same discount rate and scenario which excluded the revenue increase (compare tables 24 and 25). The B-C ratio in which labor reduction was counted as a benefit, 3% was used as the discount rate, and which did not utilize the increase in net revenues (3.7) was only 82 percent as large as the corresponding B-C ratio which did include the increase in net total revenues as a benefit (4.5).

A total of twelve B-C ratios were estimated in this study. The lowest B-C ratio estimated under any set of assumptions was 2. This B-C ratio was obtained when labor reduction was not counted as a benefit, the net increase in revenues of cow-calf producers was not counted, and the 8.625% discount rate was used. The highest estimated B-C ratio was 4.5. This ratio was obtained when labor reduction and the increase in net revenues were considered to be benefits and the 3% discount rate was used. Under all of the scenarios, the estimated benefits to Mexico from the screwworm eradication campaign were at least twice the costs of that campaign.

Expected Benefits in the Yucatan Peninsula

Two sets of estimates were made of the benefits that producers in the Yucatan Peninsula of Mexico might experience if the eradication campaign were extended to their area. One set was arrived at using the benefit per expansion animal from the sample of producers in the screwworm free area of Mexico as a measure of benefits. The other set used the potential benefit from screwworm infestation per expansion animal that were determined from the survey of producers in the Yucatan Peninsula of Mexico. No projections of benefits for the Yucatan Peninsula were made which included the potential increase in the net returns of owners of cow-calf operations. Since the potential benefits of screwworm eradication estimated for the Yucatan Peninsula were generally lower than the benefits of eradication reported in the eradicated area, estimation of benefits using both of these sets of figures provides high and low estimates of benefits livestock producers in the Yucatan Peninsula might obtain from screwworm eradication.

The annual benefits expected from eradicating the screwworm from the Yucatan Peninsula as estimated from the eradicated area questionnaire are presented in Table 26. These estimates were obtained by multiplying the inventories of expansion animals of each livestock class in the Yucatan in 1984 by the estimates of per expansion animal benefits in 1984 constant dollars from the eradicated area of Mexico (see Table 20). This provided an estimate of the total benefits that owners of livestock in the Yucatan Peninsula would experience from not having to contend with the screwworm in 1984 if the benefits estimated for the eradicated areas were applicable to the Yucatan. For purposes of estimating the present value of benefits, the level of benefits that would have occured in 1984 was assumed to be the level that would continue to perpetuity. Secondary data indicated that no feeder cattle

Table 26. Total Annual Expected Benefits per Livestock Category From Screwworm Eradication in the Yucatan Peninsula in 1984 Constant Dollars (Estimated Using per Expansion Animal Benefits From the Eradicated Area of Mexico)

Livestock Category	1984 # of Expansion Animals	Eradicated Area Ben. per Expansion Animal (with labor)	Eradicated Area Ben. per Expansion Animal (no labor)	Total Expected Annual Benefit (Labor Included)	Total Expected Annual Benefit (Labor Excluded)
				---------000----------	
cow-calf	1,053,810	5.95	3.75	6,270.2	3,951.8
stocker	1,217,265	2.51	1.88	3,055.3	2,288.5
feeder	0	1.20	.97	0.0	0.0
dairy	92,194	10.69	5.82	985.6	536.6
swine	20,889	13.00	7.02	271.6	146.6
sheep	13,978	1.17	.21	16.4	2.9
goats	3,956	2.28	1.69	9.0	6.7
horses	38,420	2.09	.93	80.3	35.7
work animals	386,854	.67	.62	259.2	239.9

were located in the Yucatan so there was no estimation of benefits in Table 26 for owners of of that type cattle.

As shown in Table 26, there were 1,217,265 stocker cattle in the Yucatan Peninsula in 1984. The total potential benefit per stocker, including labor cost reduction, was $2.51. If labor cost reduction were not considered to be beneficial the potential benefit per stocker from screwworm eradication was $1.88. The total potential annual benefits for the stocker category were $3.1 million if labor reduction was considered to be a benefit and $2.3 million if labor cost reduction was not considered to be a beneficial result for Mexico.

Table 26 indicates that the highest total expected annual benefits of screwworm eradication in the Yucatan Peninsula would be for owners of cattle in the cow-calf category. They would be expected to have an annual benefit of $6.3 million if labor cost reduction was counted and $3.9 if labor cost reduction was excluded. The second and third highest annual benefits, both when labor cost reduction was included and when it was excluded, went respectively to owners of cattle in the stocker and dairy categories.

Table 27 was constructed in the same manner as Table 26 except that the potential per expansion animal benefits from the screwworm infested area of Mexico were used (see Table 21). There were fewer observations in each livestock category in the infested region than in the eradicated region. No data were collected for feedlot operations in the infested region so no per expansion animal benefits for that category are given in Table 27.

For all cattle categories, total annual expected benefits were larger when per expansion animal benefit estimates from the eradicated area were used. For example, in comparing Tables 26 and 27 the annual expected benefit for the dairy category, labor cost reduction included, is $986 thousand when the per expansion animal benefits from the

Table 27. Total Annual Expected Benefits per Livestock Category From Screwworm Eradication in the Yucatan Peninsula in 1984 Constant Dollars (Estimated Using per Expansion Animal Benefits From the Infested Area of Mexico)

Livestock Category	1984 # of Expansion Animals	Infested Area Ben. per Expansion Animal (with labor)	Infested Area Ben. per Expansion Animal (no labor)	Total Expected Annual Benefit (Labor Included)	Total Expected Annual Benefit (Labor Excluded)
				---------000	----------
cow-calf	1,053,810	2.12	1.72	2,234.1	1,812.6
stocker	1,217,265	.75	.35	912.9	426.0
feeder	0		no data collected		
dairy	92,194	2.75	.96	253.5	88.6
swine	20,889	9.24	8.07	193.0	168.6
sheep	13,978	.63	.45	8.7	6.2
goats	3,956	1.12	0.00	4.4	0.0
horses	38,420	6.11	4.32	234.7	166.0
work animals	386,854	.87	.42	336.6	162.5

eradicated area are used and $254 thousand when the potential per expansion animal benefits from the infested area are used. The annual benefits for the dairy category are about 74 percent higher when the eradicated area per expansion animal benefits are used. When labor cost reduction is excluded, the annual benefit for the dairy category, estimated with the per expansion animal benefits from the eradicated area is $537 thousand. This is about 83 percent higher than the $88.6

thousand annual benefit estimated with potential per expansion animal benefits from the infested area.

The other livestock categories were mixed as to which estimate of per expansion animal benefits gave the highest annual benefit. As an example, the annual expected benefit for work animals, using the per adult work animal benefit from the eradicated area of Mexico and including the reduction in labor cost, was $259 thousand. That estimate of annual benefits increased by about 23 percent to $337 thousand when potential per expansion animal benefits from the infested area, labor cost reduction included, were used. When labor cost reduction is excluded from work animal estimates the situation reverses. The annual benefits using per expansion animal estimates from the eradicated area were $240 thousand. This was 32 percent larger than the estimated $163 thousand annual benefits using the per expansion animal estimates from the infested area.

Table 28 shows the 1984 present value of the annual benefits projected to perpetuity from a screwworm eradication campaign in the Yucatan Peninsula. The estimates in Table 28 include the benefits that would accrue to owners of all the livestock categories included in this study.

Table 28 shows that a wide range of expected benefits was calculated depending on the discount rate used and the inclusion or exclusion of labor as a benefit. With each discount rate, the expected benefits to perpetuity were higher when the per expansion animal

Table 28. Benefits To Be Expected From a Screwworm Eradication Campaign in The Yucatan Peninsula in 1984 Present Value Terms

Discount Rate	Per Expansion Animal Benefit Estimate From	Benefits To Perpetuity With Labor	Benefits To Perpetuity Without Labor
3%	Yucatan	139,241,594	94,376,399
3%	Eradicated Area	364,813,978	240,317,767
6%	Yucatan	69,620,799	47,188,199
6%	Eradicated Area	182,406,989	120,158,883
8.625%	Yucatan	48,431,860	32,826,573
8.625%	Eradicated Area	126,891,818	83,588,778

benefits from the eradicated area were used. For example, at a 3% discount rate the expected benefits to perpetuity from eradication, including labor, were $364.8 million when per expansion animal benefit estimates from the eradicated area of Mexico were used. That estimate was 62 percent higher than $139.2 million, the 1984 present value estimate of benefits to perpetuity obtained when the 3% discount rate was used along with the potential per expansion animal benefit estimates from the infested area. When the 8.625% discount rate was used along with the benefit estimates from the eradicated area the 1984 present value estimation of benefits inluding labor, $126.9 million, was 34 percent higher than the estimation that did not include labor calculated at the same discount rate, $83.6 million. This once again underscores that the decision whether or not to include labor as a benefit greatly changes the estimations of the total benefits derived from a screwworm eradication program.

The highest estimate of benefits into perpetuity in Table 28, \$364.8 million was obtained when the 3% discount rate and the per expansion animal benefits, including labor, from the eradicated area were used. That high estimate was more than eleven times greater than the lowest estimate in Table 28, \$32.8 million. The lowest estimate was arrived at by using the 8.625% discount rate and the estimates of per expansion animal benefits, labor excluded, from the Yucatan Peninsula.

Decision makers may use the benefit scenario from Table 28 they feel is most appropriate. Projected benefit-cost ratios could then be formed if it were known how much it would cost to eradicate the screwworm in the Yucatan Peninsula. For example, it might be decided that \$240.3 million, the estimation of benefits using the 3% discount rate and the per expansion animal benefits from the eradicated area, excluding labor, is the most appropriate estimate to use when considering an expansion of the program into the Yucatan Peninsula. If the projected cost in 1984 present value terms of eradicating screwworms was \$100 million then the estimated B-C ratio of a screwworm eradication program in the Yucatan Peninsula would be 2.4.

Expected Benefits in Central America

Estimates of benefits that livestock producers in Central America might experience from a screwworm eradication campaign were made in the same way as they had been for Mexico's Yucatan Peninsula. An example of the annual benefits per livestock category that might be experienced by livestock producers in Central America if the screwworm were eradicated from their countries is presented in Table 29. The projected benefits in Table 29 were calculated by multiplying the per expansion animal benefits from the eradicated area of Mexico by the estimated number of expansion animals in Central America in 1984. The data in Table 29 can be interpreted in the same way as the data in Tables 26 and 27. The benefits livestock owners in Central America would have obtained in 1984 from the absence of the screwworm were considered to continue to perpetuity.

Cow-calf and dairy operations in Central America show the highest potential benefits when labor cost reduction is counted as a benefit (Table 29). Under that scenario, the annual potential benefits to cow-calf operations in Central America are $25.8 million while dairy operations could experience a benefit of $6.4 million annually from screwworm eradication. When labor cost reduction is not included as a benefit the annual potential benefit for the cow-calf category, $16.3 million, is still the highest of any category. Under those conditions, however, the annual potential benefits of the stocker category, $3.9 million, become the second highest potential benefit of any category.

The total annual expected benefits per livestock category in Central America estimated with per expansion animal benefits from the

Table 29. Total Annual Expected Benefits per Livestock Category From Screwworm Eradication in Central America in 1984 Constant Dollars (Estimated Using per Expansion Animal Benefits From the Eradicated Area of Mexico)

Livestock Category	1984 # of Expansion Animals	Eradicated Area Ben. per Expansion Animal (with labor)	Eradicated Area Ben. per Expansion Animal (no labor)	Total Expected Annual Benefit (Labor Included)	Total Expected Annual Benefit (Labor Excluded)
				---------000	----------
cow-calf	4,336,920	5.95	3.75	25,804.7	16,263.5
stocker	2,047,990	2.51	1.88	5,140.5	3,850.2
feeder	2,047,990	1.20	.97	2,457.6	1,986.6
dairy	602,350	10.69	5.82	6,439.1	3,505.7
swine	257,200	13.00	7.02	3,343.6	1,805.5
sheep	406,800	1.7	.21	476.0	85.4
goats	78,000	2.28	1.69	177.8	131.8
horses	111,965	2.09	.93	234.01	104.3
work	784,835	.67	.62	525.8	486.6

infested area of Mexico are given in Table 30. No data was gathered on the potential benefits of screwworm eradication for feeder cattle operations in the infested area. Thus the per stocker benefits from the infested area of Mexico were applied to the feeder cattle inventory in this instance.

As was the case when per expansion animal benefits from the eradicated area of Mexico were used, the cow-calf category showed the

Table 30. Total Annual Expected Benefits per Livestock Category From Screwworm Eradication in Central America in 1984 Constant Dollars (Estimated Using per Expansion Animal Benefits From the Infested Area of Mexico)

Livestock Category	1984 # of Expansion Animals	Infested Area Ben. per Expansion Animal (with labor)	Infested Area Ben. per Expansion Animal (no labor)	Total Expected Annual Benefit (Labor Included)	Total Expected Annual Benefit (Labor Excluded)
				---------000---------	
cow-calf	4,336,920	2.12	1.72	9,194.3	7,459.5
stocker	2,047,990	.75	.35	1,536.0	716.8
feeder	2,047,990	.75	.35	1,536.0	716.8
dairy	602,350	2.75	.96	1,656.5	578.3
swine	257,200	9.24	8.07	2,376.5	2,075.6
sheep	406,800	.63	.45	252.2	183.1
goats	78,000	1.12	0.00	87.4	0.0
horses	111,965	6.11	4.32	684.1	483.7
work animals	784,835	.87	.42	682.8	329.6

highest potential annual benefit in Central America from screwworm eradication when potential per expansion animal benefits from the infested area of Mexico were used. The potential benefit for the cow-calf category was $9.2 million when labor cost reduction was considered to be a benefit and $7.5 million when labor cost reduction was not included as a benefit. The second highest potential benefits were for the swine category both in the case when labor cost reduction is included in the summation of benefits and in the case when it is not. The potential annual benefit for the swine category, labor included, is $2.4 million. That potential annual benefit declines to $2.1 million when labor cost reduction is not included in the benefits.

The expected benefits from a Central American Screwworm Eradication campaign in 1984 present value terms are presented in Table 31. The benefit estimations for Central America may be compared to the budgeted cost of any eradication program for that area to obtain an idea of the B-C ratio that might result.

Table 31. Benefits To Be Expected From a Screwworm Eradication Campaign in Central America In 1984 Present Value Terms

Discount Rate	Per Expansion Animal Benefit Estimate From	Benefits Into Perpetuity With Labor	Benefits Into Perpetuity Without Labor
3%	Yucatan	600,098,306	518,128,857
3%	Eradicated Area	1,486,225,139	941,090,114
6%	Yucatan	300,049,153	209,064,428
6%	Eradicated Area	743,112,564	470,545,057
8.625%	Yucatan	208,729,845	145,436,124
8.625%	Eradicated Area	516,947,874	327,335,692

The highest estimate of benefits for a Central American campaign was $1,486 million. That estimate was obtained by using a 3% discount rate and the estimations of per expansion animal benefits to perpetuity, including labor, from the eradicated area of Mexico. The lowest estimate of benefits to perpetuity in Table 31, $145 million, resulted from using the 8.625% discount rate and the potential per expansion animal benefits estimated for the Yucatan Peninsula. These results provide insight into the potential value of an expanded eradication program. What is not included are considerations of the the cost of maintaining the current eradication boundary; risk of reinfestation; possible positive effects of lower meat prices to consumers; and effects of the screwworm on pets, people, and wildlife.

CHAPTER VII

SUMMARY AND CONCLUSIONS

A screwworm eradication program was extended beyond the United States to the country of Mexico in 1977. The purpose of this study was to quantify the benefits to Mexico of the screwworm eradication program and compare those benefits to the program's costs. Such comparisons are useful in quantifying the value of social programs such as screwworm eradication and may help provide economic insight into proposals to extend the program beyond Mexico into Central American countries where the screwworm remains a problem. The study developed physical estimates such as reduced death loss and economic measures including benefits and benefit-cost ratios.

Procedures

With the aid of the Mexican-American Screwworm Commission, Mexico was divided into nine work zones for purposes of the study. Zones 1-8 included areas of Mexico where the screwworm had been eradicated (e.g., the eradicated region). The Yucatan Peninsula, the only region in Mexico where the screwworm was found at the time of the study, was designated as zone 9 or the infested region.

Two survey instruments were developed to collect data needed for an economic analysis of the impact of screwworm eradication in the country of Mexico. One was to be used in study zones 1-8 (eradicated region), the other in study zone 9 (infested region). Both questionnaires asked for data on the physical damages to livestock caused by screwworms such as increased death loss and sale weight reduction. The questionnaires also asked Mexican producers to provide data on the increase in production cost caused by practices necessary to combat the screwworm. The eradicated area questionnaire solicited information from producers about the last year when screwworms had been present in their area. The benefits producers in the eradicated area of Mexico gained from the screwworm eradication campaign were derived from no longer experiencing the negative effects of that pest. The negative effects of the screwworm they reported for the last year when that pest presented them with a problem thus represented their annual level of benefits received from the eradication campaign. In zone 9 livestock producers were asked for information about the effects of the screwworm on their operations in 1984. The negative effects of the screwworm they reported for that year were considered to represent their potential annual benefits if the screwworm were eradicated in the Yucatan Peninsula.

Complete evaluation of a social investment such as screwworm eradication implies estimating the program's effects on both livestock producers and consumers of livestock products. In economic terms that would mean quantification of the effects of screwworm eradication on producers' surplus and consumers' surplus. Lack of market data on demand for livestock products in Mexico precluded an evaluation of the eradication campaign's effect on consumers surplus' in that country. Hence, only the benefits of screwworm eradication that accrued to Mexican livestock producers were estimated. Exclusion of consumer benefits can be expected to cause all the estimations of benefits made in this study to be conservative.

For the cow-calf, stocker, dairy, feeder, swine, sheep, goat, and sale horse categories, the effect of the screwworm was estimated on the basis of adult female breeding animals. In the work animal category; which is composed of work horses, mules, and burros; adult work animals were used as the basis for estimating the effects of the screwworm. The animals used as the basis for establishing a per unit estimate of benefits in each category are referred to as expansion animals. Given the average benefits per expansion animal from the survey, the total benefits accruing to a category for any year for which the total number of expansion animals in that category is known can be estimated.

Although the primary benefit of screwworm eradication estimated in this study was the decrease in the costs incurred by livestock producers, information was also obtained on increases in production made possible by screwworm eradication. Any increase in production can potentially increase the net revenues of producers. Since any increase in production entails an increase in variable cost, detailed cost of production data are necessary to calculate what percentage of the increase in total revenue due to screwworm eradication constitutes a net benefit to producers. The only fairly reliable cost of production data available from Mexico was for the cow-calf category. An estimate of the net returns for the added sales due to eradication was developed for the cow-calf category.

The reduction in costs experienced by livestock owners was composed of reductions in costs for medicine, confinement of animals, insecticides, veterinarian services, equipment, days of feeding, and labor. Any reduction in the need for unskilled labor may benefit producers but not be a benefit to society unless alternative employment is readily available for displaced workers. For that reason, estimates of total benefits for each category were made both with and without the labor component of the decrease in variable cost.

Once a category's total benefits per expansion animal had been estimated from the producer sample, the annual benefits per category were determined by multiplying the benefit per expansion animal by the total number of expansion animals found in eradicated zones in a given year. Secondary data from Mexico provided some information on yearly inventories of expansion animals in each livestock category for each state in Mexico. Procedures were developed for estimating numbers of expansion animals in cases where no explicit information could be found. Four estimates of total benefits per year were made for the cow-calf category, two that included the increases in net returns for added sales due to eradication and two that did not. Only two estimates of benefits per year were calculated for the other categories, one composed of the reduction in variable cost including the labor component and one excluding the labor component. Data were not available for estimating the net return for added sales due to eradication in the other livestock categories. Total benefits were arrived at by summing the benefits from the cow-calf, stocker, feeder, dairy, swine, sheep, goat, horse, and work-animal categories. The summation of benefits was done both with and without the net returns for added sales due to eradication for the cow-calf category and with and without the decrease in labor. Thus, a total of four different estimates of total annual benefits were constructed.

Each of the four yearly estimates of benefits was converted to 1984 present value terms at three different discount rates; 3%, 6%, and 8.625%. Benefits for 1984 were considered to continue into perpetuity. Using three discount rates with the four different yearly estimates of total benefits resulted in twelve different estimates of the present value of total benefits for zones 1 through 8.

Results

The benefits of screwworm eradication per expansion animal in the eradicated region of Mexico were found to be higher than the potential benefits per expansion animal from a screwworm eradication campaign in the Yucatan Peninsula for all categories except horses and work-animals. The estimates of potential benefits per expansion animal from the Yucatan were thus considered to be the lower bound of the benefits that livestock owners in the Yucatan or Central America might gain from an eradication campaign. There are several possible explanations of the seeming difference in the effects of the screwworm reported in the eradicated and infested areas of Mexico. One explanation is that there have been small incursions of the eradication campaign into the Yucatan Peninsula. At the time of the survey, producers could already have been suffering fewer losses than before due to the Commission's efforts. Other possible explanations include differences in cultural practices between the eradicated region and infested regions, less intensive production in the eradicated region, or the possibility that the infested region was not as good a natural habitat for the screwworm as the eradicated region had been.

Death losses, extra feeding days, sale weight loss, extra labor, loss of work from work animals, and loss of milk production were the physical impacts of the screwworm considered in this study. In most cases those physical impacts were found to be greater in the eradicated region than in the infested region. For every livestock category death losses were greater for young animals than for adults. Cow-calf operations and swine operations reported the largest amount of extra feeding days and sale weight loss in both regions. Dairy operations needed the most extra labor days due to the screwworm in the eradicated region and swine operations needed the most extra labor days due to the screwworm in the infested region.

The benefit to producers from 1977 to perpetuity from decreased variable costs, expressed in 1984 present value terms using a 6%

discount rate, was $2,883.5 million. Without the labor component of the reduction in variable cost, that benefit decreased by 36 percent to $1,826.2 million. This points out the importance of the decision about whether or not to include labor reduction as a benefit.

The evidence from the calculations done in the cow-calf category suggested that the eradication of the screwworm did increase total revenues gained by producers by reducing death and sales losses. The net value of the increased output in that category from 1977 into perpetuity was estimated to be $584.5 million in 1984 present value terms when a 6% discount rate was used for calculation. Benefits from screwworm eradication may have been underestimated since accurate estimates of the net increases in the total revenues of owners of all the livestock categories included in this study could not be made.

The estimated 1984 present value of total benefits for all livestock categories from 1977 to perpetuity was $3,418 million when the 6% discount rate was used, labor reduction was included as a benefit, and the increase in net returns for increased sales from cow-calf operations was included. The net returns for added sales in the cow-calf category comprised 17 percent of that total. This suggests that if this value (benefit) could be estimated across all categories, the benefit-cost ratios estimated in this study might have been higher. Reduction in labor usage accounted for 29 percent of the total economic benefit.

The total annual costs of the Mexican Eradication Program were taken from budgets supplied by the Mexican-American Screwworm Commission. The Commission's 1986 expenditure was considered to continue into perpetuity for purposes of computing benefit-cost ratios. Annual costs were converted to 1984 present value terms using each of the discount rates employed when converting yearly benefits to 1984 present value terms. This procedure yielded three estimates of the present value of the cost to perpetuity of the eradication campaign and maintaining the barrier region. That cost computed at the 6% discount rate was $830.5 million.

Twelve benefit-cost ratios for the area of Mexico from which the screwworm had been eradicated were estimated by dividing each of the estimations of benefits in present value terms by the estimation of the program's costs in present value terms calculated at the corresponding discount rate. The most conservative discount rate used for estimation was 8.625%, the rate used by the U.S. Government at the time of this study. Using the 8.625% discount rate the benefit-cost ratio was 2 when labor and the increase in net returns on added sales in the cow-calf category were not included as benefits. Thus, even the most conservative benefit-cost ratio estimated in this study showed a two to one return for every dollar invested in the eradication effort and cost of maintaining the barrier. The highest B-C ratio estimated in this study was 4.5. That B-C ratio was obtained when the 3% discount rate was used and labor reduction and the increase in the net returns for added sales by cow-calf producers were included as benefits. It must be kept in mind that consumer benefits are not included in the B-C ratios estimated in this study which means that the benefits stemming from the eradication campaign may be understated. Under any of the scenarios examined in this study, the benefits to Mexican livestock producers of screwworm eradication were higher than the costs of the eradication campaign.

Two sets of estimates were made of benefits that producers might obtain in the Yucatan Peninsula and Central America if screwworms were eradicated in those areas. The higher estimate used the decrease in benefit per expansion animal from zones 1 through 8 (eradicated region) in Mexico as a measure of the per expansion animal benefits that might occur. The lower estimate used the potential benefits per expansion animal from screwworm eradication determined from the survey in study zone 9 (infested region) of Mexico. The estimates of the potential benefits of screwworm eradication in the Yucatan Peninsula and Central America were done both with and without the labor component of the impact of the screwworm on producers' costs as before. No estimates of potential benefits in Central America and the Yucatan Peninsula were made which included the potential increase in the net returns for added output from any livestock category.

At the highest discount rate used, 8.625%, and using the estimates of potential benefits per expansion animal from the Yucatan Peninsula, the 1984 present value of future perpetual benefits from a screwworm eradication campaign in the Yucatan were estimated to be $48 million.

If the labor reduction were not considered, the present value of benefits declined to $32.8 million. Those were the lowest present value estimates of potential benefits from screwworm eradication in the Yucatan Peninsula. Using the estimate of benefits from the eradicated area of Mexico and the 3% discount rate, the highest present value of future benefits from an eradication campaign in the Yucatan Peninsula were obtained. These were $364.8 million if labor reduction were included and $94.4 million if labor reduction were not included.

The lowest estimate of the present value of a campaign to eradicate the screwworm in Central America was $208.7 million if labor cost reduction were included or $145.4 million if the labor cost reduction was excluded. Using the lower 3% discount rate and the per expansion animal benefits from the Yucatan Peninsula, the present value of future benefits was estimated to be $600.1 million with the labor component and $518.1 million without the labor component. This implies that if the screwworm can be eradicated for less than these values on a 1984 basis, then extension of the program is economically justified.

The Study's Limitations

Any study of this magnitude that encompasses such a large and diverse area with such a wide group of livestock producers faces many limitations. This section discusses many of the more serious issues that had some influence upon the study results.

Data relative to the price and quantity demanded relationship for livestock products in Mexico were not available. Investigation of that relationship was far beyond the scope of this study. Thus, the effects of an increased supply of livestock products on consumers in Mexico was not estimated; i.e., consumers' surplus was not estimated in any manner. This means that the benefits estimated included only the benefits to producers. This limitation may result in a significant understatement of the benefits associated with screwworm eradication in Mexico.

A major limiting factor was the difficulty faced by ranchers in recalling effects of the screwworm that had incurred several years in the past. For example, producers in study zone 1 were asked to recall the effects of the screwworm on their operations as far back as 1978. Only producers in zone 9 were asked to give data about 1984, the year before enumeration. Most of the ranchers did not have written records and relied solely on memory. Recognizing the difficulty of recall, the enumerators were instructed not to lead producers as they tried to remember the screwworm's effects. Additionally a large sample size was used so that acceptable estimates could be provided.

Employees of the Mexican-American Screwworm Commission served as enumerators to gather data needed in this study. This was a definite benefit in that they knew many of the producers, were familiar with the different regions of Mexico and could quickly complete a large number of questionnaires. This procedure, however, may also have introduced a possible conflict of interest into the study. Some employees may have inserted some bias in their zest to show that their efforts were highly beneficial to society. To minimize conscious or unconscious incorporation of bias by enumerators, a section of the training seminar was dedicated to this potential problem. Also, a checking procedure was presented whereby a select panel of producers were reinterviewed. In the final outcome, the check was conducted via site visits to Sonora and the Yucatan Peninsula to meet with ranchers. The results of the site visits suggested that enumerator bias was not a problem.

Lack of secondary data proved to be a hinderance throughout the study. Detailed breakdowns of livestock inventories were unavailable. It was necessary to develop a methodology to separate the inventory data available on total cattle into numbers of cows, bulls, calves, replacement heifers, etc. Transformation of data in this way compromises statistical validity.

A methodology for estimating the impact of the screwworm on producers' net returns for added sales was developed. However, lack of budget data prevented the procedure from being applied for all livestock categories except cow-calf operations. That lack of budget data made it necessary to consider the impact of the screwworm on producers' variable costs to be the major impact of the pest on livestock producers. A more accurate estimate of benefit-cost ratios would have been possible if truly representative budget data had been available for all livestock categories.

The people who were in charge of supervising the survey were based at Texas A&M University (TAMU). A telephone number was made available to all enumerators at which they could contact the personnel at the University with any questions that might arise as to how the questionnaires should be completed. Even with this number always available, communications between those in charge of the survey and the enumerators proved to be difficult since many enumerators spent a great deal of their time in locations with no phone service. When the survey supervisors at TAMU began to notice problems in the filling out of questionnaires it often took weeks to contact the responsible person. The difficulty of communicating with the study leaders may have caused some of the surveyors not to clarify points which had been puzzling them about some points in the survey instrument.

Completion of the research was delayed by an earthquake in Mexico City. That earthquake also disrupted phone service between Mexico and the United States, increasing the difficulty of communicating with the enumerators. The time needed to complete the survey was increased several months by the earthquake.

The continuity of the survey process was further disrupted by an outbreak of screwworms in the Huasteca area of Mexico. Many of the enumerators had to be moved from the region where they were surveying producers to fight the outbreak. The outbreak did however offer an unique opportunity to study the effects of screwworm infestation on livestock producers who had become unaccustomed to dealing with the pest.

In zone 9 (infested region) of this study, the Yucatan peninsula, the goal was to see how the screwworm was impacting producers at the time of the study. To get an unbiased idea of the importance of the screwworm to livestock owners, an area was needed in which the eradication campaign had not penetrated. As the surveyors began to work in the Yucatan, it became obvious that the peninsula did not meet that criteria. The Commission had conducted sporadic sterile screwworm fly drops, distributed medicine, and conducted educational campaigns in the area. Although the Yucatan was still infested with the screwworm, the Commissions's efforts are expected to have lowered the screwworm's effect as estimated by the study. The estimates from the Yucatan can give only a general idea of the current impact of the screwworm.

Need For Further Study

Further research could compensate for many of the limitations of the study on the economic effects of the screwworm eradication campaign in Mexico. To gain a completely true idea of the current impact of the screwworm on producers it would be necessary to conduct interviews in an infested area that has had no penetration by the eradication campaign. Central America would be a good candidate for such an investigation. If the eradication campaign is extended to Central America, producers could be surveyed before the eradication effort began. They would be able to give current information about how the screwworm was affecting their livestock production. Ideally they would then be surveyed again after the screwworm were no longer present to see if there were significant changes in their revenues and operating expenses.

The question of the effects of screwworm eradication on consumers is also a prime candidate for further study. A methodology could be developed to estimate the effects of screwworm eradication in Mexico on the consumers surplus of that country's inhabitants. Similarly if the campaign is extended to Central America the effects of screwworm eradication on consumers' surplus in that region could be determined and would be expected to be a large proportion of total benefits of eradication based on previous studies of pest management.

This study dealt only with the Mexican screwworm eradication campaign's benefits to Mexican livestock producers. Significant benefits, however, are obtained by United States producers and consumers from maintaining the barrier south of the United States and thus avoiding reinfestation. A much more extensive research effort would have been necessary to determine the United States' benefits from the Mexican screwworm eradication effort.

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APPENDIX A

ERADICATED AREA QUESTIONNAIRE

CONFIDENCIAL

AREA LIBRE

Encuesta Para Estimar el Impacto Económico de la Erradicación del Gusano Barrenador del Ganado en la República Mexicana

Sr. Ganadero, deseamos hacerle algunas preguntas relacionadas con el programa para la erradicación del gusano barrenador del ganado en México. Las respuestas que de al presente cuestionario, serán confidenciales. Por su ayuda, le damos nuestras anticipadas gracias y nos complace informarle que esta labor es solo una parte de un trabajo muy completo, que permitira evaluar los efectos de dicho programa en los ganaderos, pequeños propietarios de animales y el pueblo en general de la República Mexicana. Al realizar el trabajo final, solamente se citarán promedios y cifras totales de los datos proporcionados por las personas entrevistadas. Toda la información en este cuestionario se enfoca únicamente al año 19____

Zone	Año	Estado	Zona	Año	Estado
1	1978	Baja California Norte	5	1980	Guanajuato
		Sonora			Hidalgo
		Chihuahua			Queretaro
2	1977	Baja California Sur	6	1981	Michoacan
3	1976	Coahuila			Colima
		Nuevo leon			Estado de Mexico
		Tamaulipas			Morelos
4	1979	Sinaloa			Veracruz
		Durango			Puebla
		Zacatecas	7	1982	Guerrero
		San Luis Potosi	8	1983	Tabasco
5	1980	Nayarit			Chiapas
		Jalisco			Oaxaca
		Aguas Calientes			

Nombre del encuestador ____________________
Cuestionario Número: ____________ Fecha: ____________
Encuestado principal ____________________
Encuestado de reemplazo ____________________
Numero del encuestador ____________________

1-P1 Dirección

1. Estado ____________________
2. Municipio ____________________
3. Poblado ó Rancheria ____________________
4. Domicilio ____________________
____
5. Telefono ____________________

Motivo por el cúal el encuestado principal no respondio: ____________________
____
____
____

1-P1A Dirección

1. Estado ____________________
2. Municipio ____________________
3. Poblado ó Rancheria ____________________
4. Domicilio ____________________
5. Telefono ____________________

1-P2 ¿Esta familiarizado con el programa para la erradicación del gusano barrenador del ganado?

1. Sí ______ (si contesta sí; vaya a 1-P3)
2. No ______ (si contesta no; vaya a 1-P4)

1-P3 ¿Por que medio se enteró del programa?

1. La televisión ____________
2. La radio ____________
3. La prensa ____________
4. Inspector de la comisión ______
5. Un vecino ____________
6. Otra fuente ____________

1-P4 ¿Ha tenido alguna vez problemas con el gusano barrenador en sus animales?

1. Sí ______ (si contesta sí; vaya a 1-P5)
2. No______ (si contesta no; termine la entrevista)

1-P5 ¿Cuál de las siguientes actividades realizó?
(Marque todas las actividades realizadas)

________ ¿Tomó y envió muestras de posibles larvas de gusano barrenador?
________ ¿Curó animales heridos para prevenir infestaciones de gusano barrenador?
________ ¿Recibió asistencia técnica acerca de la erradicación del gusano barrenador?
________ ¿Recibió propaganda tecnica sobre la erradicación del gusano barrenador?
________ ¿Alguna vez vió cajas conteniendo moscas esteriles de las que el programa suelta por avion en los terrenos cercanos en donde esta su rancho?
________ ¿Modificó el calendario de pariciones, castrado y marcado para evitar el ataque del gusano barrenador?
________ ¿Desempeño algun trabajo en la comisión?

1-P6 ¿Cuántas Ha de tierra tiene usted en su explotación ganadera? ___________

1-P7 ¿Cuál considera que fue la plaga más nociva en su ganado en 19____?
(anote las 3 mas importantes)

____
____
____

1-P8 ¿Tipo de explotacion en 19____?	NO	SI	
2- Ganado para cria	_____	_____	vaya a la página 4
3- Ganado de engorda	_____	_____	vaya a la página 7
4- Ganado de engorda en corral	_____	_____	vaya a la página 9
5- Ganado lechero	_____	_____	vaya a la página 11
6- Porcina	_____	_____	vaya a la página 14
7- Ovina	_____	_____	vaya a la página 17
8- Caprina	_____	_____	vaya a la página 20
9- Caballar	_____	_____	vaya a la página 23
10- Avícola	_____	_____	vaya a la página 26
11- Animales para trabajo y de tiro	_____	_____	vaya a la página 27

2. GANADO PARA CRIA

2-P1 Número de Vacas

1. 1984
1.1 Vacas
_______ (cabezas)
1.2 Becerros
_______ (cabezas)

1.3 Otros
(especifique) _______ (cabezas)

2. En 19____
2.1 Vacas
_______ (cabezas)
2.2 Becerros
_______ (cabezas)

2.3 Otros
(especifique) _______ (cabezas)

2-P2 ¿Porcentaje de las vacas que paren anualmente?

1. 1984 ___________ %
2. En 19____ _____ %

2-P3 ¿Debido a la erradicación del gusano barrenador, concidera que cambió el porcentaje de las vacas que parieron en 19____?

1. Si ______
2. No ______ (si contesta no; vaya a 2-P4)
___________ disminuyó ______ %
___________ aumentó ______ %

2-P4 ¿Qúe porcentaje de su ganado fue atacado por el gusano barrenador en 19___?

1. Vacas _________ %
2. Becerros _________ %
3. Otros _________ %

2-P5 ¿Cuántos animales se le murieron en 19____? (no importa la causa)

1. Vacas __________
2. Becerros __________
3. Otora (específique) __________ (no se debe incluir ganado de engorda, el ganado de corral o el ganado lechero)

2-P6 ¿Cuántos animales murieron debido al ataque del gusano barrenador en 19___?

1. Vacas _________
2. Becerros _________
3. Otros (específique) _________

2-P7 ¿Cuántos animales vendió en el año 19____?

1. Vacas ___________
2. Becerros ___________
3. Otros (especifique) __________ (no se debe incluir ganado de engorda, el ganado de corral o el ganado lechero)

2-P8 ¿Cuál fué el peso promedio de un becerro vendido en 19____? _____ (kg)

2-P9 ¿Fué afectado el peso de venta de un becerro atacado por el gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 2-P10)
1. disminuyó ___________ ¿Cuánto? ___________ (kg / cabeza)
2. aumentó ___________ ¿Cuánto? ___________ (kg / cabeza)

2-P10 ¿Afectó el gusano barrenador el tiempo promedio para criar y vender un becerro en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 2-P12)
disminuyó ___________ ¿Cuántos días? ___________
aumentó ___________ ¿Cuántos días? ___________

2-P11 ¿Cuál fué su costo promedio por becerro por día en 19____?
_____ (pesos / día)

2-P12 ¿Compró medicinas para curar del gusano barrenador a sus animales en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 2-P13)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a su ganado en 19____? _______ (pesos)

2-P13 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador en su ganado en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 2-P14)
¿Cuánto gasto en insecticidas para prevenir los ataques del gusano barrenador en su ganado en 19____? _______ (pesos)

2-P14 ¿Para sus vacas, usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 2-P15)
¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en 19____? ________ (número de días en 19____?)

2-P15 ¿Contrato los servicios medico veterinarios para el tratamiento de casos del gusano barrenador en su ganado durante 19____?

1.Sí ______
2.No ______ (si contesta no; vaya a 2-P16)
¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en su ganado en 19____? _______ (pesos)

2-P16 ¿Tuvo que apartar y dar comida suplementaria a algunas de sus vacas debido al ataque del gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 2-P17)
¿Cuántas cabezas apartó en 19____? ________ (cabezas)
¿Cuál fué su costo por cabeza? _____________ (cabezas)

2-P17 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en 19____?

1. Sí _____
2. No ______ (si contesta no; regrese a la página 3, pregunta P8-3)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en 19____? ________ (pesos)
Regrese a la página 3, pregunta P8-3

3. GANADO DE ENGORDA

3-P1 ¿Cuántos bovinos por año metió a potreros para engordar?

1. En 1984? __________ (cabezas)
2. En 19__? __________ (cabezas)

3-P2 ¿Qué porcentaje del total del ganado de engorda fué atacadado por el gusano barrenador del ganado en 19____? ______ %

3-P3 ¿Cuánto ganado de engorda se le murió en 19____? ________ (cabezas) (no importa la causa)

3-P4 ¿Cuánto ganado de engorda se le murió debido al gusano barrenador del ganado en 19____? ________ (cabezas)

3-P5 ¿Cuántas cabezas de ganado de engorda vendió en 19____? ______ (cabezas)

3-P6 ¿Cuál fué el peso promedio de un bovino gordo en el momento de su venta 19____? ________ (kg / cabeza)

3-P7 ¿Fué afectado el peso de venta de un bovino gordo atacado por el gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 3-P8)

Disminuyó ___________ ¿Cuánto? __________ (kg / cabeza)
Aumentó ____________ ¿Cuánto? __________ (kg / cabeza)

3-P8 ¿Afectó el gusano barrenador el tiempo promedio para producir un animal gordo listo para la venta en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 3-P10)

Disminuyó ___________ ¿Cuántos días? ___________
Aumentó ___________ ¿Cuántos días? ___________

3-P9 ¿Cuál fué su costo promedio por día por animal de engorda en 19____? ___________ (pesos / día)

3-P10 ¿Compro medicinas para curar del gusano barrenador a sus animales de engorda en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 3-P11)

¿Cuánto gastó en medicamentos parar curar del gusano barrenador a sus animales de engorda en 19___?

3-P11 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador en su ganado de engorda en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 3-P12)

¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador en su ganado de engorda en 19___? _______ (pesos)

3-P12 ¿ Usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en su ganado de engorda en 19___?

1. Sí _____
2. No _____ (Sí contesta no; vaya a 3-P13)

¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en su ganado de engorda en 19___? _______ (días en 19___?)

3-P13 ¿Contrató servicios médico veterinarios para el tratamiento de casos del gusano barrenador en su ganado de engorda en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya 3-P14)

¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en su ganado de engorda en 19___? _______ (pesos)

3-P14 ¿Tuvo que apartar y dar comida suplementaria a algunos animales de su ganado de engorda debido al ataque del gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 3-P15)

¿Cuántas cabezas apartó en 19___? _______ (cabezas)
¿Cuánto le costó por cabeza? ___________ (pesos)

3-P15 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en su ganado de engorda en 19___?

1. Sí _____
2. No _____ (si contesta no; regrese a la página 3, pregunta P8-4)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en su ganado de engorda en 19___? _______ (pesos)
Regrese a la página 3, pregunta P8-4

4. GANADO DE ENGORDA EN CORRAL

4-P1 ¿Cuántos bovinos engordó por año?

1. 1984 __________ (cabezas)
2. 19___ _______ (cabezas)

4-P2 ¿Qué porcentaje de su ganado fue atacado por el gusano barrenador en 19___? _______ (%)

4-P3 ¿Cuántos animales se le murieron en 19___? _____ (cabezas)

4-P4 ¿Cuántos animales se le murieron debido al ataque del gusano barrenador en 19___? _______ (cabezas)

4-P5 ¿Cuántos animales vendió en 19___? _______ (cabezas)

4-P6 ¿Cuál fué el peso promedio de uno de sus bovinos engordado en 19___? ________ (kg)

4-P7 ¿Fué afectado el peso de venta de un bovino atacado por el gusano barrenador en 19___?

1.Sí _____
2. No _____ (si contesta no; vaya a 4-P8)
disminuyó _______ ¿Cuánto? _______ (kg / cabeza)
aumentó _______ ¿Cuánto? _______ (kg / cabeza)

4-P8 ¿Afectó el gusano barrenador el tiempo promedio para producir un bovino gordo para la venta en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 4-P10)
disminuyó _______ ¿Cuántos días? _______
aumentó _______ ¿Cuántos días? _______

4-P9 ¿Cuál fué su costo promedio por bovino por día en 19____? _______ (pesos / día)

4-P10 ¿Compró medicinas para curar del gusano barrenador a sus animales en 19____?

1. Sí _____
2. No _____ (si contesta no; vaya a 4-P11)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a sus animales en 19____? ________ (pesos)

4-P11 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador a sus animales en 19____?

1. Sí _____
2. No _____ (si contesta no; vaya a 4-P12)
¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador en su ganado en 19____? ________ (pesos)

4-P12 ¿Usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en 19____? ________ (pesos)

1. Sí _____
2. No _____ (si contesta no; vaya a 4-P13)
¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en su ganado en 19____? ______ (días en 19____)

4-P13 ¿Contrató servicios veterinarios para el tratamiento de casos del gusano barrenador en su ganado en 19____? ________ (pesos)

1. Sí _____
2. No _____ (si contesta no; vaya a 4-P14)
¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en su ganado en 19____? ________ (pesos)

4-P14 ¿Tuvo que apartar y dar comida suplementaria a algunos de sus bovinos debido al ataque del gusano barrenador en 19____?

1. Sí _____
2. No _____ (si contesta no; vaya a P-15)
¿Cuántas cabezas apartó en 19____? ________ (cabezas)
¿Cuál fué su costo por cabeza? ____________ (pesos)

4-P15 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; regrese a la página 3, pregunta P8-5)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en 19____? ________ (pesos)
Regrese a la página 3, pregunta P8-5

5. GANADO LECHERO

5-P1 Número de vacas lecheras

1. 1984	2. 19____
1.1 Vacas lecheras	2.1 Vacas lecheras
________ (cabezas)	________ (cabezas)
1.2 Becerros	2.2 Becerros
________ (cabezas)	________ (cabezas)
1.3 Otros	2.3 Otros
________ (cabezas)	________ (cabezas)

5-P2 ¿Porcentaje de las vacas que paren anualmente?

1. En 1984 ______ %
2. En 19____ ______ %

5-P3 ¿Debido a la erradicación del gusano barrenador, considera que cambió el porcentaje de las vacas que parieron en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P4)
________ disminuyó ______ (%)
________ aumentó ______ (%)

5-P4 ¿Qué porcentaje de su ganado lechero fué atacado por el gusano barrenador en 19____?

1. Vacas ______ %
2. Becerros ______ %
3. Otros ______ %

5-P5 ¿Cuántos animales se le murieron en 19___? (no importa la causa)

1. Vacas ______ (cabezas)
2. Becerros ______ (cabezas)
3. Otros ______ (cabezas)

5-P6 ¿Cuántos animales murieron debido al ataque del gusano barrenador en 19___?

1. Vacas ______ (cabezas)
2. Becerros ______ (cabezas)
3. Otros ______ (cabezas)

5-P7 Producción de leche (litros / vaca / año)

1. En 1984? ________
2. En 19___ ______

5-P8 ¿Afectó la presencia del gusano barrenador la producción lechera por vaca en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P9)

disminuyó ________ ¿Cuánto? _______ (%)
aumentó ________ ¿Cuánto? _______ (%)

5-P9 ¿Cuál fué el peso promedio de un becerro vendido en 19___? ______ (kg)

5-P10 ¿Fué afectado el peso de venta de un becerro atacado por el gusano barrenador en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P11)

aumentó _______ ¿Cuánto? _______ (kg / cabeza)
disminuyó ______ ¿Cuánto? _______ (kg / cabeza)

5-P11 ¿Afectó el gusano barrenador el tiempo promedio de producir un becerro para la venta en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P13)

disminuyó _______ ¿Cuántos días? _______
aumentó _______ ¿Cuántos días? _______

5-P12 ¿Cuál fué su costo promedio por diá por un becerro en 19___? ______ (pesos / diá)

5-P13 ¿Compró medicinas para curar del gusano barrenador a sus animales en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P14)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a su ganado lechero en 19___? ______ (pesos)

5-P14 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador en su ganado lechero en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P15)
¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador en su ganado lechero en 19___? ______ (pesos)

5-P15 ¿Usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en su operación de ganado lechero en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P16)
¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en su operación de ganado lechero en 19___? ______ (días en 19___)

5-P16 ¿Contrató servicios médico veterinarios para el tratamiento de casos del gusano barrenador en su ganado en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P17)
¿Cuánto gastó por estos servicios veterinarios para el tratamiento del gusano barrenador en su ganado lechero en 19___? ______ (pesos)

5-P17 ¿Tuvo que apartar y dar comida suplementaria a algunos de sus animales debido al ataque del gusano barrenador en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 5-P18)
¿Cuántas cabezas apartó en 19___? ______ (cabezas)
¿Cuánto le costó por cabeza? ___________ (pesos)

5-P18 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; regrese a la página 3, pregunta P8-6)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en 19___? ______ (pesos)
Regrese a la página 3, pregunta P8-6.

6. EXPLOTACION PORCINA

6-P1 Número De Porcinos

1. En 1984	2. En 19____
1.1 Machos ______ (cabezas)	2.1 Machos ______ (cabezas)
1.2 Hembras ______ (cabezas)	2.2 Hembras ______ (cabezas)
1.3 Lechones ______ (cabezas)	2.3 Lechones ______ (cabezas)

6-P2 Número promedio anual de lechones nacidos por cerda.

1. En 1984 ______ (cabezas)
2. En ____ ______ (cabezas)

6-P3 ¿Cambió el promedio de lechones nacidos por cerda anualmente debido a la erradicación del gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 6-P4)
________ aumentó ________ (lechones)
________ disminuyó ________ (lechones)

6-P4 ¿Qué porcentaje de todos los machos, hembras, y lechones fueron infestados por el gusano barrenador en 19____?
______ %

6-P5 ¿Qué número de Porcinos murieron en 19____?

1. Machos ________ (cabezas)
2. Hembras ________ (cabezas)
3. Lechones ________ (cabezas)

6-P6 ¿Cuántos Porcinos murieron debido al ataque del gusano barrenador en 19___?

1. Machos _______ (cabezas)
2. Hembras _______ (cabezas)
3. Lechones _______ (cabezas)

6-P7 ¿Cuántos cerdos vendio en 19___?

1. Machos _______ (cabezas)
2. Hembras _______ (cabezas)
3. Lechones _______ (cabezas)

6-P8 ¿Cuál fué el peso promedio de un cerdo vendido en 19___?
_______ (kg / cabeza)

6-P9 ¿Resultó afectado el peso de venta de un porcino atacado por el gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 6-P10)
_______ disminuyó ¿Cuánto? _______ (kg / cabeza)
_______ aumentó ¿Cuánto? _______ (kg / cabeza)

6-P10 ¿Afectó el gusano barrenador el tiempo promedio para producir un cerdo para la venta en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 6-P12)
_______ disminuyó ¿Cuántos días? _______
_______ aumentó ¿Cuántos días? _______

6-P11 ¿Cuál fué su costo promedio por día por cerdo en 19___?
_______ (pesos / día)

6-P12 ¿Compro medicinas para curar del gusano barrenador a sus cerdos en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 6-P13)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a sus cerdos en 19___? _____ (pesos)

6-P13 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador a sus cerdos en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 6-P14)
¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador a sus cerdos en 19___? _____ (pesos)

6-P14 Para su crianza de cerdos. ¿Usó mano de obra familiar o contratada para detectar la presencica del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 6-P15)
¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en 19___? _____ (días en 19___)

6-P15 ¿Contrató servicios médico veterinarios para el tratamiento de casos del gusano barrenador en sus cerdos en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 6-P16)
¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en sus cerdos en 19___? _____ (pesos)

6-P16 ¿Tuvo que apartar y dar comida suplementaria a algunos machos, hembras, o lechones debido al ataque del gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 6-P17)
¿Cuántas cabezas apartó en 19___? _____ (cabezas)
¿Cuál fué su costo por cabeza? _________ (pesos)

6-P17 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; regrese a la página 3, pregunta P8-7)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en 19___? _____ (pesos)
Regrese a la página 3, pregunta P8-7.

7. EXPLOTACION OVINA

7-P1 Número de ovinos

1. 1984	2. En 19___
1.1 Hembras _____ (cabezas)	2.1 Hembras _____ (cabezas)
1.2 Machos _____ (cabezas)	2.2 Machos _____ (cabezas)
1.3 Corderos _____ (cabezas)	2.3 Corderos _____ (cabezas)

7-P2 ¿Porcentaje de ovejas que paren anualmente?

1. En 1984 _____ (%)
2. En 19___ _____ (%)

7-P3 ¿Debido a la erradicación del gusano barrenador cambió el procentaje de las ovejas que parieron en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 7-P4)

_______ aumentó _______ (%, anualmente)
_______ disminuyó _______ (%, anualmente)

7-P4 ¿Qué porcentaje de sus ovinos fué atacado por el gusano barrenador en 19___? _____ (%)

7-P5 ¿Cuántos ovinos se le mureiron en 19___? (no importa la causa)

1. Hembras _______ (cabezas)
2. Machos _______ (cabezas)
3. Corderos _______ (cabezas)

7-P6 ¿Cuántos ovinos se le murieron debido al gusano barrenador en 19___?

1. Hembras _______ (cabezas)
2. Machos _______ (cabezas)
3. Corderos _______ (cabezas)

7-P7 ¿Cuántos animales vendió en 19___?

1. Hembras _______ (cabezas)
2. Machos _______ (cabezas)
3. Corderos _______ (cabezas)

7-P8 ¿Cuál fué el peso promedio de los borregos que vendió en 19___? _____ (kg / cabeza)

7-P9 ¿Fué afectado el peso de venta de un ovino atacado por el gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 7-P10)
disminuyó _______ ¿Cuánto? _____ (kg / cabeza)
aumentó _______ ¿Cuánto? _____ (kg / cabeza)

7-P10 ¿Afectó el gusano barrenador el tiempo promedio para producir un ovino para la venta en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 7-P12)
disminuyó _______ ¿Cuántos días? _______
aumentó _______ ¿Cuántos días? _______

7-P11 ¿Cuál fué su costo promedio por día por un ovino en 19___? _____ (pesos / día)

7-P12 ¿Cuánta lana vendió en 19___? _____ (kg)

7-P13 ¿Cuál fué su producción promedio de lana por ovino en 19___? _____ (kg)

7-P14 ¿ Afectó el gusano barrenador la cantidad de lana que produce un ovino anualmente en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 7-P15)
disminuyó _______ ¿Cuánto? _______ (kg / cabeza)
aumentó _______ ¿Cuánto? _______ (kg / cabeza)

7-P15 ¿Compró medicinas para curars del gusano barrenador a sus ovinos en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 7-P16)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a sus ovinos en 19___? _____ (pesos)

7-P16 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador a sus ovinos en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 7-P17)
¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador a sus ovinos en 19___? _____ (pesos)

7-P17 ¿Para sus ovinos, usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en su operación de ovinos en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 7-P18)
¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en su explotacion ovina en 19___? ______ (días en 19___?)

7-P18 ¿Contrató servicios veterinarios para el tratamiento de casos del gusano barrenador en su explotación ovina en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 7-P19)
¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en su explotación en 19___? ______ (pesos)

7-P19 ¿Tuvo que apartar y dar comida suplementaria a algunos de sus ovinos debido al ataque del gusano barrenador en 19___?

1. Sí ______
2. No ______ (si contesta no; vaya a 7-P20)
¿Cuántas cabezas aparto en 19___? _______ (cabezas)
¿Cuánto le costo por cabeza ? ____________ (pesos)

7-P20 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en su explotación ovina en 19___?

1. Sí ______
2. No ______ (si contesta no; regrese a la página 3, pregunta P8-8)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en su explotación ovina en 19___? ______ (pesos)
Regrese a la página 3, pregunta P8-8.

8. EXPLOTACION CAPRINA

8-P1 Número de Caprinos

1. 1984 — 2. En 19___
1.1 tipo Angora _______ (cabezas) 2.1 tipo Angora _______ (cabezas)
1.2 para leche _______ (cabezas) 2.2 para leche _______ (cabezas)
1.3 para carne _______ (cabezas) 2.3 para carne _______ (cabezas)

8-P2 Número de Cabras para Cría

1. 1984 — 2. En 19___
1.1 tipo Angora _______ (cabezas) 2.1 tipo Angora _______ (cabezas)
1.2 para leche _______ (cabezas) 2.2 para leche _______ (cabezas)
1.3 para carne _______ (cabezas) 2.3 para carne _______ (cabezas)

8-P3 ¿Qué porcentaje de sus caprinos fueron atacados por el gusano barrenador en 19___? _____ (%)

8-P4 ¿Porcentaje de sus cabras que paren anualmente?

1. 1984 _________ %
2. En 19___ ______ %

8-P5 ¿Debido a la erradicación del gusano barrenador cambió el procentaje de las cabras para cría que parieron en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 8-P6)
_______ aumentó _______ %
_______ disminuyó _______ %

8-P6 ¿Cuántos caprinos se le murieron en 19___? (no importa la causa)

1. Machos _______ (cabezas)
2. Hembras _______ (cabezas)
3. Cabritos _______ (cabezas)

8-P7 ¿Cuántos caprinos se le murieron debido al ataque del gusano barrenador en 19___?

1. Machos _______ (cabezas)
2. Hembras _______ (cabezas)
3. Cabritos _______ (cabezas)

8-P8 ¿Cuántos caprinos para carne vendió en 19____?

1. Machos ________ (cabezas)
2. Hembras ________ (cabezas)
3. Cabritos ________ (cabezas)

8-P9 ¿Cuál fué el peso promedio de un caprino vendido en 19____? ______ (kg)

8-P10 ¿Fué afectado el peso de venta de un caprino atacado por el gusano barrenador?

1. Sí ______
2. No ______ (si contesta no; vaya a 8-P11)
disminuyó ________ ¿Cuánto? ________ (kg / cabeza)
aumentó ________ ¿Cuánto? ________ (kg / cabeza)

8-P11 ¿Afectó el gusano barrenador el tiempo promedio para producir un caprino para la venta en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 8-P13)
disminuyó ________ ¿Cuántos días? ________
aumentó ________ ¿Cuántos días? ________

8-P12 ¿Cuál fué su costo promedio por caprino por día en 19____? ______ (pesos / día)

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

La siguiente seccion es solamente para los propietarios de caprinos de angora.
(si no tiene caprinos de angora vaya a 8-P16)

8-P13 Venta total de lana de Angora

1. 1984 __________ (kg)
2. En 19__________ (kg)

8-P14 ¿Cuál fué su producción promedio de lana de angora por caprino de angora en 19____? ______ (kg)

8-P15 ¿Afectó el gusano barrenador la cantidad de lana de angora producida por caprino de angora en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 8-P16)
_______ disminuyó ¿Cuántos kg por cabeza? _______
_______ aumentó ¿Cuántos kg por cabeza? _______

XXXXXXXXXXXXXXXXXXXXXXXXXXXXX

La siguiente sección es solamente para los propietarios de caprinos para producir leche.
(sí no tiene caprinos para producir leche vaya a 8-P19)

8-P16 ¿Cuál fué su venta total de leche en 19___? _____ (litros)

8-P17 ¿Cuál fué su producción promedio de leche por caprino en 19___? _____ (litros / año)

8-P18 ¿Afectó el gusano barrenador la producción promedio de leche por caprino?
1. Sí _____
2. No _____ (si contesta no; vaya a 8-P19)
_______ aumentó ¿Cuántos litros / cabeza? _______
_______ disminuyó ¿Cuántos litros / cabeza? _______

8-P19 ¿Compro medicinas para curar del gusano barrenador en sus caprinos en 19___?
1. Sí _____
2. No _____ (si contesta no; vaya a 8-P20)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a sus caprinos en 19___? _____ (pesos)

8-P20 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador en sus caprinos en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 8-P21)
¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador en sus caprinos en 19___? _____ (pesos)

8-P21 ¿ Para sus caprinos usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 8-P22)

¿Cuántos diás usó para detectar, curar y prevenir los ataques del gusano barrenador en 19___? _____ (días en 19___)

8-P22 ¿Contrató servicios veterinarios para el tratamiento de casos del gusano barrenador en sus caprinos en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 8-P23)
¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en sus caprinos en 19___? _____ (pesos)

8-P23 ¿Tuvo que apartar y dar comida suplementaria a algunos de sus caprinos debido al ataque del gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 8-P24)
¿Cuántas cabezas apartó en 19___? _____ (cabezas)
¿Cuál fué su costo por cabeza? _________ (pesos)

8-P24 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; regrese a la página 3, pregunta P8-9)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en 19___? _____ (pesos)
Regrese a la página 3, pregunta P8-9.

9. EXPLOTACION CABALLAR

9-P1 Número de caballos

1. 1984	2. En 19___
1.1 Yeguas __________ (cabezas)	2.1 Yeguas __________ (cabezas)
1.2 Potros y potrillos ___ (cabezas)	2.2 Potros y potrillos ___ (cabezas)
1.3 Garañones ________ (cabezas)	2.3 Garañones ________ (cabezas)
1.4 Castrados ________ (cabezas)	2.4 Castrados ________ (cabezas)

9-P2 Porcentaje de yeguas que paren anualmente

1. 1984 ______ (%)
2. En 19______ (%)

9-P3 ¿Debido a la erradicación del gusano barrenador cambió el procentaje de las yeguas que parieron en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 9-P4)
_______ aumentó ¿Cuánto? _______
_______ disminuyó ¿Cuánto? _______

9-P4 ¿Qué porcentaje de su manada caballar fué atacada por el gusano barrenador en 19____? ______ (%)

9-P5 ¿Cuántos animales murieron en su manada caballar en 19____? (no importa la causa)

1. Yeguas _______________ (cabezas)
2. Potros y Potrillos ________ (cabezas)
3. Garañones _____________ (cabezas)
4. Castrados ______________ (cabezas)

9-P6 ¿Cuántos animales murieron en su manada caballar debido al ataque del gusano barrenador en 19____?

1. Yeguas ______________ (cabezas)
2. Potros y Potrillos _______ (cabezas)
3. Garañones _____________ (cabezas)
4. Castrados _____________ (cabezas)

9-P7 ¿Cuántos animales de su manada caballar vendió en 19____?

1. Yeguas ______________ (cabezas)
2. Potros y Potrillos ______ (cabezas)
3. Garañones _____________ (cabezas)
4. Castrados _____________ (cabezas)

9-P8 ¿Fué afectado el precio de venta de sus caballos atacados por el gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 9-P9)
_______ aumentó
_______ disminuyó

¿Cuánto varió? (en porcentaje)
1. Yeguas ___________ (%)
2. Potros y Potrillos ______ (%)
3. Garañones ___________ (%)
4. Castrados ___________ (%)

9-P9 Para sus caballos; ¿Usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados o prevenir los ataques de dicha plaga en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 9-P10)
¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en 19____? ______ (días en 19____)

9-P10 ¿Gastó en insecticidas para prevenir los ataques del gusano barrenador en su manada caballar en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 9-P11)
¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador en su manada caballar en 19____? ______ (pesos)

9-P11 ¿Compro medicinas para curar del gusano barrenador a su manada caballar en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 9-P12)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a su manada caballar en 19____? ______ (pesos)

9-P12 ¿Contrato servicios veterinarios para el tratamiento de casos del gusano barrenador en su manada caballar en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 9-P13)
¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en su manada caballar en 19____? ______ (pesos)

9-P13 ¿Tuvo que apartar y dar comida suplementaria a algunos de sus caballos debido al ataque del gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a 9-P14)

9-P14 **¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en 19___?**

1. Sí _____
2. No _____ (si contesta no; regrese a la página 3, pregunta P8-10)
¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en 19___? _____ (pesos)
Regrese a la página 3, pregunta P8-10.

10. AVICULTURA

10-P1 **¿Mató el gusano barrenador algunas de sus aves en 19___?**

1. Sí _____
2. No _____ (si contesta no; vaya a 10-P2)

1. ¿Cuántas aves para huevo murieron debido al gusano barrenador?_____ (aves)
2. ¿Cuántas aves para carne murieron debido al gusano barrenador? _____ (aves)
3. ¿Cuántos pavos murieron debido al gusano barrenador? _____ (pavos)
4. ¿Cuántas otras aves (especifique) murieron debido al gusano barrenador? _____ (aves) _____

10-P2 **¿Compró medicinas para curar del gusano barrenador a sus aves en 19___?**

1. Sí _____
2. No _____ (si contesta no; vaya a 10-P3)
¿Cuánto gastó en medicamentos para curar del gusano barrenador a sus aves en 19___? _____ (pesos)

10-P3 **¿Gastó en insecticidas para prevenir los ataques del gusano barrenador en sus aves en 19___?**

1. Sí _____
2. No _____ (si contesta no; vaya a 10-P4)
¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador en sus aves en 19___? _____ (pesos)

10-P4 ¿Para sus aves, usó mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en 19____?

1. Sí ______
2. No ______ (si contesta no; regrese a la página 3, pregunta P8-11)
¿Cuántos días usó para detectar, curar y prevenir los ataques del gusano barrenador en sus aves en 19____? ______ (diás)
Regrese a la página 3, pregunta P8-10.

11. ANIMALES PARA TRABAJO Y DE TIRO

11-P1 Número de animales para trabajo y de tiro en 19____?

1.Caballos	2. Burros	3. Bueyes	4. Otros (especifique)
Adultos ______	Adultos ______	Adultos ______	Adultos ______
Jóvenes ______	Jóvenes ______	Jóvenes ______	Jóvenes ______

11-P2 Número de animales para trabajo y de tiro en 1984.

1. Caballos	2. Burros	3. Bueyes	4. Otros (especifique)
Adultos ______	Adultos ______	Adultos ______	Adultos ______
Jóvenes ______	Jóvenes ______	Jóvenes ______	Jóvenes ______

11-P3 ¿Tuvo problemas con el gusano barrenador en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya a la seccion 12)

11-P4 ¿Cuántos de sus animales de trabajo o de tiro murieron en 19____? (pregunte solo por el tipo de animales especificado en 11-P1)

1. Caballos	2. Burros	3. Bueyes	4. Otros (especifique)
Adultos ______	Adultos ______	Adultos ______	Adultos ______
Jóvenes ______	Jóvenes ______	Jóvenes ______	Jóvenes ______

11-P5 ¿Cuántos de sus animales de trabajo y de tiro murieron debido al ataque de gusano barrenador en 19____? (pregunte solo por el tipo de animales especificado en 11-P1)

1. Caballos	2. Burros	3. Bueyes	4. Otros (especifique)
Adultos ______	Adultos ______	Adultos ______	Adultos ______
Jóvenes ______	Jóvenes ______	Jóvenes ______	Jóvenes ______

11-P6 ¿Vendió alguno de sus animales de tiro o de trabajo en 19____? (pregunte solo por el tipo de animales especificado en 11-P1)

1. Sí ______
2. No ______ (si responde no; vaya a 11-P7)

Cuántos?

1. Caballos	2. Burros	3. Bueyes	4. Otros (especifique)
Adultos ______	Adultos ______	Adultos _____	Adultos ______
Jóvenes ______	Jóvenes ______	Jóvenes _____	Jóvenes ______

11-P7 ¿Fué afectado el precio de venta de un animal de trabajo o de tiro atacado por el gusano barrenador en 19____?

1. Sí ______
2. No ______ (si responde no; vaya a 11-P8)

________ Aumentó
________ Disminuyó

¿Cuánto aumentó o disminuyó? (pregunte solo por el tipo de animal especificado en 11-P1)

1. Caballos	2. Burros	3. Bueyes	4. Otros (especifique)
Adultos ______	Adultos ______	Adultos _____	Adultos ______
Jóvenes ______	Jóvenes ______	Jóvenes _____	Jóvenes ______

11-P8 ¿Cuántas horas de trabajo perdió debido a que sus animales para trabajo o de tiro fueron atacados por el gusano barrenador en 19____?

1. Sí ______
2. No ______ (sí contesta no; vaya a 11-P8)

¿Cuántas horas de trabajo perdió debido al gusano barrenador en 19____?
________ (horas / año)

11-P9 ¿Compró medicinas para curar del gusano barrenador a sus animales de trabajo o de tiro en 19____? ______ (pesos)

1. Sí ______
2. No ______ (si contesta no; vaya a 11-P9)

¿Cuánto gastó en medicamentos para curar del gusano barrenador en sus animales de trabajo o de tiro en 19____?_______ (pesos)

11-P10 ¿ Gastó en insecucidas para prevenir los ataques del gusano barrenador en sus animales de trabajo o de tiro en 19____?

1. Sí ______
2. No ______ (si contesta no; vaya 11-P11)

¿Cuánto gastó en insecticidas para prevenir los ataques del gusano barrenador en sus animales de trabajo o de tiro en 19____? ______ (pesos)

11-P11 Para sus animales de trabajo o de tiro; ¿Usó usted mano de obra familiar o contratada para detectar la presencia del gusano barrenador, curar los animales atacados, o prevenir los ataques de dicha plaga en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya 11-P12)
¿Cuántos días usó para detectar curar y prevenir los ataques del gusano barrenador en 19___? _____ (días en 19___)

11-P12 ¿Contrató servicios veterinarios para el tratamiento de casos del gusano barrenador en sus animales de trabajo o de tiro en 19___?

1. Sí _____
2. No _____ (sí contesta no; vaya a 11-P12)
¿Cuánto gastó en servicios veterinarios para el tratamiento del gusano barrenador en sus animales en 19___? _____ (pesos)

11-P13 ¿Tuvo que apartar y dar comida suplementaria a algunos animales de trabajo o de tiro debido al ataque del gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a 11-P14)

¿Cuántos animales confinó en 19___? _____ (cabezas)
¿Cuál fué el costo por animal? ___________ (pesos)

11-P14 ¿Compró o alquiló equipo adicional para el tratamiento o prevención del ataque del gusano barrenador en 19___?

1. Sí _____
2. No _____ (si contesta no; vaya a la sección 12)

¿Cuánto gastó por el equipo adicional para el tratamiento del gusano barrenador en 19___? _____ (pesos)_____________________
vaya a la sección 12

12. PREGUNTAS GENERALES Y OPINIONES

12-P1 ¿Cuánto tiempo tiene operando esta granja / rancho? ______ (años)

12-P2 ¿Recibió algún ingreso por actividades de cazería en 1984?

1. Sí ______
2. No ______ (sí contesta no; vaya a 12-P3)

_______ Aumentó ¿Qué tanto? _______ (pesos / año)
_______ Dismimuyó ¿Qué tanto? _______ (pesos / año)

12-P3 ¿Debido al programa de erradicación del gusano barrenador el número de animales salvajes ha

1. aumentado _______
2. disminuido ______
3. no cambió _______

12-P4 ¿Este cambio en el número de animales salvajes es un beneficio ______ o un perjuicio ______ a sus explotaciones ganaderas?

12-P5 ¿Recibió algún otro benificio a causa de la erradicación del gusano barrenador?

1. Sí ______
2. No ______ (sí contesta no; vaya a 12-P6)

Por favor especifique:

____
____
____

12-P6 Tuvo efectos nocivos el programa de la erradicación del gusano barrenador en sus explotaciones ganaderas?

1. Sí ______
2. No ______ (si contesta no; vaya a 12-P7)

Por favor especifique:

____
____
____

12-P7 ¿Hay algunos otros costos atribuidos a la presencia del gusano barrenador que este cuestionario no mencionó?

1. Sí _____
2. No _____ (si conteste no; vaya a 12-P8)

Por favor especifique:

____
____
____

12-P8 ¿Cuál fué el salario promedio que pagó a sus trabajadores en esta explotacion ganadera en 1984? _____ (pesos /día)

12-P9 ¿Edad del operador o dueño de este rancho / granja? _____ (años)

12-P10 ¿Nivel educativo del operador o dueño?
primaria ______________________________
secundaria ______________________________
preparatoria ______________________________
uno o mas años de universidad ______________________
titulo universitario ______________________________
titulo de post-grado ______________________________

12-P11 ¿Cuál fué el número de personas que trabajó en esta granja / rancho en 1984? _______ (número de personas)

12-P12 El programa de la erradicación del gusano barrenador del ganado es financiado por fondos públicos. ¿Si el programa se iniciara de nuevo bajo la misma administración y si a los granjeros / rancheros se les pidiera financiar este programa, estarí́a dispuesto a contribuir?

1. Sí _____
2. No _____ (si contesta no; vaya a 12-P13)

¿Con cuánto contribuiría por cabeza? _______ (pesos)

12-P13 ¿Cuál fué el ingreso anual de esta granja / rancho debido a las actividades económicas de esta unidad productiva en 1984?

0-300,000 (pesos) ______________
300,001 - 600,000 (pesos) ______________
600,001 - 900,000 (pesos) ______________
900,001 - 1,200,000 (pesos) ______________
1,200,001 - 5,000,000 (pesos) ______________
5,000,0001 - 10,000,000 (pesos) ______________
10,000,001 - 15,000,000 (pesos) ______________
15,000,001 - 20,000,000 (pesos) ______________
20,000,001 - 25,000,000 (pesos) ______________

12-P14 ¿Húbo algunos problemas serios asociados con la operación del programa de la erradicación del gusano barrenador en su area? (Por favor descríbalos)

____
____
____
____

12-P15 ¿Sabe de algún otro país que le esta ayudando al gobierno mexicano en la erradicación de gusano barrenador en méxico?

1. Sí ____________ ¿Cuál?
____
2. No ____________

12-P16 ¿Qué necesita hacer la industria ganadera para prevenir la reinfestación del gusano barrenador en su area? (Anotar sus sugerencias o acciones a tomar.)

____
____
____
____
____

APPENDIX B

MANUAL FOR ENUMERATORS

EVALUACION DEL IMPACTO DE LA ERRADICACION DEL GUSANO BARRENADOR

PORGRAMA DEL ENTRENAMIENTO DE LOS ENCUESTADORES

PARA LOS DIAS

20 Y 21 DE JUNIO DE 1985

PRIMER DIA:

8:00 - 9:00 a.m.

1. Preliminares y presentaciones

Ozuna 2. Introducción del estudio: propósito; uso y discusión general del análisis; métodos; procedimiento para la revisión y y evaluación de encuestadores y cuestioarios; reporte final.

Harston: 3. Importancia de la exactidud de la información reportada, peligros en la parcialización de los datos recolectados, tipo de parcializaciones, necesidad de la objetividad de la encuesta.

9:00 - 9:30 a.m. Descanso

9:30 - 10:30 a.m.

Jinkins: 1. Defjinición de los zonas: cómo fueron establecidas? año de impacto, diferencias en el enfoque del estudio del area libre y del area infestada.

Ozuna 2. Explicación del método de análisis; el papel del cuestionario, el papel dela muestra; desarrollo de la muestra estadistica por zona; estimado del tamaño de la población de cada clase de ganado por zona; estimado de los beneficios totales del programa por zona y para Mexico.

3. Como se escogió la muestra

Jinkins
A. Contacto con la Confederación.
B. Contacto en Campeche.
C. Técnica especifica para escoger la muestra del listado de miembros de la confederación nacional Sanaddera.

10:30 - 2:00 p.m.

Jinkins 1. Estructura del cuestionario.

Ozuna 2. Discusión detallada del cuestionario.

Romero 3. Preguntas y repaso del cuestionario.

2:00 - 3:30 p.m. Almuerzo

3:30 - 6:00 p.m.

Jinkins, Romero, 1. Discusión general del cuestionario.

Jinkins 2. Primera ronda de entrevistas por pares. (A entrevista a B)

Ozuna 3. Asignación de un problema come ejemplo.

4. Cierre de actividades: para el día.

SEGUNDO DIA:

8:00 - 9:30 a.m.

Jinkins, Ozuna 1. Representación de una entrevista, usando el problema asingnado el dia anterior.

Ozuna 2. Discusión general del problema tomado como ejemplo.

9:30 - 10:00 a.m. Descanzo

10:00 - 12:00 p.m.

Jinkins 1. Instrucciones especificas de la logistica de la encuesta.

2. Discusion del manual para encuestadores.

3. Procedimientos especificos.

A. Reemplazo de un ranchero que no ha podido ser localizado.
B. Repazo despues de la entrevista: (permitale al entrevistado llenar la ultima página de precios mientras usted revisa el cuestionario para chequear si han quedado cálculos incompletos, malentendidos o para revisar si se han dejado algunas preguntas en blanco. En La noche vuelva sobre el cuestionario y revise todas Las preguntas otra vez.)
C. Método para retornar el cuestionario.

1. Selle los cuestionarios que ha llenado durante el dia (al sobre en que los ha puesto pongales fecha, firmelos, ponga su nombre, cierrelos y sèlle los.)
2. Envielos semanalmente a su supervisor.

D. Procedimientos para evaluar las entrevistas.

E. Asignación del cuestionarios y listas de rancheros a muestrar.

INTRODUCCION A LOS ENCUESTADORES

Le damos las gracias por el tiempo y esfuerzo que usted esta contribuyendo a esta encuesta. Es importante que la encuesta sea conducida en una forma profesional y objectiva para asegurar la credibilidad que dicha encuesta debe tener para que sea util a los encargados de tomar las decisiones.

El exito y utilidad de este estudio depende basicamente de usted. Depende en que usted haga que el entrevistado entienda las preguntas y en que usted obtenga respuestas completas y en la forma correcta y en que usted explique cualquier desviación del cuestionario de lo que es requerido. Sea cuidadoso en no dejar que el entrevistado le haga a usted decir cual es o debe ser la respuesta. Alguien le puede preguntar "No piensa usted que 60% es más o menos correcto?". Usted debe contestar "Solamente puedo escribir lo que usted considera que es correcto, su respuesta es lo que importa".

Para asegurar que la encuesta sea conducida lo más efectivamente posible, hemos preparado este manual que lo ayudara en problemas potenciales que puedan surgir. Si usted se encuentra con algún problema que no este incluido en este manual (lo mas probable que sí), puede llamar por cobrar al número (409) 845-3479 y le trataremos de ayudar.

Incluido en este manual hay una lista de instrucciones que debe seguir para completar y retornar los cuestionarios. Tal vez necesite chequearla regularmente para asegurarse que ha completado y seguido cada paso requerido y que el cuestionario se encuentre en una forma que pueda ser usado.

De nuevo, le damos las gracias por participar en y conducir esta encuesta y a la vez le recordamos, "Cuan importante es usted y su objectividad para este estudio".

EXPLICACION DE LA ENCUESTA PARA LOS ENCUESTADOS

La Comision Mexico/Americana Para La Erradicacion Del Gusano Barrenador ha eliminado la infestacion del gusano barrenador al norte y al oeste del Istmo de Tehuantepec. El proposito de esta encuesta es determinar como se beneficiaron los ganaderos y avicultores de la republica mexicana por la erradicación del gusano barrenador. La encuesta esta diseñada para estimar el valor monetario de los beneficios obtenidos por los ganaderos y avicultores mexicanos debido a la erradicación del gusano barrenador. Este estudio esta apoyado por la Confederacion Nacional Ganadera y su Asociacion Ganadera Local.

Usted fue seleccionado al azar de la lista de membresia de las asociaciones ganaderas y avicolas locales que la Confederacion Nacional Ganadera posee. Necesitamos su cooperacion para completar este cuestionario sobre la infestación del gusano barrenador en su ganado, aves y fauna en su rancho. El cuestionario una vez llenado sera enviado directamente a la Universidad de Texas A&M en los Estados Unidos. Sus respuestas seran agregadas con las de otros ganaderos encuestados para que las respuestas de ninguna persona pueda ser identificada. Ninguna respuesta individual sera divulgada a personas o grupo de personas. Solo se citaran promedios y cifras totales de las respuestas proporcionadas por los entrevistados.

Sus respuestas son importantes pues aseguran la credibilidad del estudio y dicha credebilidad del estudio se vera aumentada si se obtiene un número grande de respuestas correctas. En todos los casos este completamente seguro que sus respuestas seran manejadas y mantenidas confidencialmente.

COMO COMPLETAR Y MANDAR EL CUESTIONARIO

I. Como usar la lista de ganaderos

La lista de ganaderos que van a ser entrevistados es dos veces el tamaño que se necesita para hacer el estudio. Se amplió el tamaño previendo el caso de la imposibilidad de no poder entrevistar a algunos de los ganaderos seleccionados. Por eso, el encuestador empezara con el primer numero impar en la lista. El encuestador seguira escogiendo nombres para entrevistar de los numeros impares en la lista.

II. Reemplazo de un ganadero no localizado

Si no es posible entrevistar a un ganadero que ha sido escogido, este ganadero sera reemplazado por el nombre del ganadero con número par que esta inmediatamente abajo del nombre que fue escogido originalmente. Si el nuevo ganadero tampoco puede ser entrevistado, escoga el nombre del ganadero con número par que esta inmediatamente arriba del nombre con el numero impar que fue escogido originalmente. Si encuentra 10 ganaderos consecutivos que no pueden ser entrevistados hablenos de inmediato por telefono. El número es (409) 845-3479. Haga la llamada por cobrar.

III. Como ponerse en contacto con el ganadero

En la dirección de cada ganadero se encuentra el nombre de la Asociacion Ganadera Local con la cual este ganadero esta afiliado. Primero pongase en contacto con esta asociación para que le pueda ayudar a encontrar al ganadero que va a ser entrevistado. La asociacion talvez le pida al ganadero que venga a la oficina de la asociación, o a otro lugar designado para llevar a cabo la entrevista. En el manual de los encuestadores hay una carta de la Confederacion Nacional Ganadera en la cual esta institución da su apoyo a este estudio. Esta carta puede ayudarle a ganar la cooperación de las Asociaciones Ganaderas y de los ganaderos que van a ser entrevistados.

IV. Como empezar la entrevista

Primero explique al ganadero que va a ser entrevistado el porque del estudio. La seccion del manual titulada "Explicacion de la encuesta para los encuestados" fue diseñada para ayudarle a Ud. cuando este dando esta explicación. También estan incluidas en este manual cartas de la Confederacion Nacional Ganadera Y la Comision Mexico/Americana Para La Erradicacion Del Gusano Barrenador.

V. Durante la entrevista

* Ponga el mismo numero en el cuestionario que se encuentra al lado del nombre del ganadero que este entrevistando (este número se encuentra en la lista de ganaderos que Ud. tiene).

* Obtenga la información en la forma correcta.

* Obtenga respuestas completas.

* Explique cualquier desviacion en el cuestionario de lo que fue pedido.

* No deje que el encuestado le saque a Ud. sus propias opiniones de como deben ser contestadas las preguntas.

* Al completar el cuestionario ponga al encuestado a llenar la página de precios. Mientras tanto revise de nuevo el cuestionario. Esté seguro que no ha saltado ninguna pregunta pertiniente y que todas las respuestas esten en forma correcta.

VI. Despues de la entrevista

En la noche, revise Ud. los cuestionarios que hizo durante el dia. Si alguna respuesta necesita explicación, asegurese que sea completada en este momento. Ponga el cuestionario en el sobre que esta usando para esa semana. Al terminar la semana asegurese que todos los cuestionarios que Ud. completó esten en el sobre, dicho sobre séllelo, fírmelo, pongale la fecha y entregelo a su supervisor.

INSTRUCCIONES A SUPERVISORES DE CAMPO

I. Recuperacion de los cuestionarios

* Asegurese de que cada encuestador le entregue los cuestionarios completos semanalmente.

* Los cuestionarios le deben ser entregados en sobres previamente sellados, firmados y fechados.

* Tome todos los sobres de la semana, pongalos en una caja de carton, selle la caja, pongale la etiqueta de dirección y envielo por avión a Houston, Texas.

II. Reembolso de gastos del flete aereo

* Page el flete aéreo al mandar las cajas.

* Guarde los recibos del flete y despues entregueselos a la Comision en la Cuidad de Mexico.

* El proyecto reembolsara a la Comision por los gastos de fletes aereos.

EXPLICACION DE ALGUNAS PREGUNTAS DEL CUESTIONARIO

1. Número de Animales

area libre : 2-P1,3-P1,4-P1,5-P1,6-P1,7-P1,8-P1,9-P1 Y 11-P1
area infestada : 2-P1,3-P1,4-P1,5-P1,6-P1,7-P1,8-P1,9-P1 Y 11-P1

En estas preguntas incluya todos los animales que el ganadero tenía en el año en cuestión. No importa si nacieron en el rancho o fueron comprados. Tenga cuidado de incluir solamente el tipo de animal que corresponde a cada sección.

2. Porcentaje de Animales Paridos

area libre : 2-P2, 5-P2, 7-P2, 8-P4, 9-P2
area infestada : 2-P2, 5-P2, 7-P2, 8-P4, 9-P2

El Siguiente es un ejemplo de como contestar las preguntas sobre el porcentaje de animales que paren anualmente:

Si un ganadero le dice que tenia 83 vacas en el año en cuestión y si de las 83 vacas, 67 parieron; entonces el porcentaje de las vacas que parieron se calcula de la siguiente manera: divida el número de vacas paridas por el número total de vacas y el resultado multipliquelo por cien asi: 67 / 83 = 0.80 x 100 = 80%. Esto quiere decir que del número total de vacas, el 80% parió. Si el ganadero le da a Ud. un porcentaje como respuesta, no es necesario hacer éste cálculo. Solamente apunte el porcentaje que él le da a Ud. en su respuesta.

3. Lechones Nacidos

area libre : 6-P2
area infestada : 6-P2

La respuesta correcta de esta pregunta no es un porcentaje, es el número total de lechones nacidos por cerda en el año en cuestión. Si las cerdas tuvieron un promedio de 8 lechones en febrero y un promedio de cinco más en noviembre del año en cuestión la requesta correcta a la prequnta es 13.

4. Cambio en el Número de Partos

area libre : 2-P3, 5-P3, 6-P3, 7-P3, 8-P6, 9-P3

Esta pregunta no esta incluida en el cuestionario del area infestada.

Esta pregunta se refiere solamente a un cambio en el número de partos debido a la erradicación del gusano barrenador. Un cambio en el número de partos por otras razones como un cambio en el manejo del rancho no debe ser incluido en la repuesta de esta pregunta.

5. <u>Porcentaje de Animales Atacados</u>

area libre : 2-P4, 3-P2, 4-P2, 5-P4, 6-P4, 7-P4, 8-P3, 9-P4
area infestada : 2-P3, 3-P2, 4-P2, 5-P3, 6-P3, 7-P3, 8-P3, 9-P3

El porcentaje de animales atacads por el gusano barrenador se calcula asi: Por ejemplo el ganadero dice que tenia 219 cabezas de ganado en el año del cual usted le esta preguntando. De las 219 cabezas,. 56 fueron atacadas por el gusano barrenador. El <u>porcentage</u> qué fue atacado se cálcula de la siguiente manera; divida el nmero de cabezas que fueron atacadas por el número total de cabezas. Luego el reultado de la divisiòn se mutiplica por cien. Por ejemplo 56 / 219 = 0.25 y 0.25 x 100 = 25%. Si el ganadero le da a Ud. un porcentaje como respuesta no es necesario hacer este cálculo, solamente anote el porcentaje.

6. <u>Animales Muertos (no importa la causa)</u>

area libre : 2-P5, 3-P3, 4-P3, 5-P5, 6-P5, 7-P5, 8-P6, 9-P5, 11-P4
area infestada : 2-P4, 3-P3, 4-P3, 5-P4, 6-P4, &-P5, 8-P5, 9-P4, 11-P2

Esta pregunta incluye todos los animales del encuestado que se murieron por <u>cualquier</u> razon en el año en cuestión. Incluya muertes debido al gusano barrenador, accidentes, enfermedades o cualquier otra causa.

7. <u>Animales Muertos Debido al Ataque</u>

area libre : 2-P6, 3-P4, 4-P4, 5-P6, 6-P6, 7-P6, 8-P7, 9-P6, 11-P4
area infestada : 2-P5, 3-P4, 4-P4, 5-P5, 6-P5, 7-P6, 8-P6, 9-P5, 11,P4

Esta pregunta incluye solamente los animales que murieron debido al ataque del gusano barrenador en el año en cuestión.

8. <u>La influencia del gusano barrenador en el peso de venta de un animal.</u>

area libre : 2-P9, 3-P7, 4-P7, 5-P10, 6-P9, 7-P9, 8-P10
area infestada : 2-P8, 3-P7, 4-P7, 5-P9, 6-P8, 7-P8, 8-P9

En esta pregunta se trata de averiguar si el ataque del gusano barrenador puede influenciar o variar el peso de venta de un animal. Suponga que el ranchero le contesta positivamente y le dice que el peso de venta de un animal atacado por el gusano bajò un promedio de 10 KG. Lo que tiene que hacer Ud. es marcar el renglón si y el renglón disminuyó. Despues indique en el renglo ¬cuánto? La cantidad queel animal haya disminuido debido al ataque del gusano barrenador.

1. Si __X__
2. No ______

1. Disminuyo X cuánto? 10
2. Aumento ___ cuánto? ___

9. Cambio En El Tiempo Necesario Para Producir un Animal.

area libre : 2-P10, 3-P8, 4-P8, 5-P11, 6-P10, 7-P10, 8-P11
area infestada : 2-P9, 3-P8, 4-P8, 5-P10, 6-P9, 7-P9, 8-P10

Con esta pregunta queremos averiguar si el ataque del gusano barrenador cambia el tiempo necesario para producir un animal para la venta. Ejemplo: Un ganadero produce becerros para la venta. Algunos de sus becerros estan atacado por el gusano barrenador, otros no estan atacados. Los becerros que fueron atacados estan listos para el mercado a los 195 dias de edad y los becerros que no fueron atacados estan listos para el mercado a los 180 dias de edad. Se ve que el ataque del gusano barrenador aumentó por 15 dias el tiempo necesario para producir un animal para la venta. Entonces la pregunta se debe contestar asi:

1. Si X
2. No ___

1. Disminuyó ___ cuántos dias? ___

2. Aumentó X cuántos dias? 15

10. Costo Promedio Para Producir Un Animal

area libre : 2-P11, 3-P9, 4-P9, 5-P12, 6-P11, 7-P11, 8-P12
area infestada : 2-P10, 3-P9, 4-P9, 5-P11, 6-P10, 7-P10, 8-P11

El gasto total de mantenimiento de un animal por un dia en el año en cuestión. En esta pregunta se incluyen gastos para mano de obra, medicinas, alimentación, sal, minerales suplementarias, y todos los otros gastos para el mantenimiento del becerro. Esta pregunta solamente debe ser contestada si el encuestado contestó Si en la pregunta anterior.

11. Gastos En Medicamentos

area libre : 2-P12, 3-P10, 4-P10, 5-P13, 6-P12, 7-P15, 8-P19, 9-P11, 10-P2, 11-P9

area infestada : 2-P11, 3-P10, 4-P10, 5-P12, 6-P11, 7-P14, 8-P18, 9-P10, 10-P2, 11-P8

Esta pregunta solamente incluye gastos por medicinas para tratar bovinos atacados por el gusano barrendor. Gastos por medicinas que se usaron para tratar otras plagas o enfermedades no deben ser incluidos en la respuesta de esta pregunta.

12. Gastos En Insecticidas

area libre: 2P-13, 3P-11, 4P-11, 5-P14,6-P13, 7-P16, 8-P20, 9-P10, 10-P3, 11-P10

area infestada : 2P-12, 3P-11, 4P-11, 5-P13, 6-P12, 7-P15, 8-P19, 9-P10, 10-P3, 11-P9,

Esta pregunta solamente incluye gastos por insecticidas para prevenir ataques del gusano barrenador. Gastos por insecticidas que fueron usados para aprevenir o combatir ortas plagas (como la garrapata) no deben ser incluidos en la respuesta de esta pregunta.

13. Mano de Obra

area libre : 2-P14, 3-P12, 4-P12, 5-P15, 6-P14, 7-P17, 8-P21, 9-P9, 10-P4, 11-P11

area infestada : 2-P13, 3-P12, 4-P12, 5-P14, 6-P13, 7-P16, 8-P20, 9-P8, 10-P4, 11-P10

La respuesta de esta pregunta debe incluir toda la mano de obra que se usó para el control del gusano barrenador en el rancho. Incluya todo el tiempo que el dueno, su familia y la mano de obra contratada emplearon en buscar animales atacados, curarlos y tratar de evitar que fueran atacados por el gusano barrenador. Un dia consiste de ocho horas de trabajo. La respuesta de esta prequnta debe incluir todos los di as que se trabajaron en el año en cuestiòn debido a la presencia del gusano barenador. Posiblemente el ganadero contestará en horas en vez de contestar en dias. Si el ganadero contesta en horas los dis deben ser calculados como esta hecho en este ejemplo:

El ganadero contesta que'el trabajó 23 horas durante el año en cuestiòn para combatir el gusano barrenador, sus hijos 95 horas, y sus trabajadores 186 horas para combatir esta plaga. Primero se calcula el total de horas que se usó 23 + 95 + 186 = 304. Luego el total de horas se divide por 8 para calcular el número de días que se usó para el control del gusano barrenador asi: 304 / 8 = 38 dias de trabajo para el ano en cuestión.

14. Gastos En Servicios Médico Veterinario

area libre :2-P15, 3-P13, 4-P13, 5-P16, 6-P16, 7-P18, 8-P22, 9-P12, 11-P12
area infestada : 2-P14, 3-P13, 4-P13, 5-P15, 6-P14, 7-P17, 8-P21

Esta pregunta solamente incluye gastos para servicios veterinarios para el tratamiento de casos del gusano barrenador. Si el ganadero gastó en servicios veterinarios para el tratatamiento de otros tipos de heridos, plagas, o enfermedades en el año en cuestión; estos gastos no deben ser incluidos en la repuesta de esta pregunta.

15. Apartamiento y Comida Suplementaria

area libre : 2-P16, 3-P14, 4-P14, 5-P17, 6-P16, 7-P19, 8-P23, 9P13, 11-P13

area infestada : 2-P15, 3-P14, 4-P14, 5-P16, 6-P15, 7-P18, 8-P22 9-P12, 11-P12,

Esta pregunta trata de averiguar si el ganadero tuvo que apartar y dar comida suplementaria a algunos de sus bovinos por causa del gusano barrenador. Es posible que acorraló algunos bovinos que tuvieron gusanos para no tener que buscarlos diariamente para curarlos. Tambien es posible que acorraló algunos bovinos para poder inspeccionarlos más facilmente y así evitar que el gusano barrenador se estableciera en su ganado. Aunque nada más los aparto un día, este día se debe reportar en la respuesta de esta pregunta. Comida suplementaria es cualquier alimento que el ganadero llevó a los corrales para alimentar a los bovinos mientras estuvieron allí por causa del gusano barrenador.

16. Equipo Adicional

area libre : 2-P17, 3-P15, 4-P15, 5-P18, 6-P17, 7-P20, 8-P24, 9-P14, 11-P14
area infestada : 2-P16, 3-P15, 4-P15, 5-P17, 6-P16, 7-P19, 8-P23, 9-P13, 11-P13

Incluya en la respuesta de esta pregunta solamente equipo que se compró of que se alquiló por causa del gusano barrenador. Si el ganadero gastó en equipo para combatir otras plagas (por ejemplo baños para combatir la garrapata) estos gastos no se deben incluir en la respuesta. Ejemplos de gastos que deben ser incluidos son materiales para construir corrales que se usan para animales atacados por el gusano barrenador o pinzas para sacar los gusanos de las heridos.

ENSAYO PARA LLENAR UN CUESTIONARIO

El Sr. González con domicilio particular en Valle Plateado #333, Monterrey, Nuevo Leon, tiene desde 1970 un rancho en París, Nuevo Leon. Este rancho consiste de 500 hectareas de las cuales 400 utiliza para pasto, 90 para la siembra y 10 para corrales y almacenes.

El Sr. González se familiarizó con el programa de la erradicación del gusano barrenador atravez de un inspector de la comisión y un ranchero vecino. En 1976 las plagas más nocivas en su ganado fueron el gusano barrenador y la garrapata. En varias ocasiones él tomó y envió muestras de posibles larvas de gusano barrenador, curó animales heridos para prevenir infestaciones de gusano barrenador y tambien vió cajas conteniendo moscas estériles de las que el programa suelta por avión en los terrenos cercanos de donde vive. Debido al gusano barrenador él tuvo que modificar el calendario de pariciones, castrado, y marcado para evitar el ataque del gusano barrenador en su ganado.

Para 1976, el ganado para cria del Sr. González consistió en 120 vacas, 70 becerros y 3 toros. De los 70 becerros, 10 fueron comprados a un vecino ranchero que los vendió por motivos financieros. En contraste, para 1984 su explotación de ganado para cría consistió en 120 vacas, 60 becerros y 3 toros.

Durante 1976, 12 vacas y 24 becerros fueron atacados por el gusano barrenador. En este año tambien 6 vacas y 3 becerros (uno debido al gusano barrenador) se murieron. En 1976, él vendió 8 vacas y todos los becerros que le sobraron despues de reemplazar las bajas que tuvo en sus vacas productoras. El peso de los becerros que vendió varió de entre 300 y 350 kilos.

Debido al problema del gusano barrenador el tiempo promedio para producir un becerro para la venta aumentó 27 dias y el pesó promedio a la venta disminuyó un 7%. El costo total de producción por dia de los becerros en 1976 fue 8,400.00 pesos. Tambien se compró 3,000.00 pesos de medicinas para la explotación de ganado de cria, de las cual el 50% fue para el tratamiento de el gusano barrenador. El Sr. González y uno de sus hijos trabajaron por 15 dias cada uno para detectar, curar y prevenir ataques del gusano barrenador. Durante este mismo año hicieron uso de insecticidas para prevenir los ataques de dicha plaga.

En 1976, el Sr. González tuvo que apartar 6 becerros y 3 vacas debido al ataque del gusano barrenador. Al estar apartados, estos animales consumieron 19,980.00 pesos de comida suplementaria. En este año no se tuvo que comprar o alquilar equipo adicional para el tratamiento o prevención del ataque del gusano barrenador, pero si se gastaron 20,000.00 pesos para servicios medico veterinarios debido a que algunos de sus animales se lastimaron en el traslado de un pasto a otro.

Junto con su explotación de ganado para cria este ranchero tambien tiene una explotación porcina. En 1976, su explotación porcina consistia de un macho, 5 hembras, y 60 lechones. Para 1984 ya tenia 7 hembras con 84 lechones y el mismo número de machos. Cada hembra tiene por lo menos dos partos por año y el promedio de lechones nacidos por hembra por parto fue 6 en 1976 y 7 en 1984.

Durante 1976 diez lechones (3 a causa del gusano barrenador) y una hembra resultaron muertos. De todos los porcinos 7 fueron atacados por el gusano barrenador. Tambien todos los lechones, excepto uno, se vendieron en un peso promedio de 70 kilogramos. En este año el gusano barrenador no afectó el tiempo promedio para producir un cerdo para la venta, pero si resultó afectadó el peso de venta de estos animales. Los porcinos para la venta atacados perdieron por lo menos 4 kilogramos cada uno. El Sr. González no recordó el costo promedio diario para criar un cerdo en 1976.

Para el tratamiento del gusano barrenador se compró 700.00 pesos de medicamentos, pero no se tuvo que contratar los servicios médico veterinarios o comprar insecticidas para prevenir o curar los animales atacados por el gusano barrenador

Para poder tratar y curar mejor a los animales atacados por el gusano barrenador, el Sr. González tuvo que apartar a estos animales en unos corrales especiales. Para estos animales apartados no se gastó en comida suplementaria, pero el equipo adicional para este alojamiento especial le costó al Sr. González 10,000.00 pesos.

En 1976 se ocuparon como animales de trabajo 2 caballos adultos y 2 jóvenes y en 1984 aumentó este número por un caballo adulto. Solamente uno de los caballos adultos fue atacado por el gusano barrenador. También en este año ninguno de los animales de trabajo se murieron o fueron vendidos.

A causa de que uno de los caballos fue atacado por el gusano barrenador el ranchero perdió 2 días de trabajo. Para los animales de trabajo no se compraron medicamentos, insecticidas o equipo adicional para curar y prevenir los ataques del gusano barrenador. Inclusive, no se contrataron los servicios médico veterinarios para los animales atacados por dicha plaga.

Durante 1984, el Sr. González no recibió ingresos por actividades de cazería en su rancho y el número de animales salvajes no cambió debido al programa del gusano barrenador. Este rancho no obtuvo otros beneficios a causa de la erradicación del gusano barrenador. Tampoco se notaron efectos nocivos debido a la erradicacion del gusano barrenador o costos adicionales atribuidos a la presencia de dicha plaga que este cuestionario no mencionó

El Sr. González tiene 54 anos y solo fué a la escuela primaria. El ingreso anual provinlente de este rancho es de 3,200,000.00 pesos. El número total de personas que trabajaron en esta unidad productiva son dos y el salario que se pagó fué de 750.00 a 850.00 pesos por día. El Sr. González estaría dispuesto a contribuir con 10.00 pesos por cabeza para el financiamiento del programa del gusano barrenador. Al no haber encontrado ningun problema grave con el actual programa, él sugirió que lo que debe hacer la industria ganadera para prevenir la reinfestación del gusano barrenador es apoyar la labor que la comisión está desempeñando.

Confederación Nacional Ganadera

CONSTITUIDA CONFORME A LA LEY DE ASOCIACIONES GANADERAS

CDA MARIANO ESCOBEDO No. 714 TEL. 5-33-21-75 CON 5 LINEAS

MEXICO 5. D.F.

7 DE JUNIO DE 1985 OFICIO NUM.

EXPEDIENTE NUM.

C I R C U L A R

A TODAS LAS UNIONES
GANADERAS REGIONALES DEL PAIS.
P R E S E N T E.

Con motivo del estudio que esta llevando a cabo La Comisión México-Americana para la erradicación del Gusano Barrenador, agradecemos otorgan las facilidades necesarias a los representantes de esta Comisión, con el objeto de que realizen su trabajo.

f r a t e r n a l m e n t e

CONFEDERACION NACIONAL GANADERA

SR. ALFREDO JIMENEZ VILLARREAL
PRESIDENTE

LIC. JAVIER DUARTE FRANCO.
SECRETARIO.

APPENDIX C

EXPANSION ANIMALS FOUND IN ERADICATED ZONES BY YEAR

Table 32. Numbers of Expansion Animals by Year Found In Screwworm Free Zones (Thousands of Animals)

Year	Cow-Calf	Stocker	Feeder	Dairy	Swine	Sheep	Goats	Horses	Work
1977	633.7	202.0	3,232.3	9.3	46.4	424.5	943.5	53.2	632.4
1978	652.0	202.0	3,232.3	9.3	50.1	424.6	1,026.9	55.8	647.4
1979	2,810.8	275.0	3,232.3	208.7	163.4	609.6	1,286.6	131.5	1,443.6
1980	6,237.1	860.4	4,084.0	612.3	297.1	1,451.0	2,274.6	271.7	3,252.2
1981	7,406.7	1,257.2	5,060.1	803.6	462.3	2,105.8	3,112.3	341.2	3,112.3
1982	8,764.6	2,706.5	5,139.5	1,380.0	741.5	3,104.4	3,915.4	539.1	3,915.4
1983	8,923.1	2,706.5	5,179.2	1,380.0	778.0	3,170.2	4,186.2	563.4	4,186.2
1984	10,010.6	3,962.0	5,179.2	1,681.9	867.7	3,661.4	4,639.8	647.4	4,639.8

APPENDIX D

PIE CHARTS OF COMPONENTS OF VARIABLE COST REDUCTION IN THE ERADICATED AREA

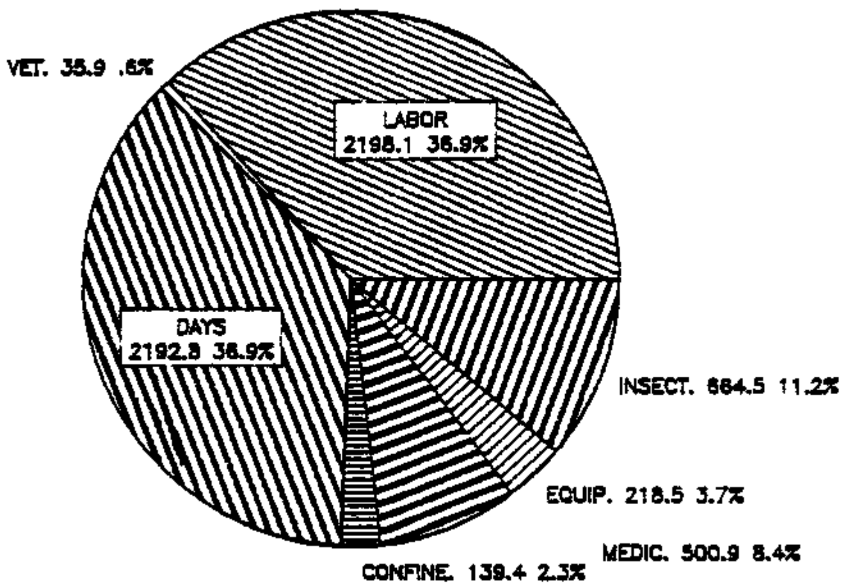


Figure 8. Components of variable cost reduction for the cow-calf category (days refers to extra production days made necessary by screwworm infestation)

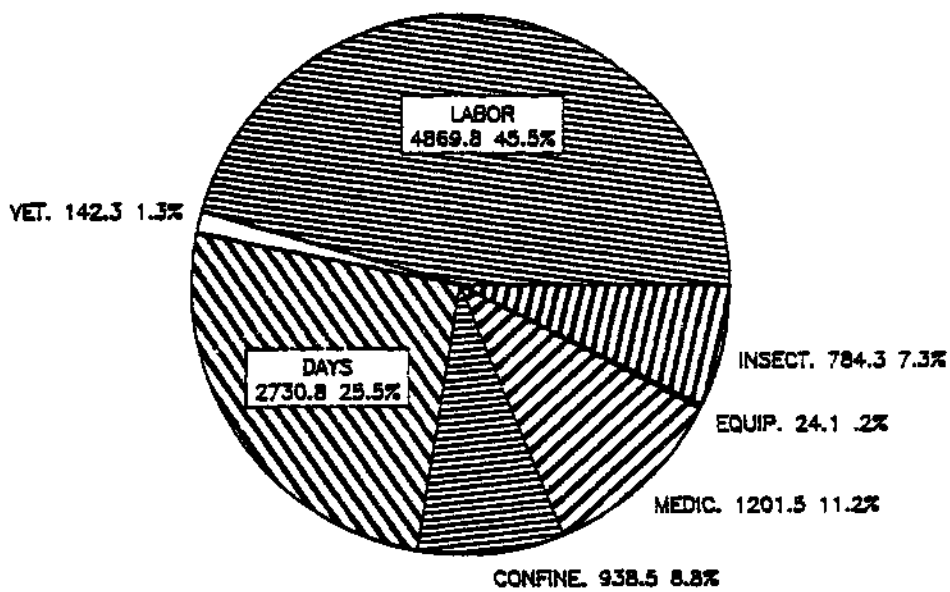


Figure 9. Components of variable cost reduction for the dairy category (days refers to extra production days made necessary by screwworm infestation)

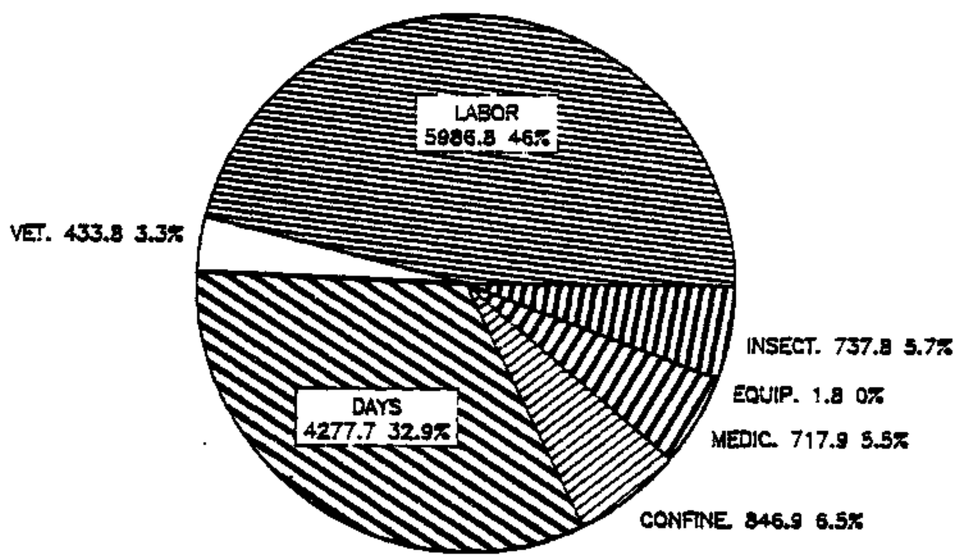


Figure 10. Components of variable cost reduction for the swine category (days refers to extra production days made necessary by screwworm infestation)

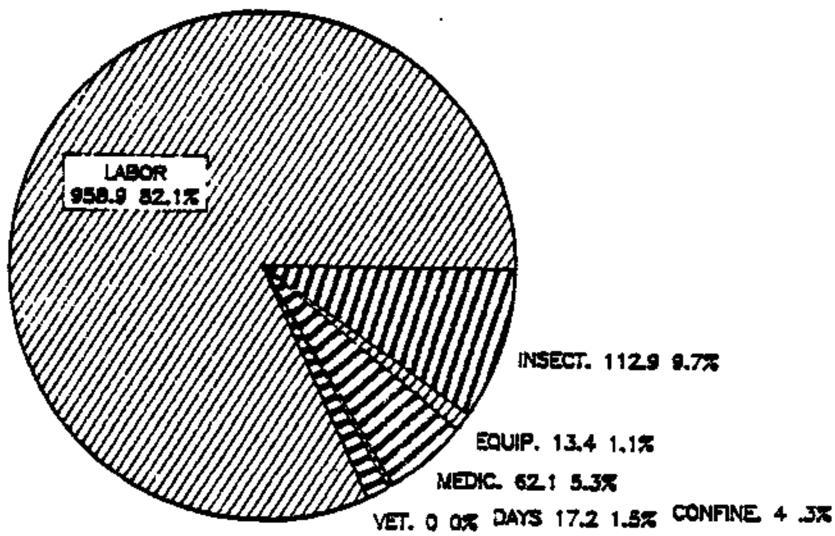


Figure 11. Components of variable cost reduction for the sheep category (days refers to extra production days made necessary by screwworm infestation)

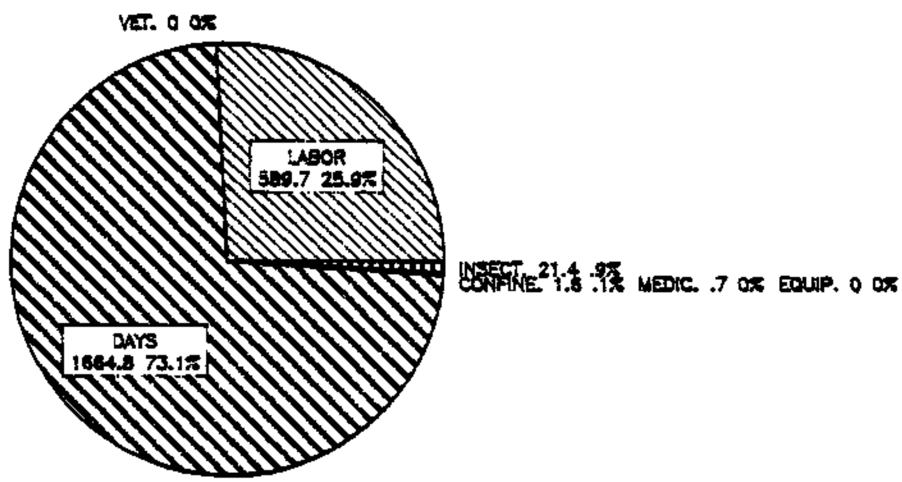


Figure 12. Components of variable cost reduction for the goat category (days refers to extra production days made necessary by screwworm infestation)

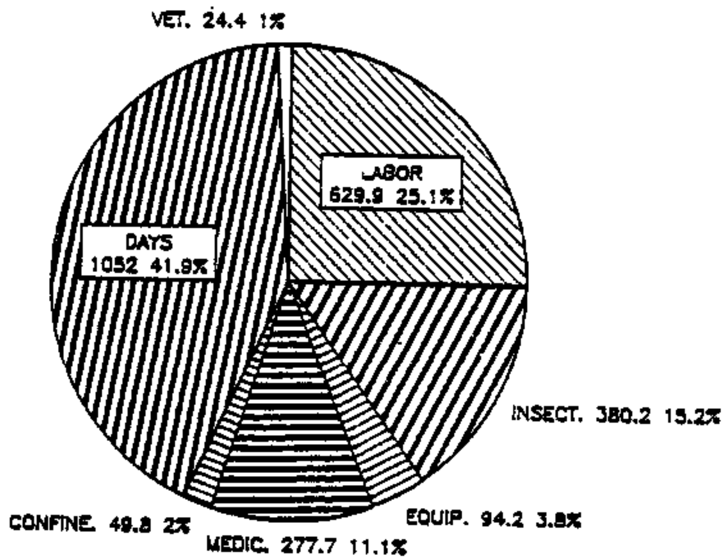


Figure 13. Components of variable cost reduction for the stocker category (days refers to extra production days made necessary by screwworm infestation)

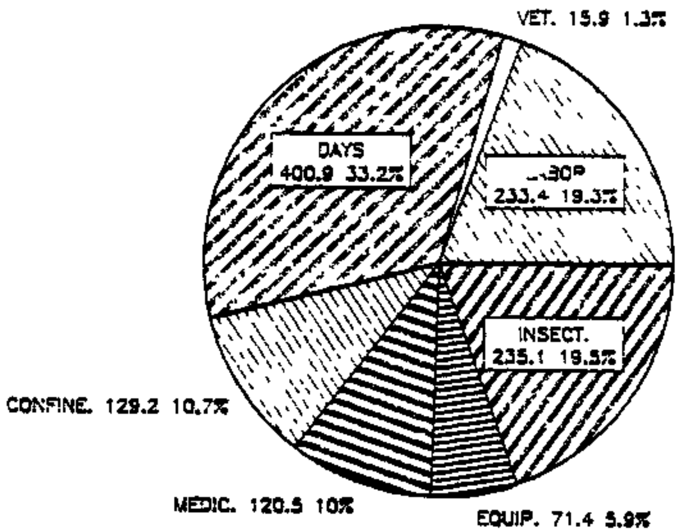


Figure 14. Components of variable cost reduction for the feeder category (days refers to extra production days made necessary by screwworm infestation)

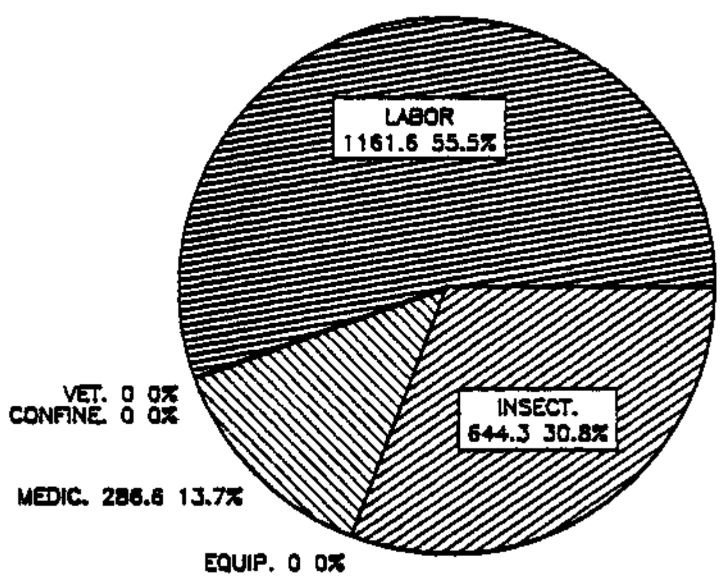


Figure 15. Components of variable cost reduction for the horse category

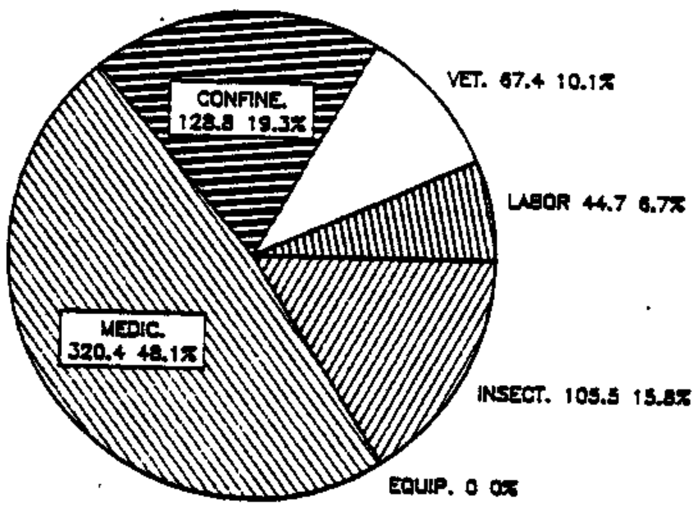
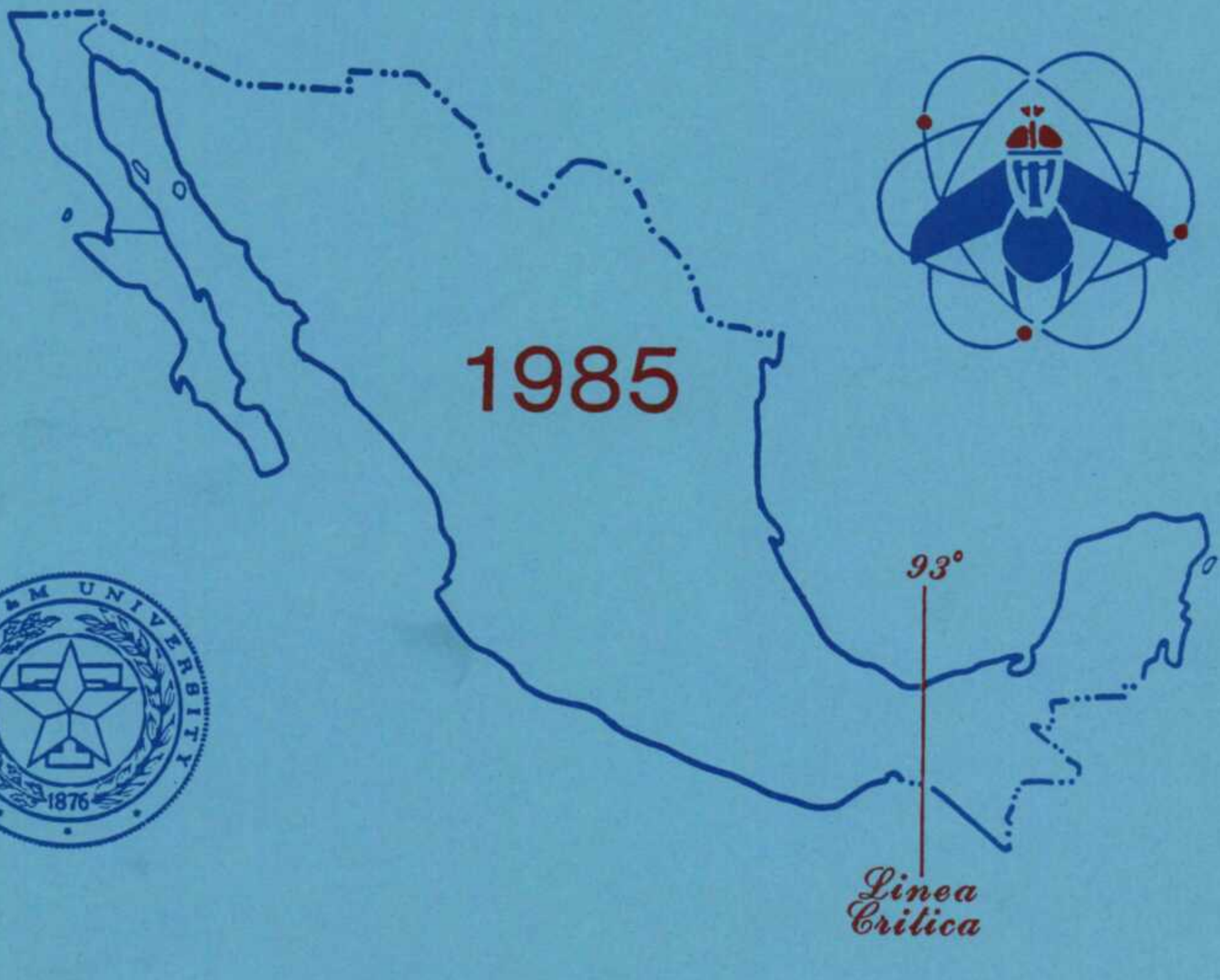


Figure 16. Components of variable cost reduction for the work animal category

EVALUATION OF THE MEXICAN-AMERICAN SCREWWORM ERADICATION PROGRAM IN MEXICO



VOLUME II

TECHNOLOGY EVALUATION OF THE SCREWWORM ERADICATION IN MEXICO

TEXAS AGRICULTURAL EXTENSION SERVICE

THE TEXAS A&M UNIVERSITY SYSTEM

VOLUME II

TECHNOLOGY EVALUATION OF THE SCREWWORM ERADICATION IN MEXICO

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ABSTRACT

A series of surveys were developed and sent to Commission field operations personnel, program administrators and Mexican livestock producers associations to identify program components which impact the screwworm eradication process. These surveys were designed to aid in the management process in identifying both successful and less efficient aspects of the Mexican-American screwworm eradication program. Evaluations can help to focus future program directions to emphasize positive components. The program evaluation team at Texas A&M University considered their evaluation could add support to the studies being conducted on the program's economic impact provided in Volume I.

The survey for both the field operations and administration personnel provides constructive information. Surveys returned from the Mexican cattlemen were small and are of only limited value. Results are presented in a series of data tables and graphs. In general, problems were identified and solutions to these problems were suggested by the survey respondents.

Critical job roles identified by the survey indicated the field inspector's role to be of primary importance. A major effort was made to have program functions ranked in order of importance by respondents. The employment of dedicated and well trained personnel was a top item identified by program personnel. The second item followed listing the importance of having adequate funds to conduct and support the eradication program.

Education of the livestock producers in Mexico regarding eradication procedures and goals was identified as the most difficult program function to be achieved by Commission employees. The educational process and diffusion of information were listed as difficult to achieve because of the lack of cooperation by livestock owners, public skepticism and special communication problems (ethnic languages). It was interesting to note the personnel survey

indicated the greatest problems encountered by employees were as follows: (1) Convincing the Mexican public the program would be successful; (2) Logistical problems; and, (3) Communication problems.

Conducting tasks outside their assigned duties was identified by employees. This indicated worker flexibility which is good. These additional tasks were identified as dispersion of sterile flies, inspection of livestock and clerical jobs. A positive attitude did exist with workers to achieve program goals regardless of formal work assignments. A small quantity of unnecessary work was identified by Commission personnel. It became apparent the workers took pride in their work for the eradication effort and most indicated the livestock producer will receive increased livestock profits. The social well-being of livestock producers should be enhanced because the screwworm has been eradicated from Mexico.

The interview process identified several important program aspects which aided in the accomplishment of program goals. Field inspectors developed and maintained an excellent working relationship with ranchers, farmers, agricultural and political leaders in the various regions of Mexico. Program personnel had a positive view of their work assignments and displayed good worker morale and enthusiasm.

TECHNOLOGY EVALUATION OF THE SCREWWORM ERADICATION IN MEXICO

Chapter I

INTRODUCTION

Eradicating the screwworm from Mexico and establishing a biological barrier at the Isthmus of Tehuantepec are logistically difficult operations. About 500 million sterile insects must be produced per week and air dropped in specific locations to achieve eradication. Naturally, this task requires huge quantities of fly rearing supplies, as well as other equipment, labor and capital, be delivered when and where needed and carefully coordinated. Project personnel are continually challenged by such diverse responsibilities as rearing flies of good quality, dispersing flies in the field, establishing field surveillance, and disseminating public information.

PURPOSE

This study examined all the components of the screwworm eradication program to identify those which were most successful and those which were not as effective. We also identified personnel roles, field operation procedures and eradication strategies which contributed most to the success of the program, so that less important components can be improved or not be emphasized in the future. Knowing which parts of the program were most successful also adds meaning to the economic impact study contained in the total report.

POSSIBLE SOLUTIONS

When a program attempts to eradicate an insect species from a land mass as large as Mexico, the undertaking can become extremely complicated. Therefore, it is necessary to keep the operation as simple as possible. Complicated machinery and sophisticated mechanical technology should not be used in daily operations without a clear-cut need and careful evaluation. Much of the screwworm eradication program adhered to this principle, but the massive rearing plant at Tuxtula Gutierrez, Chiapas was a major exception. This "fly factory" has a single large production floor and massive environmental control equipment. This report contains suggestions for improving future plants.

A major problem was the inadequate number of field inspectors available to accurately determine low-density populations of wild screwworm flies. Surveying for infested animals over an extended period of time was the only way to determine whether or not an area was free of the pest. To avoid reinfestation in an area, sterile flies were dropped until no positive cases had been observed for 3 months. Potential reinfestation of free areas continues to be a major concern in all of Mexico and the southern United States.

METHODS

Separate surveys were developed to collect data from field personnel, program administrators and Mexican livestock organizations. Evaluation team members recognized the special insight program personnel and producer cooperators would have in identifying the strengths and weaknesses of the eradication effort.

The three survey groups were asked to estimate the economic impact of screwworm eradication in Mexico. The economic impact report deals entirely with the economic data derived from the livestock producer survey. This survey presents the opinions of personnel working in the

Mexican-American Screwworm Eradication Commission as to program operations and economic impact.

MATERIALS

Copies of the surveys used in Mexico are provided in attachments A, B and C. Attached surveys were used for the following audiences in Mexico: A: field personnel; B: commission administrative personnel and C: members of Mexican livestock associations. The surveys were printed on blue, pink and green paper respectively to aid in identification during the complying of data. The surveys were evaluated by field personnel on April 6, 1985 in Vera Cruz, Mexico. Results of the test were summarized and evaluated. Questions which did not produce meaningful information were corrected or deleted. The surveys for field personnel and administrative personnel were printed on blue and pink paper, respectively, and sent to most personnel working in the Mexican-American Commission. The completed surveys were collected by Dr. Moses Vargas, Mexican Chief of Field Operations in the Mexico City headquarters. Dr. Vargas mailed the completed surveys to Texas A&M University for translation to English and summarization.

The survey forms for producers were printed on green paper. These surveys were mailed to the presidents of 1,500 livestock associations randomly selected from a list of 4,100 associations provided by the National Mexican Cattlemen's Association in Mexico City. A stamped and addressed return envelope was provided with each survey sheet. Envelopes were returned to Mr. Jorge Contreras, agricultural representative at the American Embassy in Mexico City. Completed surveys were subsequently mailed to Texas A&M University for translation to English and summarization.

Program personnel in Mexico were interviewed as to which program components worked well and which needed improvement. Emphasis was placed on future program strategies and past successful operations. The interview information will be used to develop a list of recommendations which reflect the majority view point.

GRAPHIC INTERPRETATIONS

Survey participants ranked the 14 primary program functions according to the eight most important. This information from all three surveys is combined into a three-part graph. The percentages on the X-AXIS indicate the frequency with which a function was ranked in the top eight. The column for first place responses indicates the percentage of times the function was ranked first in importance. On two surveys, participants ranked 11 program activities from highest in importance (1) to lowest (5). The results are presented in a two-part graph. The bars represent the frequency with which activities were ranked first and second in importance.

CHAPTER II

RESULTS AND DISCUSSION

The following information documents the results of the evaluation surveys in a series of tables and graphs. Table 1 shows the sample size for each of the surveys. An excellent response of 72 percent was received from the field operations personnel. Administrative employees responded at a rate of 43 percent.

TABLE 1. Sample size for program evaluation surveys conducted in Mexico.

	SURVEY TYPE	
	Field Operation Personnel	Administrative Employees
Total responses	152	64
Total surveys sent	210	150
Total population	210	150
Percent of population sampled	72%	43%

The response rate from livestock producers was only 2 percent, apparently because of two problems. First, the survey was mailed December 10, 1985, which conflicted with the Christmas season. Second, livestock association groups generally do not respond well to written mail-out surveys in Mexico. Since the response was so low, and since time did not permit a follow-up survey effort, only the data from the first two surveys will be included in this report. Table 2 shows the position titles of all persons responding to the surveys as commission employees.

TABLE 2. Personnel responding to program survey.

Survey Group	Position Titles	Percent of Total
Field Operations	Field inspector	80.0
	Chief of inspectors	7.6
	Auxiliary supervisor	6.6
	District supervisor	3.0
	Chief of field operations	1.0
	Diffusion agent or information specialist	0.6
	Professional technician	0.6
	Third-year student	0.6
	TOTAL	100%
Administrative	Supervisor of field operations	22.0
	District supervisor	20.5
	Chief of inspectors	20.5
	Delegation of diffusion	17.0
	Auxiliary supervisor	8.0
	Chief of personnel	6.0
	Entomological advisor	1.5
	Chief of legal department	1.5
	Comptroller	1.5
	Subdirector general	1.5
	TOTAL	100%
Livestock Associations	President	66.0
	Secretary	17.0
	Medical veterinarian	6.0
	Treasurer	5.0
	Manager	2.5
	Member	2.5
	Counselor	1.0
	TOTAL	100%

The program experiences of survey respondents is provided in Table 3. Most respondents from field operations had been with the program for 1 to 3 years. Administrative personnel responding had more years of experience in program activities. The length of service time was expected to be smaller for field operations personnel because program administrators have been moving their field personnel to southern Mexico as the critical line for fly eradication moves south.

TABLE 3. Length of service for field and administrative personnel.

	Percent of Total			
		Field		Administrative
1-3 years		47		30
4-6 years		32		30
7-10 years		13		22
over 10 years		8		18
	TOTAL	100%	TOTAL	100%

Livestock Producer Association respondents became aware of program operation during the following time periods:

	Percent of Total
before 1976	23
1976-77	12
1978-80	31
1981-83	22
1984 or after	4
not answered	8
TOTAL	100%

The work roles of survey respondents are presented Table 4. The main roles of field personnel respondents were distributing public information, distributing insecticides for application to wounds, collecting samples and distributing educational materials. The roles most frequently listed by administrative respondents were collecting samples to identify positive screwworm cases and supervising employees.

TABLE 4. Roles performed by respondents in eradication program.

	Percent of Total	
	Field	Administrative
Collection of samples	13.0	58.0
Supervision of field operations	9.0	17.0
Informing public	31.0	4.0
Distribution of insecticide	20.0	3.0
Diffusion & vigilance in the field	13.0	3.0
Coordination of actions for quarantined animals	1.0	0.0
Detect infested areas	10.0	10.0
Train personnel	1.5	1.0
Dispersion	0.0	1.0
Personnel management	0.0	6.0
Advisement to officials	0.0	1.0
Legal accessory	0.0	3.0
Clerical & backup	0.0	0.0
Honorary inspector	0.0	0.0
Liaison	0.0	0.0
Treatment of animals	0.0	0.0
None	0.0	0.0
Not answered	1.5	3.0
TOTAL	100%	100%

Employees were asked which work roles they considered most critical. This information should be helpful to future program planners, since limited funds usually mean that critical jobs must be identified and filled on a priority basis. The ranking of critical job roles is presented in Table 5. Both field personnel and administrators identified the role of the field inspector as most critical to program operation. Information gathered by field inspectors provides the basis for the entire eradication effort. Both survey groups said that all jobs needed to be filled for a successful and efficient operation.

TABLE 5. Critical personnel roles identified for the eradication effort.

	Percent of Total	
	Field	Administrative
All jobs	28.0	56.0
Directors	2.3	6.0
Information specialists	15.0	10.0
Field inspectors	36.0	20.0
Supervisors	14.0	6.0
Administrative personnel	2.3	1.0
Biotechnicians and epidemiologists	2.0	0.0
Not answered	0.4	1.0
TOTALS	100%	100%

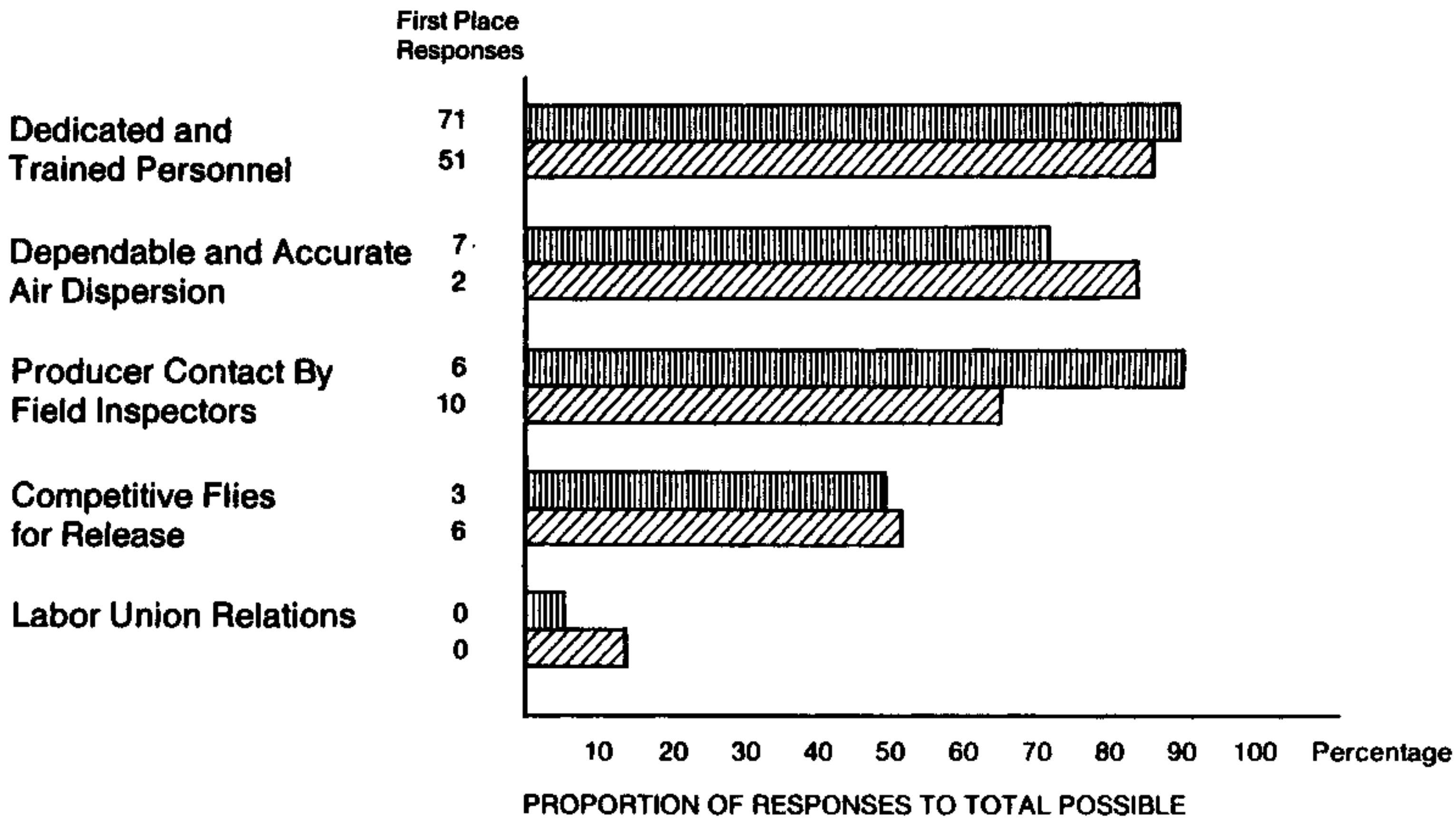
The relative importance of fourteen program functions was determined by asking respondents to select and rank the top eight program activities from a list of 14 choices. The results are illustrated in three graphs on the following pages (Figures 1a, 1b and 1c). The number in the column in front of each bar graph represents the percentage of first place selections for that program function. These graphs indicate that all groups place high value on the employment of dedicated and trained personnel. The program function of dedicated and trained personnel received 71 percent and 51 percent of the first place votes by field operations and administrative personnel, respectively. The item ranked second in importance was the availability of funds for conducting program activities. Other functions receiving substantial support were producer contacts by field inspectors, wound treatments, active case reporting and educational support materials.

A program can be successful only if its employees have the proper qualifications and characteristics. As reported in table 6, both field and administrative personnel stated that the most desirable qualifications of an employee are: (1) to be educated and properly trained;

Primary Program Functions Ranked According To Perceived Importance

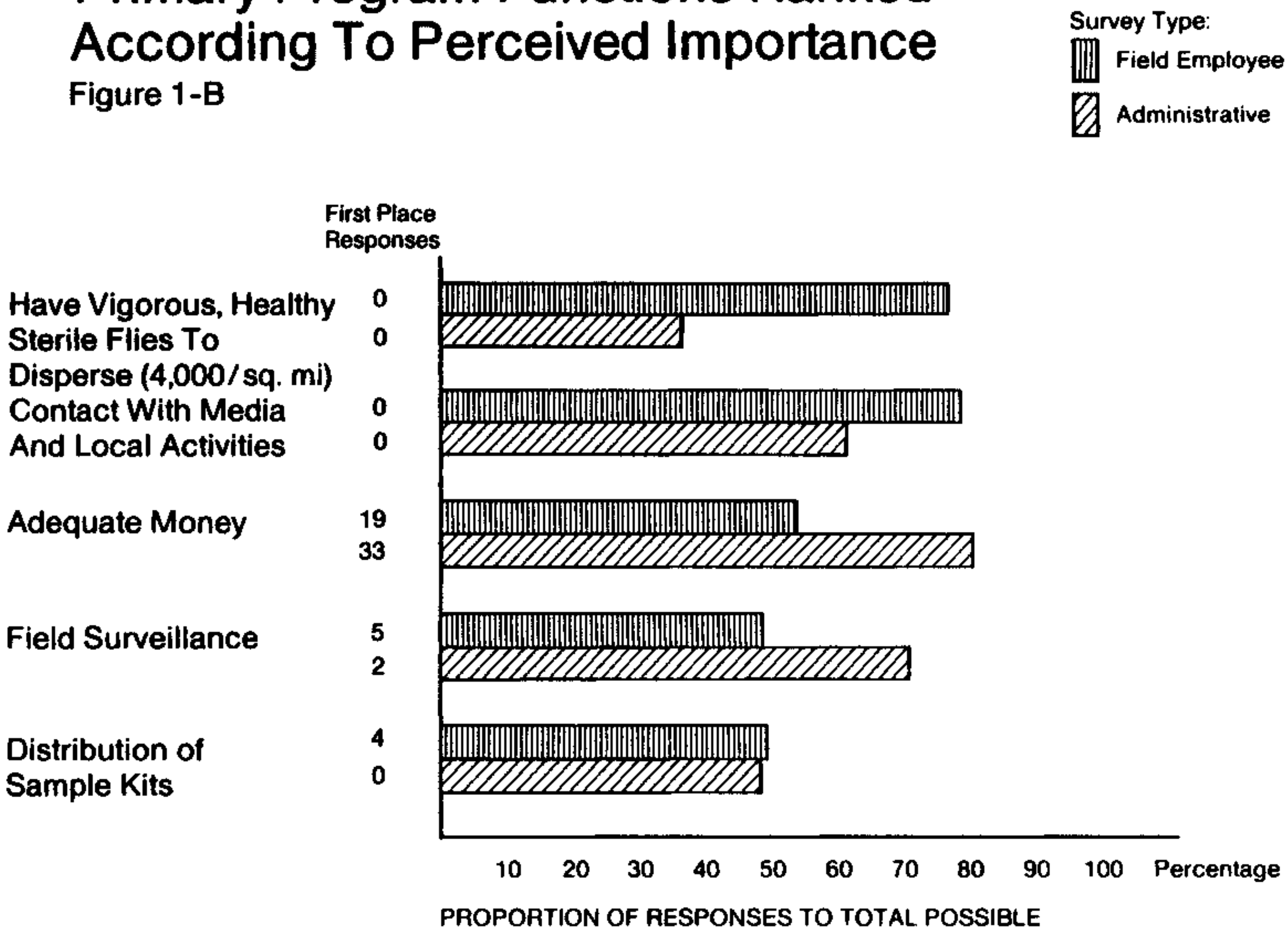
Figure 1-A

Survey Type:
Field Employee
Administrative



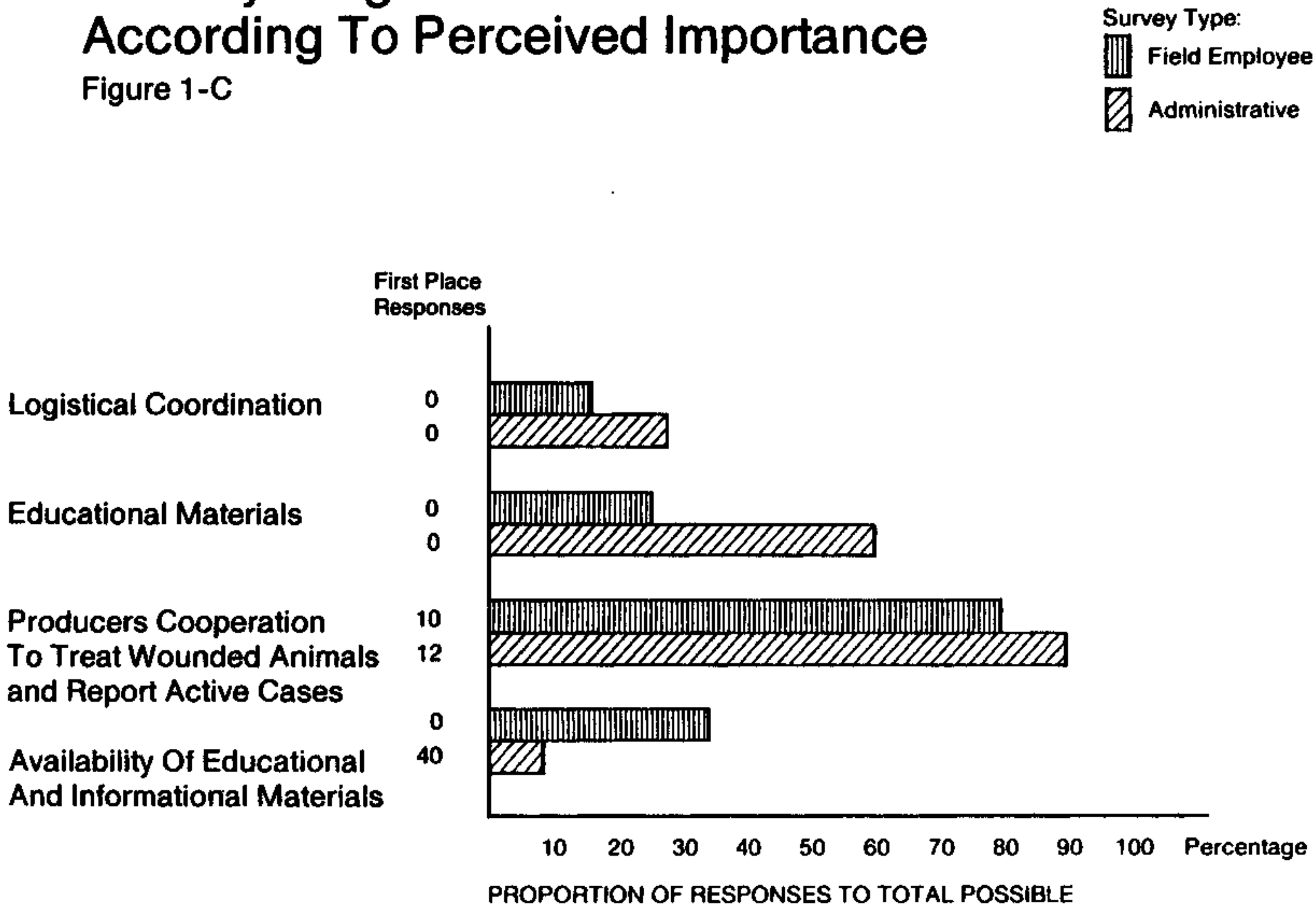
Primary Program Functions Ranked According To Perceived Importance

Figure 1-B



Primary Program Functions Ranked According To Perceived Importance

Figure 1-C



(2) to be responsible; and (3) to have a desire to work. Items such as dedication, understanding producer problems, familiarity with the work areas and honesty also were considered important. It has been readily apparent from working with program personnel in both field and office situations that the employees are well educated and properly trained to accomplish their assigned tasks.

TABLE 6. Qualifications necessary for employees.

	Percent of Total	
	Field	Administrative
Dedication	8.0	6.0
Good leadership	2.0	1.0
Educated and trained	28.0	25.0
Articulate	7.0	5.0
Responsible	17.0	12.0
Understand producers problems	6.3	10.0
Professionalism	3.0	3.0
Familiarity with areas & zones	4.7	6.0
Desire to work	12.0	7.0
Honesty	3.0	6.0
Experienced & knowledgeable about livestock	4.7	1.0
Work well with landowners	0.3	0.0
Political influence	4.0	5.0
Efficiency	0.0	0.0
Not answered	0.0	13.0
TOTALS	100%	100%

Data in Table 7a indicate which program functions survey respondents thought were the most difficult to accomplish. Table 7b shows the reasons respondents thought these functions were difficult to accomplish. Education was identified by all groups as the most difficult program function to achieve. This response is understandable, because a massive effort was required to educate most of the livestock owners in Mexico about screwworm eradication strategies and requirements. Lack of cooperation from livestock owners, public skepticism and communication problems were identified as the main reasons for the difficulties. The communication problems are caused partially by the many different dialects spoken in Mexico. The success of the program indicates that these problems were overcome with dedicated and hard working employees.

TABLE 7a. Program functions which were the most difficult to achieve.

	Percent of Total	
	Field	Administrative
Diffusion	17.0	12.0
All difficult	0.5	0.0
Extension (general)	9.0	6.0
Eradication	4.0	10.0
Education	45.0	42.0
Inspection	5.5	5.0
All easy	15.0	20.0
Supervision	0.0	0.0
Not answered	4.0	5.0
TOTAL	100%	100%

TABLE 7b. Why were the above functions difficult to achieve?

	Percent of Total	
	Field	Administrative
Lack of cooperation from livestock owners	22.0	0.0
Lack of cooperation from officials	3.0	0.0
Public skepticism	18.0	0.0
Isolation from area under attack	7.0	3.0
Communication problems	18.0	15.0
Distribution of workers	0.0	0.0
Other	2.0	0.0
Not answered	30.0	82.0
TOTAL	100%	100%

Survey respondents were asked to identify the single most important problem encountered in their work. As Table 8a shows , both groups said that convincing the public of the efficacy of the program was the biggest problem. Administrators also identified logistical problems involved in rearing and dispersing flies as significant concerns. It is interesting to note that 21.5 percent of the field personnel and 16 percent of the administrative personnel reported no difficulty in their work duties.

TABLE 8a. Greatest problems encountered in the program.

	Percent of Total	
	Field	Administrative
Communication problems	22.0	13.0
Location of leaders to cooperate with program	2.0	1.0
Lack of cooperation from public officials	4.0	3.0
Convincing public of efficacy of program	25.0	36.0
Terrain (bad roads)	7.0	3.0
Familiarity with zones	4.5	0.0
No difficulty	21.5	16.0
Logistic problems	8.0	24.0
Lack of education of the Mexican people	0.0	0.0
Technical problems	0.0	0.0
Lack of collaboration from ranchers	0.0	0.0
Lack of field inspectors	0.0	0.0
Not answered	6.0	4.0
TOTALS	100%	100%

Respondents were asked to identify ways in which these difficult tasks were overcome. Most field employees (79%) did not offer any solutions. Administrative personnel identified public education, individual visits and producer meetings as helpful ways of solving difficult problems.

TABLE 8b. Suggestions to overcome difficult problems.

	Percent of Total	
	Field	Administrative
Cooperation from all parties involved	0.6	5.0
By work meetings with producers	4.7	16.0
By individual visits	7.0	16.0
Solution within institution	4.7	2.0
Convincing the public	4.0	18.0
Education	0.0	10.0
Not answered	79.0	33.0
TOTALS	100%	100%

The program evaluation team was interested in whether or not workers performed any jobs beyond their assigned duties. Data in Table 9a indicate that approximately one-fourth of the employees were required to accomplish extra tasks. Table 9b summarizes the additional tasks performed. The extra task most often reported by field personnel was helping to build favorable relationships with the livestock union (29%). Administrative personnel helped with the duties of fly dispersion and livestock inspection. This type of cooperation among employees indicates a willingness to help colleagues to accomplish program goals.

TABLE 9a. Worker jobs performed outside their job description.

	Percent of Total	
	Field	Administrative
Yes	25	27
No	73	73
Not answered	2	0
TOTALS	100%	100%

TABLE 9b. Additional tasks identified outside their assignment.

	Percent of Total	
	Field	Administrative
Diffusion	20.0	0.0
Dispersion	20.0	42.0
Inspection	4.0	42.0
Clerical jobs	2.5	11.0
Engineering or technical tasks	2.5	0.0
Other (relations with labor unions)	29.0	5.0
Not answered	22.0	0.0
TOTALS	100%	100%

Table 10 presents a summary of the tasks respondents considered unnecessary to accomplish program goals. A majority, 95 percent and 97 percent of field and administrative respondents, respectively, did not feel they were asked to conduct unnecessary work. It was interesting to note that the only task identified as unnecessary were certain clerical jobs.

TABLE 10. Tasks or jobs considered unnecessary to program goals.

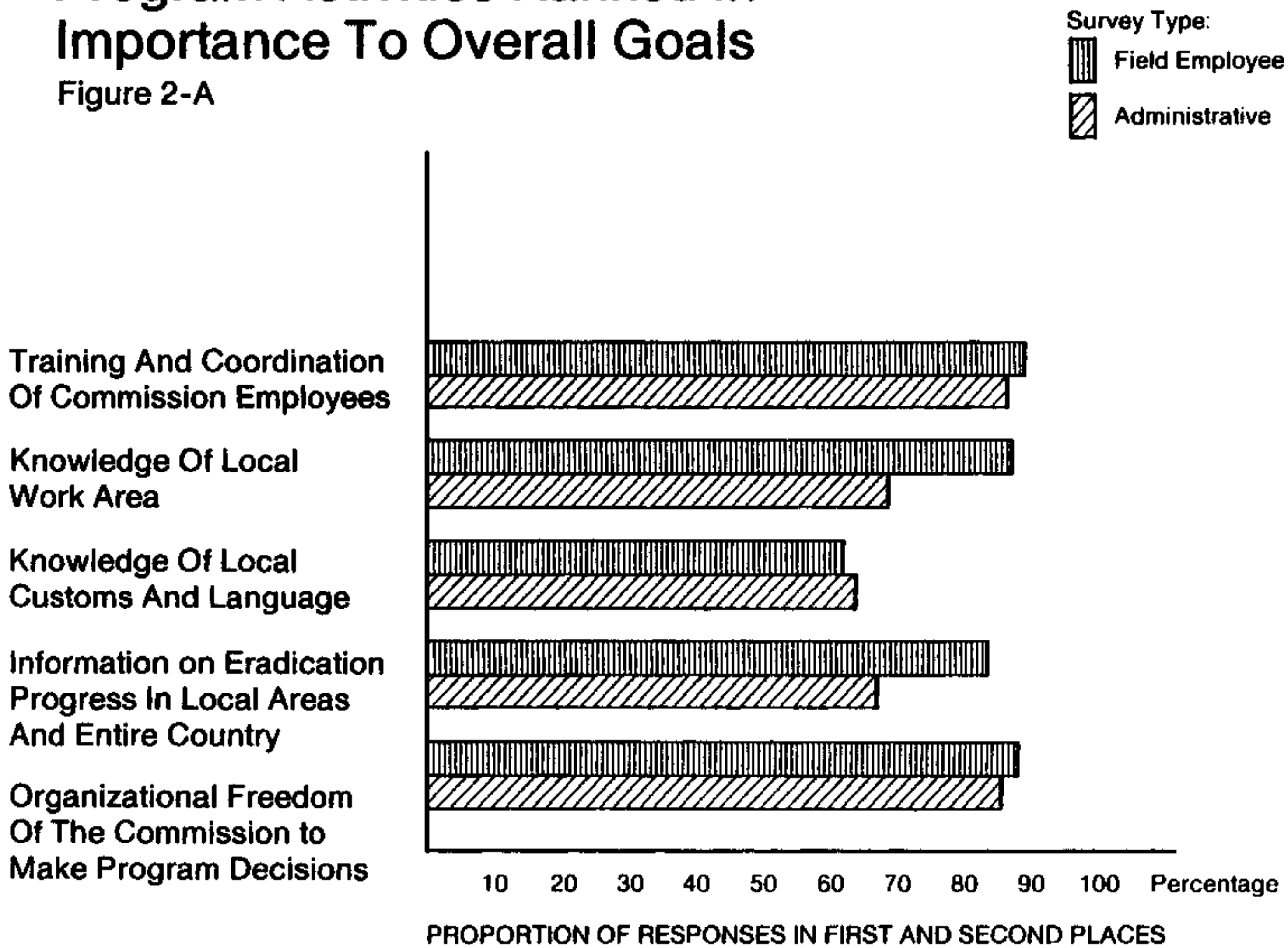
		Percent of Total	
		Field	Administrative
Yes		4.0	1.5
No		95.0	97.0
Not answered		1.0	1.5
	TOTALS	100%	100%
What were they?			
Clerical jobs		83	100
Not answered		17	
	TOTALS	100%	100%

Survey respondents ranked program activities according to their perceived importance to overall goals. These activities are presented in figures 2a and 2b. Each respondent rated the activities on a scale of 1 (highest) to 5 (lowest). In general, most activities were ranked in a high position except the use of Screwworm Adult Suppression System (SWASS). Both groups surveyed responded that SWASS use was not of major importance in achieving eradication. There were slight differences in the two groups responding to various activities.

The administrative respondents were asked for suggested program changes if a new screwworm eradication program was organized. Table 11 summarizes their responses. A majority, 71 percent, indicated they would

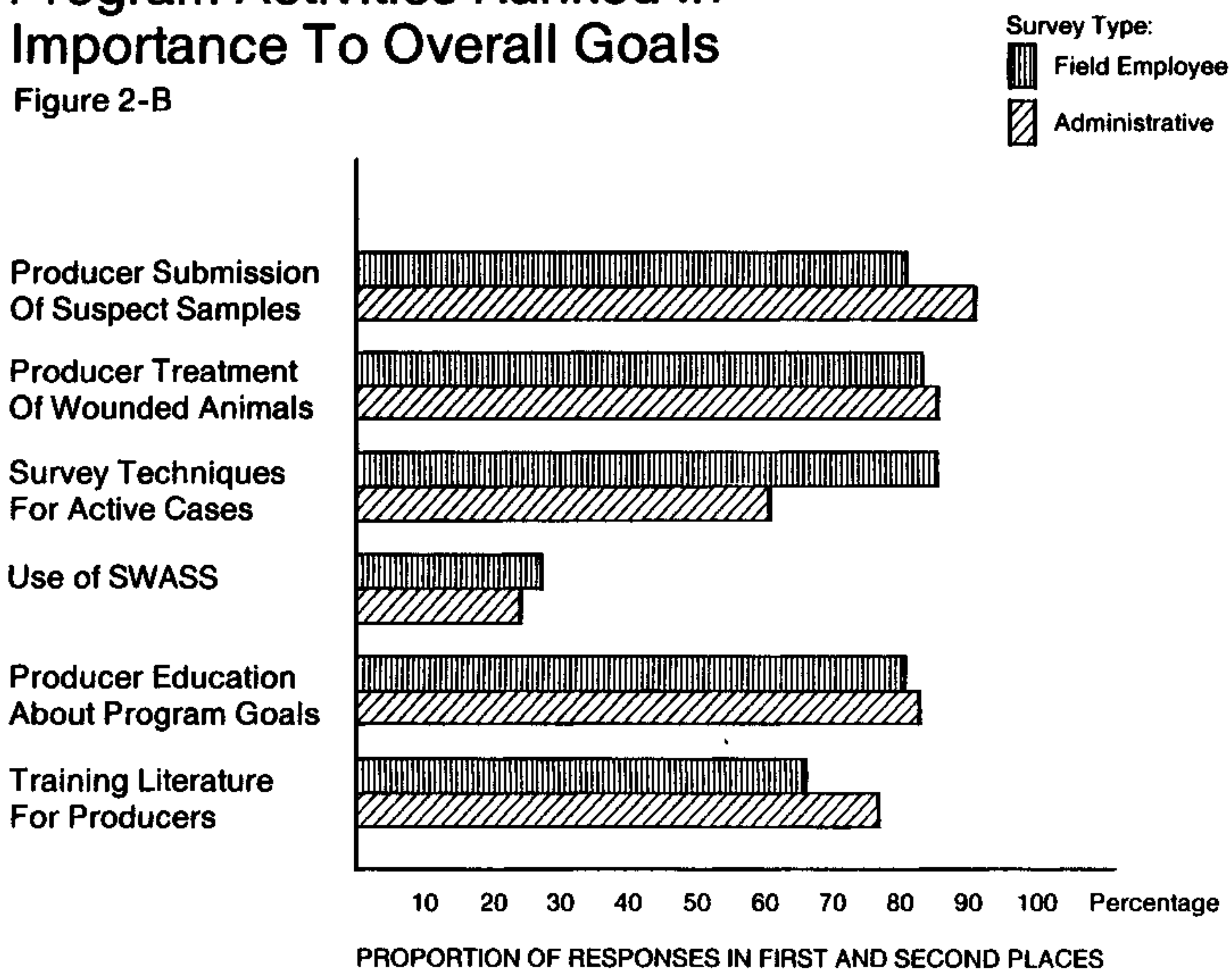
Program Activities Ranked In Importance To Overall Goals

Figure 2-A



Program Activities Ranked In Importance To Overall Goals

Figure 2-B



organize the program in the same way as the original Mexican-American program. A variety of other suggestions were offered but no obvious change emerged as a consensus opinion.

TABLE 11. Suggestions for organization of screwworm commission.

Administrative Survey Only		Percent of Total
Same as original		71
Eliminate some supervisory positions & emphasize field operations		6
Give workers more responsibility		4
Avoid political issues		1
Other		14
Not answered		4
	TOTAL	100%

Field personnel were asked whether or not livestock owners had developed a greater sense of pride and social well being as a result of screwworm fly eradication. As Table 12 indicates, 97 percent answered "yes." Decreased costs of medicine for wound treatment and increased economic benefits and livestock productivity were the major benefits listed. Ranchers have greater financial security because screwworm fly losses have been eliminated.

TABLE 12. Has screwworm eradication improved the pride and social well-being of livestock owners?

Field Survey Only		Percent of Total
Yes		97
No		2
Not answered		1
	TOTAL	100%

In what ways?

		Percent of Total
Increased financial security for ranchers		23
Increased benefits & productivity		34
Diminished cost of operation		2
Better management of time		4
Decreased cost of medicine		36
Not answered		1
	TOTAL	100%

According to the data in Table 13, field personnel expected livestock producers to benefit financially from screwworm eradication. The main contributing factors were identified as decreased costs of production and increased weight gains.

TABLE 13. Will the eradication program provide more income to livestock owners?

Field Survey Only		Percent of Total
Yes		97
No		1
Not answered		2
	TOTAL	100%

How?		Percent of Total
Decreased cost of production		37
Keep livestock free from screwworm		7
Increased weight gains		37
Decreased failure of operation		3
Increased product quality		6
Other		2
Not answered		8
	TOTAL	100%

The question in Table 14 was asked to cattleman associations to determine awareness of program support from the United States. Most respondents reported that another country provided help in eradicating the screwworm from most of Mexico, and 96 percent said the assistance came from the U.S.A.

TABLE 14. Identify other governments involved in the screwworm eradication program.

Livestock Producer Survey Only (134 respondents)		Percent of Total
Yes		60
No		32
Not Answered		8
	TOTAL	100%

If yes, which countries?		Percent of Total
U.S.A.		96
Venezuela, Argentina		2
Not Answered		2
	TOTAL	100%

CHAPTER III

THE INTERVIEW PROCESS

The collecting of data by means of individual interviews was productive. Notes from each interview were summarized and are presented in this section of the evaluation report. A total of 22 interviews were conducted during 4 separate trips to Mexico. The suggestions made should help administrators and future program planners develop more efficient operations.

Program workers routinely stated that it is important to establish and maintain good relationships with ranchers, farmers, agricultural leaders and political leaders in the various regions of the county. They also noted that wound treatment by livestock owners is a vital component of the screwworm eradication strategy. It was evident that commission employees in Mexico have inspired public confidence in the program. For example, when the evaluation team visited the national Cattlemen's Union office in Mexico City, they received excellent cooperation from staff members in carrying out the evaluation project.

Program employees presented a positive view of the program, and most had a good grasp of the eradication effort and how their work assignments contributed to it. As a result, there appeared to be a high degree of worker morale and enthusiasm. Equipment, work space and supplies were kept in an orderly and businesslike fashion.

A significant topic of discussion was the design of a new fly rearing facility. The present facility in Tuxtla Gutierrez has some design and functional problems. It is a large plant with massive chillers, boilers, air handling equipment and other machinery. Routine maintenance on machinery is difficult to perform because of the 24 hour nature of the fly rearing. Backup or secondary systems are not available. Since a constant supply of sterile flies is required to accomplish eradication goals, when equipment problems arise the whole rearing operation is adversely affected. Employees were asked for their suggestions on improving fly rearing facilities.

A modular fly rearing system was suggested as an alternative to the present facility. A complete, self-contained module could be designed to rear 100 million flies per week. If the program required 500 million flies per week, six modules would be constructed. Five of the modules would provide needed fly production, while the extra module would be on standby for emergency use or use when repair and maintenance were being conducted on other modules. It was suggested that the modules be designed with a balance of new technology and simple ease of operation.

A similar modular system could be designed for livestock inspection and quarantine facilities. Present quarantine facilities will need to be located at a point further south as the critical line is relocated. Portable cattle handling equipment is available which is strong and durable.

A review of the important fly rearing plant indicates there is a lack of written job descriptions for the various types of employees. The key roles of some employees have been gradually shifted to meet the program needs of this action orientated program. It is suggested that all employees receive a written job description from their supervisor of their duties and responsibilities when reporting for work. These written items need to be established for all employees regardless of position. Supervisory personnel should be given well documented job description statements to insure job completion. Personnel should review their job role with their immediate supervisor.

LIST OF TABLES

LIST OF FIGURES

Directions for Completion

The attached survey is part of a project to evaluate the Screwworm Eradication Project in Mexico. This survey is being conducted as part of a year study to evaluate the environmental, economic and social impact of the screwworm eradication program in Mexico. The information is strictly confidential and becomes the property of Texas A&M University. The information is needed to provide a historical record of program activities and for future program operations.

Special group surveys have a vital role in the evaluation phase of the Mexican-American Screwworm Evaluation Project. Future program operations and possible expansion to other areas demands that this type of information be collected and evaluated.

The screwworm eradication program has enjoyed great progress during the past few years with a permanent barrier zone now established at the Isthmus of Tehuantepec.

If there are any questions, please contact:

Dr. Moises Vargas
Sub-Director Operaciones
Apartado Postal M-2890
06000 Mexico, D.F.

250-10-2890

When the survey is complete, please mail to:

Ing. Jorge Contreras
Agricultural Specialist/Economist
Embassy of the United States of America
Reforma No. 305
Col-Cuauhtemoc
06500 Mexico, D.F.

FIELD OPERATION EMPLOYEE SURVEY
Mexican-American Screwworm Eradication Commission

1. What is your official job title?____

2. Number of years as a Commission employee? ____________

3. Briefly describe your role in the screwworm eradication program.

4. What are the key personnel roles which need to be filled in the eradication effort?

5. What qualifications do the people need who are employed to fill these critical jobs?

6. List in order of importance 6 to 8 primary program functions necessary to achieve screwworm eradication in Mexico.

Please list:
1.
2.
3.
4.
5.
6.
7.
8.

A. dedicated and trained personnel
B. dependable and accurate air dispersion
C. producer contact by field inspectors
D. competitive flies for release
E. labor union relations
F. have available vigorous, healthy, sterile flies to disperse 4,000/sq. mile on a timely basis
G. contact with media local activities
H. adequate money
I. field surveillance
J. distribution of sample kits
K. logistical coordination
L. educational materials
M. producers cooperation to treat wounded animals and report active cases
N. other, please list

7. Which program functions were the most difficult to achieve and why?

8. What was the single biggest problem in your job as a Commission employee? How was it overcome?

9. Did you perform tasks which were not assigned or not in your job description to accomplish program goals? If yes, list.

   (1) no _______

   (2) yes_______

10. Were there any assigned tasks in your job which you feel were not needed to achieve program goals? If yes, list.

    (1) no _______

    (2) yes_______

11. On a scale of 1 to 5 (1=little, 5=major) rank the following activities as to their importance in the accomplishment of the goals of the Mexican-American Screwworm Eradication Program.

	IMPORTANCE (Circle #)				
	Little				Major
Producer submission of suspect samples	1	2	3	4	5
Producer treatment of wounded animals	1	2	3	4	5
Survey techniques for active cases	1	2	3	4	5
Use of SWASS	1	2	3	4	5
Producer education about program goals	1	2	3	4	5
Training literature for producers	1	2	3	4	5
Training and coordination of Commission employees	1	2	3	4	5
Knowledge of local work area	1	2	3	4	5
Knowledge of local customs and language	1	2	3	4	5
Information on eradication progress in local areas and the Mexican wide program progress	1	2	3	4	5
Organizational freedom of the Commission to make program decisions	1	2	3	4	5

12. Has the accomplishment of screwworm eradication goals improved the pride and social well being of the Mexican livestock owner?

    (1) no ______

    (2) yes______, if yes, list.

13. Do the Mexican ranchers you contact think the eradication program will provide him more income from his operation?

    (1) no ______

    (2) yes______, if yes, list.

Directions for Completion

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Ing. Jorge Contreras
Agricultural Specialist/Economist
Embassy of the United States of America
Reforma No. 305
Col-Cuauhtemoc
06500 Mexico, D.F.

EMPLOYEE SURVEY
Mexican-American Screwworm Eradication Commission

1. What is your official job title?______________________________

2. Number of years as a Commission employee? ____________

3. Briefly describe your role in the screwworm eradication program.

4. What are the key personnel roles which need to be filled in the eradication effort?

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Please list:
1.
2.
3.
4.
5.
6.
7.
8.

A. dedicated and trained personnel
B. dependable and accurate air dispersion
C. producer contact by field inspectors
D. competitive flies for release
E. labor union relations
F. have available vigorous, healthy, sterile flies to disperse 4,000/sq. mile on a timely basis
G. contact with media local activities
H. adequate money
I. field surveillance
J. distribution of sample kits
K. logistical coordination
L. educational materials
M. producers cooperation to treat wounded animals and report active cases
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7. Which program functions were the most difficult to achieve and why?

8. What was the single biggest problem in your job as a Commission employee? How was the problem overcome?

9. Did you perform tasks which were not assigned or not in your job description to accomplish program goals? If yes, list.

   (1) no _______

   (2) yes_______, explain

10. Were there any assigned tasks in your job which you feel were not needed to achieve program goals? If yes, list.

    (1) no _______

    (2) yes_______

11. If a new screwworm commission was to be organized, how should it be structured and developed? Explain suggested changes.

12. On a scale of 1 to 5 (1=little, 5=major) rank the following activities as to their importance in the accomplishment of the goals of the Mexican-American Screwworm Eradication Program.

	IMPORTANCE (Circle #)				
	Little				Major
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Training and coordination of Commission employees	1	2	3	4	5
Knowledge of local work area	1	2	3	4	5
Knowledge of local customs and language	1	2	3	4	5
Information on eradication progress in local areas and the Mexican wide program progress	1	2	3	4	5
Organizational freedom of the Commission to make program decisions	1	2	3	4	5

Directions for Completion

The attached survey is part of a project to evaluate the Screwworm Eradication Project in Mexico. This survey is being conducted as part of a year study to evaluate the environmental, economic and social impact of the screwworm eradication program in Mexico. The information is strictly confidential and becomes the property of Texas A&M University. The information is needed to provide a historical record of program activities and for future program operations.

Special group surveys have a vital role in the evaluation phase of the Mexican-American Screwworm Evaluation Project. Future program operations and possible expansion to other areas demands that this type of information be collected and evaluated.

The screwworm eradication program has enjoyed great progress during the past few years with a permanent barrier zone now established at the Isthmus of Tehuantepec.

If there are any questions, please contact:

Dr. Moises Vargas
Sub-Director Operaciones
Apartado Postal M-2890
06000 Mexico, D.F.

250-20-2890

When the survey is complete, please mail to:

Ing. Jorge Contreras
Agricultural Specialist/Economist
Embassy of the United States of America
Reforma No. 305
Col-Cuauhtemoc
06500 Mexico, D.F.

MEXICAN LIVESTOCK ASSOCIATION SURVEY
Mexican-American Screwworm Eradication

1. What is your official job title?______________________________

2. What year did you first become aware of the screwworm eradication program?

   ____

3. Briefly describe your role in the screwworm eradication program.

4. What are the key personnel roles which need to be filled in the screwworm eradication effort?

5. What qualifications do the people need who are employed to fill these critical jobs?

6. Rank in order of importance 6 primary program functions necessary to achieve screwworm eradication in Mexico.

Please list:
1.
2.
3.
4.
5.
6.
7.
8.

A. dedicated and trained personnel
B. dependable and accurate air dispersion
C. producer contact by field inspectors
D. competitive flies for release
E. labor union relations
F. have available vigorous, healthy, sterile flies to disperse 4,000/sq. mile on a timely basis
G. contact with media local activities
H. adequate money
I. field surveillance
J. distribution of sample kits
K. logistical coordination
L. educational materials
M. producers cooperation to treat wounded animals and report active cases
N. other, please list

7. Which program functions were the most difficult to achieve and why?

8. What was the single greatest problem in your job as a livestock association leader in getting screwworms eradicated?

9. Were there any program activities which you feel were not needed to achieve eradication of the screwworm in Mexico? Please explain your answers.
   (1) no ______

   (2) yes______

10. What economic impact do you feel this program has had on producers in your country? Such as increased number of cattle to sell, less costs for medication, reduced labor or increased weight gain.

11. Has the screwworm eradication program improved the quality of life of the livestock producer in your association? Please explain your answers.

    (1) no ______

    (2) yes______

12. Now that screwworm eradication is completed, do you have other major pest problems? If yes, explain pest problems.

    (1) no ______

    (2) yes______

13. Has the screwworm eradication reduced any other parasite problems? Such as the vampire bat problem, tick or other wild animals.

    (1) no _______

    (2) yes_______

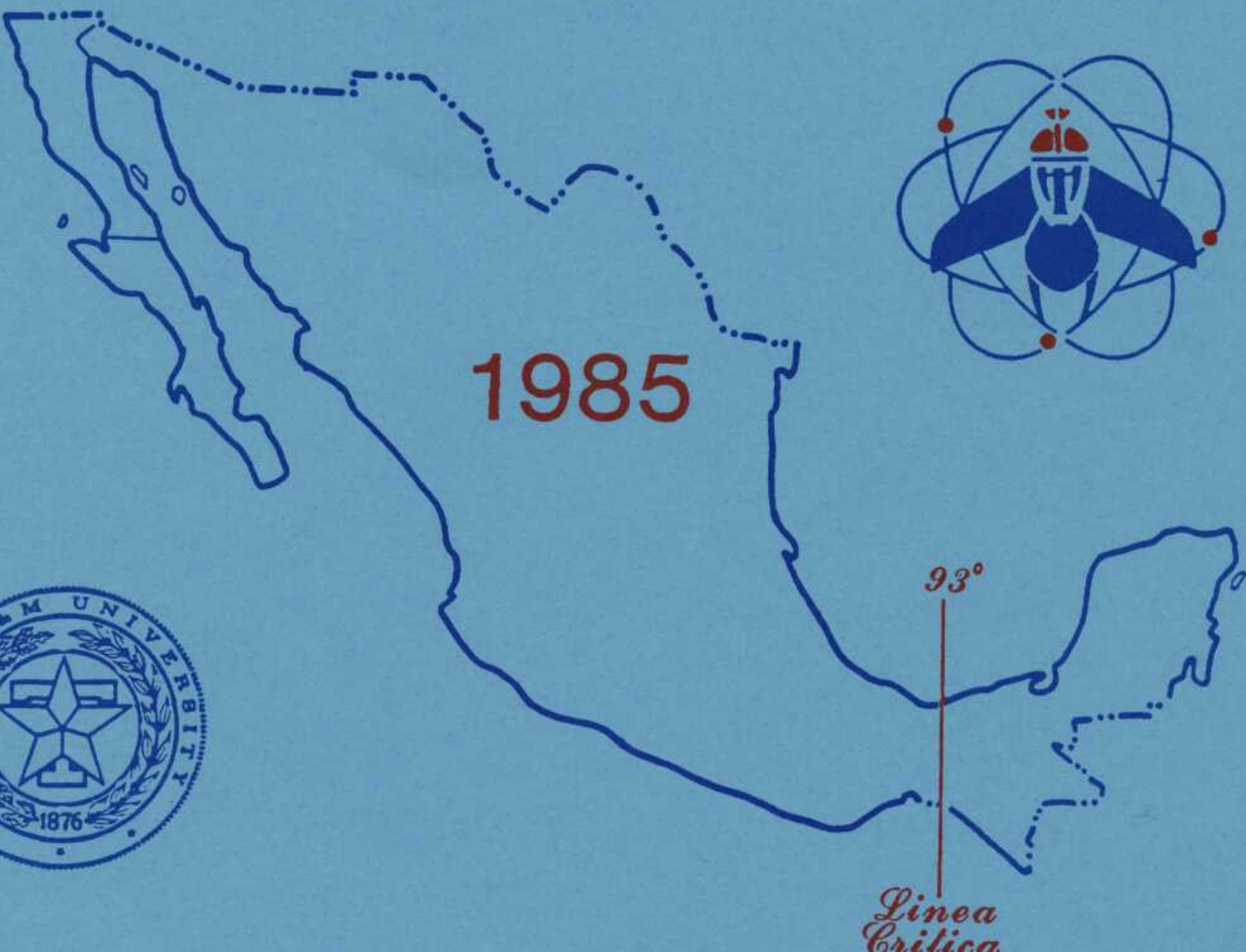
14. Do you know of any other countries that are helping the Mexican government in achieving screwworm eradication in Mexico?

    (1) no _______

    (2) yes_______, if yes, list.

15. What does the Mexican livestock industry need to do to prevent reinfestation for the screwworm in Mexico? List any suggestions or actions.

EVALUATION OF THE MEXICAN-AMERICAN SCREWWORM ERADICATION PROGRAM IN MEXICO



VOLUME III

IMPACTS AND IMPLICATIONS OF SCREWWORM REINFESTATIONS IN MEXICO

TEXAS AGRICULTURAL EXTENSION SERVICE
THE TEXAS A&M UNIVERSITY SYSTEM

VOLUME III

IMPACTS AND IMPLICATIONS OF SCREWWORM REINFESTATION IN MEXICO

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EXECUTIVE SUMMARY

Impacts and Implications of Screwworm Reinfestation In Mexico

In the summer of 1985, there was a major screwworm outbreak into the previously eradicated regions of Mexico in the states of San Luis Potosi and Tamaulipus. Livestock in these areas were once again exposed to the screwworm. This outbreak provided an opportunity to evaluate the effects of reinfestation while the livestock producers' experience was fresh on his mind.

Towards this end, two questionnaires were developed; one for the livestock producers with infested livestock and one for the Commission employees who helped combat the screwworm. Both questionnaires were designed to try and gather information from both groups as to: (1) the cost incurred from screwworm reinfestation; (2) how livestock producers reacted to the outbreak; (3) identifying problems associated with combating screwworm outbreaks; and (4) determining livestock producer attitudes towards the overall screwworm eradication effort conditioned by the outbreak. In total, 42 Commission employees and 43 of 92 ranchers reporting screwworm infested animals were surveyed.

Major findings of the survey indicate that Mexican ranchers, before this outbreak, no longer thought of the screwworm as a threat to their livestock. Now, because of this outbreak 95 percent of those surveyed planned to use preventive practices to prevent screwworm

attacks in the future. This practice would mainly be in the form of treating and confining wounded animals.

Even though producers expressed concern about potential loss of time and money in combating reinfestation, they relied entirely on the Commission employees for control of the outbreak. A significant part of the cost of re-eradicating the screwworm from this area fell on the Mexican-American Screwworm Commission, since the majority of the ranchers reported having no cost. The Commission thus played an important role in containing the screwworm from spreading any further and perhaps reaching Texas livestock.

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CHAPTER I

INTRODUCTION

The Mexican-American Screwworm Commission has eradicated the screwworm from Mexico north of the 92 meridian. A biological barrier has been established at the Isthmus of Tehuantepec. In the summer of 1985, however, there was a major screwworm outbreak into the previously eradicated regions of Mexico in the states of San Luis Potosi and Tamaulipas. The outbreak exposed livestock in the areas once again to the screwworm.

The first active case of the outbreak was reported on June 25, 1985 and the last active case was detected on August 15, 1985. Producers in this region were again in an animal inspection and treatment program for screwworms. The Mexican-American Screwworm Commission was required to treat infested animals, release sterile flies and survey the area to eradicate the outbreak. Quick and decisive action by Commission employees was successful in re-establishing a clean region north of the barrier zone. A total of 140 screwworm cases were reported and confirmed during the outbreak.

A total of 92 ranchers reported screwworm infested animals. A task force of 168 Commission members was dispatched to the infested areas to quickly bring the outbreak under control. Sterile screwworm flies were dropped at a rate of 94 million per week with 5,040 pounds of SWASS. Serile fly drops continued for 8 weeks after the last active case was detected on August 15, 1985.

At the time of the 1985 screwworm outbreak, the Mexican-American Screwworm Commission field inspectors had just completed the "Screwworm Economic Impact Survey" enumeration school. The enumeration school had been conducted by the Texas A&M University research team to insure that the Commission's field inspectors could properly administer the survey.

Many of the field inspectors that had been trained to enumerate were dispatched to the outbreak area. Although this delayed the primary impact study, it provided an oppportunity for the research team already actively involved in measuring the effects of Mexico's screwworm eradication program to witness first hand the effects of an outbreak.

Producers in Mexico had decades of experience with methods of inspection and treatment for screwworms in livestock before the eradication program. When eradication was achieved, the screwworm was no longer a problem and many producers abandoned routine inspection of animals. With the summertime outbreak, producers' reaction to the impact of the screwworm could be quite different than it would have been before eradication.

The outbreak provided a unique case of reverse technology and an opportunity to evaluate the effects of reinfestation while the producers' experience was fresh on his mind. Up to this time, little is known about the impacts of reverse technology. This experience in Mexico gave an opportunity to develop some insight as to control requirements of the screwworm when producers have forgotten how to manage and control this pest. It is possible that the impact of an outbreak in Texas may be even greater than that in Mexico because more years have passed since the eradication of screwworm in Texas.

Study Objectives

The objectives of this part of the study, stimulated by the 1985 outbreak of screwworms in Mexico, were as follows:

(1) To quantify producer costs associated with screwworm reinfestations or sporadic outbreaks.

(2) To determine, after years of eradication, how livestock producers react with treatment and control practices.

(3) To identify problems associated with combating screwworm outbreaks.

(4) To identify any changes in production practices that have evolved as a result of the eradication of the screwworm.

(5) And, to determine the livestock producer attitude towards the overall screwworm eradication effort conditioned by the outbreak.

The survey included personal enumeration of livestock producers who experienced screwworm reinfestations in their animals during the summer of 1985. The areas surveyed have previously been declared an eradicated zone. Also, as part of the study, Commission exployees involved in controlling the screwworm outbreak were surveyed. Of particular importance were issues and problems experienced by Commission employees and livestock producers that were not present during the initial country wide eradication program.

CHAPTER II

PROCEDURE

Two questionnaires were developed and used in the study of the 1985 screwworm outbreak. The questionnaires were targeted at two different types of people affected by this outbreak; livestock producers and the Mexican-American Screwworm Commission's field inspectors. The reason for two questionnaires was to obtain information from two different perspectives on the same issue, the 1985 screwworm outbreak in Mexico.

Inspectors Questionnaire

This questionnaire was developed for the Commission's field inspectors and it contained 13 questions (Appendix A). The initial five questions were related to the inspectors background and job functions. An additional five questions, 6, 9, 10, 12 and 13, asked the respondents of their experience in eradicating the screwworm in this outbreak. Question 11 ask for the inspector's estimate of cost to producers from the outbreak and questions 7A, 7B, and 8 were related to the producers perceptions and attitudes towards screwworm eradication and reinfestation as perceived by inspectors.

The field inspector questionnaire, therefore, was divided into four major sections for purposes of analysis. These sections are: (1) questions related to the inspectors; (2) questions dealing with reinfestation; (3) questions referring to producer costs; and (4) questions related to producers perceptions and attitudes about screwworm eradication and reinfestation.

Livestock Producer Questionnaire

A second questionnaire was designed for the livestock producers who had confirmed cases of screwworms (Appendix B). The questionnaire contained 18 questions. The first eight questions were related to the location and type of species infested with screwworm. To determine changes in producers' preventive medical practices, questions 9, 10, 11 and 15 were developed. Questions 12, 13 and 16 related to producers' costs associated with the outbreak. Questions 14, 17 and 18 were developed to determine producers problems, attitudes and concerns related to the outbreak.

Survey Method

Two Spanish speaking members of the Texas A&M University research team were dispatched to the infested area of Mexico to complete the questionnaire. The survey was conducted August 12-19, 1985. This allowed the survey team to collect data while the Commission's employees and livestock producers were still battling the outbreak. In fact, the last case of screwworm infestation was reported August 15, 1985 while the survey team was in the field collecting information. The questionnaires were completed by personal interviews of Commission employees involved in fighting the outbreak and of livestock producers that had animals with confirmed cases of screwworm infestation.

Data Analysis and Reporting Procedures

A total of forty-three livestock producers and forty-two Commission employees were interviewed in this outbreak survey. The data obtained from the survey of these two groups was then reviewed and tabulated. The infestation cost data was given in Mexican pesos. These were converted to U.S. dollars using the effective exchange rate as of August 15, 1985. This exchange rate was 330 Mexican pesos per U.S. dollar.

This report provides a summary and a description of the basic results from the data collected in the surveys of both Commission field inspectors and livestock producers. These results are summarized using descriptive statistical methods, mainly in the form of frequencies and averages. The estimated costs of the screwworm outbreak are reported in U.S. dollars effective in August 1985.

CHAPTER III

COMMISSION EMPLOYEE RESPONSE

Of the 42 Mexican-American Screwworm Commission personnel interviewed, field inspectors made up the majority, 84 percent, who were working on the team to eliminate the reinfestation (Table 1). These were followed by assistant supervisors, 8 percent, and a single area supervisor, diffusion agent, inspector chief and a district supervisor.

Table 1. Job Title of Field Personnel Surveyed in the Outbreak Area.

Job Title	Freq.	%
Field Inspector	35	84
Area Supervisor	1	2
Diffusion Agent	1	2
Asst. Supervisor	3	8
Inspector Chief	1	2
District Supervisor	1	2

Experience and Job Functions of Commission Employees

A summary of respondent's years of experience with the commission is presented in Table 2. Of the respondents who were surveyed, the four-years experience category ranked first with 32 percent or 13 of the respondents falling in this category. The rest of the respondents were as follows: 27 percent were in the two-years experience category; 12 percent in the three-years experience category; and 2 percent for the one, seven, eight and twelve-years experience category. This group of Commission employees represented a total of 180 years of experience and service to the program.

Table 2. Years Experience of Surveyed Commission Employees With the Eradication Program.

# of Years	Freq.	Total Years	%
1	1	1	2
2	11	22	27
3	5	15	12
4	13	52	32
5	3	15	7
6	3	18	7
7	1	7	2
8	1	8	2
10	3	30	7
12	1	12	2
	42	180	100

Information dealing with the respondent's primary job functions in working on the reinfestation problem is depicted in Table 3. The major job functions were giving information to ranchers, inspecting animals, treating animals and sending in suspect samples with 33, 22, 21 and 17 percent of the respondents falling into each of these categories, respectively.

Table 3. Primary Job Functions of Commission Employees Working on the Reinfestation Problem.

Function	Freq.	%
Inspecting animals	37	22
Treating animals	36	21
Sending in samples	28	17
Giving information to ranchers	56	33
Coordination & supervision of field personnel	2	1
Coordinating with other agencies	4	2
Checking animals to be moved out of area	4	2
Checking samples	4	2

In the 1985 screwworm infestation, 36 percent of the responding Commission Employees contacted between 501 and 1000 livestock producers each, Table 4. Another 31 percent of the respondents contacted between 0 and 500 livestock producers, while 12 percent contacted between 1001 and 1500 livestock producers each. Only two respondents contacted more than 3500 livestock producers. These two respondents were showing films to producers in "ejidos". No estimate of the total number of livestock producers contacted in this effort was estimated since the Commission's employees often worked in teams.

Table 4. Producers Contacted by Commission Employees During Outbreak.

Range	Freq.	%
0 - 500	13	31
501 - 1000	15	36
1001 - 1500	5	12
1510 - 2000	2	5
2001 - 2500	3	6
2501 - 3000	2	5
3001 - 3500	0	0
more than 3500	2	5

Possible Causes and Problems Associated with the Outbreak

A primary objective of this survey was to identify problems in combating a screwworm outbreak, to pinpoint factors that may assist in controlling future outbreaks and to identify possible causes of the outbreak. Commission employees combating the outbreak were surveyed, on site, to gain insight into these concerns.

Commission employees identified "poor weather conditions, i.e., rain" as the main problem incurred in combating the reinfestation, Table 5. Also, frequently mentioned, 24 percent, was that ranchers had become overconfident since they had not experienced a screwworm infestation for several years or that they had forgotten the seriousness of the pest. Some livestock producers had never seen a screwworm infestation and did not know how to treat one. Thirty-three percent of the responses were "no problems incurred" indicating the cooperation the inspectors received from the livestock producers.

Table 5. Major Problems Incurred by Commission Employees During Reinfestation.

	Freq.	%
No problems incurred	15	33
Ranchers were overconfident or had forgotten about screwworm	11	24
Lack of publicity about the screwworm problem	2	4
Poor weather conditions (rain)	16	35
Poor condition of the vehicles	2	4

The Commission employees were also asked what, in their opinion, was responsible for the cause of the outbreak. The response to this question is presented in Table 6. Seventy-six percent of the respondents answered that cattle movement (coming from infested areas in southern Mexico into erdicated areas) was the major cause of this outbreak. No comment was responded by 14 percent. Five percent reported that ranchers lack of animal care and failure to treat wounds was the cause. Still another 5 percent stated sabotage or that the outbreak was done purposefully. Many of the Commission employees were hesitant to answer this question and many agreed that this was not a "natural" outbreak of screwworm. There was reluctance, however, to write and report this opinion. The short duration of screwworm development definitely supports the conclusion that the outbreak did not follow established patterns of insect population development.

Table 6. Commission Employees' Opinions of the Cause of the 1985 Outbreak.

	Freq.	%
Cattle movement (coming from infested areas)	32	76
Ranchers lack of care (such as not treating wounds)	2	5
Program Sabotage or done on purpose	2	5
No comment	6	14

Table 7 lists additional observations of the Commission employees based on the eradication effort against the reinfestation and work with area livestock producers. Twenty-five percent of the respondents had no comments, but another 25 percent said that there was a need to continue informing ranchers of possible infestations and to continue treating wounds for screwworms. An additional comment mentioned by the respondents, 20 percent, was the need for more or improved care in movement of animals from infested areas to eradicated areas.

Table 7. Summary of Additional Observations by Commission Employees in Controlling Future Outbreaks.

	Freq.	%
No comment	10	25
Needed to receive good cooperation from ranchers	4	10
Need for more or improved care in movement of animals from infested to noninfested areas	8	20
Need to continue informing ranchers of possible reinfestations and to continue treating wounds	10	25
More diffusion of screwworm information is needed.	4	10
Others	4	10

Increased Producer Cost

Before estimating the annual per animal cost of controlling and treating screwworm infestations, it was necessary to identify the species of animal infested during the outbreak. Mother nature did not appear to have provided any immunization to screwworms during their eradication. According to the Commission employees, infestations were identified in cattle, hogs, sheep and goats. Cattle were most prevalent in the outbreak area and received the brunt of infestations, 76 percent, Table 8. Infestation in pigs were next most frequent, 14 percent, followed by sheep, 6 percent, and goats, 4 percent.

Table 8. Type of Livestock Infested by Screwworm During Outbreak.

	Freq.	%
Cattle	37	76
Pigs	7	14
Sheep	3	6
Goats	2	4

Ranchers' increased cost per animal if screwworms were not re-eradicated is presented in Table 9. The highest average response in increased cost was for cows with $8.23 per animal, with the highest response at $15.15 per animal and the lowest at $0.91 per animal. Calves were second with $7.84 for the average response per calf, $15.15 for highest response and $0.76 for the lowest response. Other estimates for horses, mules, pigs, sheep and goats are also listed in Table 9.

Table 9. Estimated Livestock Producer Annual Cost Per Animal to Control Screwworm Infestations.

	(Dollars)*		
	Average Response	Highest Response	Lowest Response
Cow	8.23	15.15	.91
Calf	7.84	15.15	.76
Horse	5.03	15.15	.61
Mule	4.98	15.15	.61
Pig	2.55	7.56	.30
Sheep	2.60	6.06	.45
Goat	2.63	6.06	.61

* Exchange rate on August 15, 1985: 330 pesos to $1 U.S.

Producer Attitude and Management Changes

The Commission employers, as discussed earlier, expressed a need for a good cooperative attitude among livestock producers in effectively controlling screwworm outbreaks. Evidently, such cooperation was prevalent as 100 percent of the surveyed Commission employees indicated they had good cooperation from livestock producers, Table 10.

Table 10. Producer Cooperation Rated by Commission Employees.

Good Cooperation	Freq.	%
No	0	0
Yes	42	100

Sixty-four percent of the respondents stated that producers had changed their perceptions and attitudes about screwworm since eradication (Table 11). Of those who stated that producers had changed their perceptions and attitudes, 78 percent said that the producers had become confident in the eradication program and were not treating wounds. Additionally, 11 percent more of the livestock producers thought the screwworm had already been completely eliminated.

Table 11. Producer Changes in Attitude Regarding Screwworm Since the Outbreak as Reported by Commission Employees.

Attitude Changed?	Freq.	%
No	15	36
Yes	27	64
If yes, what changes occurred?		
	Freq.	%
Producers have become confident (no continual wound treatment)	21	18
Ranchers thought screwworm had already been erdicated	3	11
Other (various comments that didn't make sense)	3	11

In contrast, Table 12 illustrates that 74 percent of the respondents stated that due to the recent outbreak, the producers' attitudes and perceptions changed again. Of this, 55 percent indicated that producers got alarmed with this reinfestation and worried about losing time and money. Another 10 percent were worried that additional reinfestations will occur. Twenty-six percent of the livestock producers indicated they increased the vigilance of cattle treatment.

Table 12. Producer Changes in Perceptions and Attitudes as Observed by Commission Employees.

Attitude Changed?	Freq.	%
No	11	26
Yes	31	74

If yes, what changes occurred?	Freq.	%
Producers got alarmed with the reinfestation and worried about losing time and money.	17	55
Producers increased vigilance of cattle treatment.	8	26
Producers are now worried about reinfestation can occur.	3	10
Producers worried about where infestation came from.	2	6
Producers worried about when to castrate their animals.	1	3

As far as changing management practices since eradication that might make management of screwworm outbreak more difficult with reinfestation, 64 percent of the responding Commission employees said no changes had occurred, Table 13. Of those that did respond "yes," 36 percent said the major change noted was that producers had stopped treating wounds or inspecting for worms, 63 percent.

Table 13. Producer Management Practices Changed Since Eradication That Would Make Reinfestation More Difficult to Control as Observed by Commission Employees.

Management Practices Changed?	Freq.	%
No	27	64
Yes	15	36
If yes, please identify the changes?		
	Freq.	%
Changed time of castration, branding and calving.	6	37
Stopped treating wounds or inspecting for worms.	10	63

The other changed managment practices identified as hampering control of screwworm outbreaks were changed times of castration, branding and calving.

CHAPTER IV

LIVESTOCK PRODUCER RESPONSE

Of the total 92 ranchers reporting screwworm infested animals during the 1985 outbreak, 43 or 47 percent were surveyed to identify: (1) location and time of reinfestation; (2) changes in producers' preventive practices since eradication; (3) producers' cost increase with reinfestation; and (4) general problems and attitudes associated with the outbreak of screwworms. Of the 140 confirmed screwworm cases from June 25, 1985 through August 15, 1985, 57 or 41 percent were accounted for in the survey.

Location and Time of Reinfestation

The locations where screwworm reinfestation occurred are listed in Table 14. Of the 43 producers surveyed, 58 percent were in the state of Tamaulipas and 42 percent were in the state of San Luis Potosi (SLP). The screwworm outbreak occurred in six municipios (counties in Mexico) with Cuidad Valles in SLP having 42 percent of the cases surveyed. Next was Gonzales with 23 percent. Antiguo Morelos with 21 percent, Aldama with 10 percent and Soto La Marina and Xicotencal with 2 percent each. The case surveyed at Soto La Marina was the closest the outbreak came to Texas. This area is approximately 150 miles from the Texas/Mexican border.

Table 14. Locations of Producers Surveyed Following the Screwworm Outbreak in Mexico During 1985.

	Freq.	%
STATE		
Tamaulipas	25	58
San Luis Potosi	18	42
	43	100
MUNICIPIO		
Gonzales	10	23
Aldama	4	10
Xicotencal	1	2
Antiguo Morelos	9	21
Soto La Marina	1	2
Cuidad Valles	18	42
	43	100

The date of the first confirmed case in this outbreak for the producers surveyed is presented in Table 15. The first confirmed case occurred on June 25 and the last was on July 31 of the producers surveyed. Actually, the last confirmed case occurred August 15. The majority of the confirmed cases occurred on June 29 and June 30 with seven screwworm cases each.

Table 15. Date of First Confirmed Case in the 1985 Outbreak.

Date	Freq.	Date	Freq.	Date	Freq.
June 25	1	July 1	2	July 6	1
June 27	4	July 2	3	July 7	2
June 28	2	July 3	2	July 10	1
June 29	7	July 4	1	July 22	1
June 30	7	July 5	1	July 31	1

Note: 7 questionnaires had no date.

Information of other confirmed cases in this outbreak are also given in Table 16. Here 79 percent of the producers reported having no other confirmed cases while 21 percent reported that they did have reoccurrance of the pest. Of those that did have more than one case of screwworm, on the average it was reported by most producers two days after the initial outbreak. It should be noted that most of the cases were found by the well-trained field inspectors when inspecting the producers' animals.

Table 16. Producers Report of Multiple Screwworm Cases.

Multiple Cases?	Freq.	%
No	34	79
Yes	9	21

How many days later on the average did you report those cases?

Days Later	Freq.
1	2
2	4
4	1
5	1
7	1

In Table 17 the producers indicated when the last screwworm case occurred prior to the 1985 outbreak. Thirteen of the producers surveyed responded their livestock had never been infested with screwworm (these were mostly new ranchers) and 6 stated that they could not remember. Also, 1975 and 1981 with 6 and 7 cases each respectively were the years most frequently cited by the producers as to screwworm infestations prior to this outbreak.

Table 17. Producers Report of Last Screwworm Case Prior to the Summer Outbreak of 1985.

Year	Freq.	Year	Freq.
No other time*	13	1978	3
Don't know	6	1979	1
1970	1	1980	2
1975	6	1981	7
1976	2	1983	1
1977	1		

* These were mostly new ranchers.

The majority of infested animals, as illustrated in Table 18, were calves with instance of 41 cases or 72 percent of the surveyed cases. The calves average weight loss was 4.8 kilograms. Cows were the next most infested group with 5 cases and an average loss of 10 kilograms per animal. All species of farm animals, with the exception of horses, were infested by the screwworm outbreak.

Table 18. Type and Number of Animals Reported to be Infested.

Animal	Were Infested	Died	Ave. Wt. Loss (kg)
Calves	41	0	4.8
Cows	5	0	10.0
Bulls	1	0	0.0
Stockers	3	0	10.0
Boars	2	0	0.0
Sows	2	0	2.5
Pigs	1	0	0.0
Lambs	1	0	0.0
Dogs	1	0	0.0
	57	0	

Changes in Producers Preventive Practices

Mexican livestock producers indicated they had become more lax in their preventive practices of the screwworm. Table 19 presents information relevant to producers treating animals to prevent screwworms after eradication and up to the time of this outbreak. It is interesting that 51 percent of the producers surveyed were not treating animals to prevent screwworm after eradication and up to the time of this outbreak. The majority of the producers who said no treatments were used, stated that 1976 was the last year they practiced preventive treatment for screwworms. Of those producers using preventive practices, 55 percent stated that they treated wounded animals and 21 percent confined animals to prevent screwworm attacks.

Mexican livestock producers that experienced confirmed screwworm infestations indicated they would step up their surveilance practices and treatment of screwworms and continue these practices after the outbreak, Table 20. Of the 43 livestock producers surveyed, 41 or 95 percent said they would continue preventive practices for screwworm attack. Of those continuing the practices, 60 percent planned to treat wounded animals on a regular basis, 14 percent would confine animals daily and 15 percent administered applications of insecticides.

Table 19. Management Practices as Reported by Producers to Prevent Screwworm After Eradication and Before Outbreak.

Treating Animals?	Freq.	%
No	22	51
Yes	19	44
Not applicable	2	5

If yes, what were your preventive practices?

	Freq.	%
Treated wounded animals	18	55
Confined animals	7	21
Change time of casteration, dehorning and calving	1	3
Application of insecticide	2	6
Bathing animals	3	9
Check animals closely	2	6

If no, when was the last year that you practiced preventive treatment for screwworm?

Year	Freq.
No Response	8
1970	1
1971	1
1975	1
1976	5
1977	1
1978	1
1980	1
1981	2

Table 20. Producers Intentions to Continue Animal Treatment Practices.

Plan to Continue?	Freq.	%
No	2	5
Yes	41	95

If yes, what will those preventive practices be?

	Freq.	%
Treat wounded animals	35	60
Confine animals	8	14
Change time of castration, dehorning and calving	2	3
Application of insecticides	0	0
Inspecting animals	9	15
Bathing animals	2	3
Reporting suspected cases	3	5

Information pertaining to changes in management practices since eradication that made reinfestation of screwworms particularly difficult to manage is presented in Table 21. Here, 72 percent of the respondents said that they had not changed their management practices. Of the 21 percent who did say "yes," six responded that they were treating less wounds. Two producers changed the time of castration, dehorning and calving.

Table 21. Producers Management Changes Since Screwworm Eradication That Made Reinfestation Difficult to Manage.

Management Changes?	Freq.	%
No	31	72
Yes	9	21
Not applicable	3	7
	Freq.	
Change time of castration, dehorning and calving	2	
Treat less wounds	6	
Didn't confine animals at birth or castation	1	

Table 22 data indicates that 26 percent of the producers had changed their method of treatment for screwworm since eradication. These producers said that they changed the type of medicine being used to treat animals for screwworm.

Table 22. Producers Treatment Procedures for Screwworm During Reinfestation Relative to Those Before Eradication.

Same procedures?	Freq.	%
No	11	26
Yes	19	44
Not applicable	13	30
If no, what was different?		
	Freq.	
Changed type of medicine used	11	

Producer Cost for Treating Screwworm Infestations

An attempt was made to estimate the producers additional costs resulting from the screwworm outbreak. Some estimations were obtained, but the accuracy is questionable since the Mexican livestock producers have become so dependent on the Commission for medicine, surveillance and control.

Estimated cost to eradicate screwworms during this outbreak for certain types of expeditures is presented in Table 23. Labor costs were the highest item with an average cost of $53.03 per animal. This estimate, however, was from only two producers, the others claimed no extra labor. The next highest estimated cost, $6.57, was for travel expenses. Again, care should be taken in interpreting these amounts since the data is very limited.

Table 23. Estimated Producer Cost to Combat Screwworm During the 1985 Outbreak.

	(Dollars)*			
	Labor	Medicine	Travel	Telephone
	30.30	1.02	2.12	2.12
	75.76	15.15	15.15	6.06
		1.06	2.42	
		1.21	2.00	
		3.03	.73	
		.83	2.42	
		7.57	.91	
		1.15	.18	
		6.06	36.36	
			1.67	
			1.21	
			.30	
			24.24	
			.30	
			.61	
Total	106.06	37.08	98.62	8.18
Average**	53.03	4.12	6.57	4.09

* Exchange rate on August, 1985 330 pesos to $1 U.S.

** The average is computed by summing up the columns and dividing by the number of observations in that column

Table 24 shows that 95 percent of the producers needed no extra labor to eradicate screwworms during this outbreak. This can be expected since the Commission Field Inspectors were doing most of the field work (i.e. inspecting animals, treating wounds, sending in samples and passing out medicine and information) to control the outbreak.

Table 24. Producers Reported Use of Extra Labor to Combat Reinfestation of Screwworm.

Extra labor?	Freq.	%
No	41	95
Yes	2	5

If yes, how many hours were for:

Inspection (hrs.)	Treatment (hrs.)
12	1
24	24

Based on the 1985 reinfestation, the producers estimated their increase in total herd cost if the screwworm were not once again eradicated, Table 25. Thirty-four percent of the 43 producers interviewed stated their cost increase to be in the range between 0 and $300. Again, care must be taken in interpreting or extrapolating these costs since actual cost estimates came from such a small proportion of the respondents.

Table 25. Estimated Total Herd Cost Increase if the Screwworm Eradication Was Not Achieved.

Dollars*	Frequency
0 - 300**	34
301 - 600	2
601 - 900	0
901 - 1,200	0
1,201 - 1,500	1
greater than 1,500	3

* Exchange rate on August 15, 1985: 330 peso to $1 U.S.
** 20 of the respondents answered zero.

Problems and Attitudes From Reinfestation

Most Mexican livestock producers in the outbreak area had not seen nor treated a case of screwworms for 8 to 9 years. Normally, it would be thought a reoccurance of an old enemy would cause new problems. Because of the efficiency of a well trained field crew available to combat the outbreak, no particular problems were detected. Eighty-four percent of the producers surveyed stated that they had no problem with reinfestation, Table 26. Seven percent of them devoted more time to inspection and treating wounds. These data do not represent a normal ranch operation because Commission personnel were doing most of the screwworm treatment and animal inspection. An additional nine percent of the producers stated that they felt pressured and alarmed about the reappearance of screwworms.

Table 26. Greatest Problems Identified by Producers From the Reinfestation of Screwworms.

	Freq.	%
No problem	36	84
Devoted more time to inspection and treating wounds	3	7
Uneasy, felt pressured and alarmed	4	9

Additional comments by the producers relative to screwworms are presented in Table 27. Data presented indicated 41 percent of the producers believed that the Screwworm Commission worked well to eliminate the outbreak. Only 25 percent of the producers said they were alarmed or uneasy about the outbreak and seven percent were alarmed or concerned about future screwworm outbreaks occurring in their area.

Table 27. Producers' General Comments Regarding Screwworm Outbreak.

	Freq.	%
Screwworm Commission worked well	23	41
Got alarmed about future outbreaks	4	7
Felt no more outbreaks will occur	4	7
Vigilance needs to be continued	4	7
Was alarmed or uneasy about outbreak	14	25
No response	7	13

Table 28 provides information pertaining to what the producers thought was the cause of this screwworm outbreak. Thirty-six percent of the producers did not know the cause. Thirty-five percent of the producers thought that the outbreak was caused by animals being brought from other parts of the country. Rainy weather was cited as the probable cause by 19 percent and 5 percent said that rancher's lack of vigilance was the cause.

Table 28. Producers Reported Reason for Screwworm Reinfestation.

	Freq.	%
Animals brought from other parts of the country	15	35
Carelessness of neighboring ranchers	2	5
Rainy weather	8	19
Rancher's lack of vigilance	2	5
Don't know	16	36

CHAPTER V

SUMMARY AND IMPLICATIONS

The special study of the screwworm outbreak in 1985 provides insight into the effects of a reverse situation following eradication. Data were collected and analyzed from both Commission employees and livestock producers' perceptions of changed practices since eradication and costs related to the outbreak. These results are summarized below. While the data collected adequately reflects the responses of these groups, caution should be taken in generalizing these results since producers reactions and costs were likely reduced by the effective control procedures of the Commission personnel. The following are the major points encountered:

- The primary job functions in eradicating the screwworm from the reinfested area were providing information to ranchers about the screwworm problem, inspecting animals and treating wounded animals.
- Producers expressed some concern with the outbreak because of potential loss of time and money.
- The screwworm reinfestation occurred mostly in cattle, specifically calves.
- Field inspectors and producers suspected cattle movement to be the primary cause of this outbreak.
- Field inspectors felt that producers had become overconfident of not having the screwworm present since its

eradication and as a result, had discontinued surveillance and treatment of screwworm infestations.

- Field inspectors felt that this outbreak also reduced the producers' confidence in the eradication program and increased their concern about losing time and money.
- Fifty-one percent of the producers surveyed were not treating animals to prevent screwworm attacks after eradication and up to the time of the outbreak.
- Because of this outbreak, 95 percent of the producers surveyed planned to use preventive practices to prevent screwworm attacks in the future.
- Major preventive practices producers indicated they would use to eradicate screwworms included treating and confining wounded animals
- A significant part of the cost of re-eradicating the screwworm from this area fell on the Mexican-American Screwworm Commission since the majority of the ranchers reported having no cost.

Implications

It was evident from responses from surveyed Commission employees and livestock producers, that Mexican ranchers no longer thought of the screwworm as a threat. Mexican ranchers had become lax in their surveillance and treatment of screwworms some, infact, thought the screwworm had been completely eliminated.

Most of the surveyed producers relied entirely on the Commission employees for control of the outbreak; down to the treatment of infested animals. Had a trained field crew of Commission personnel not been available to combat and control the outbreak, surely the screwworm would have again inhabited Texas.

APPENDIX A

FIELD INSPECTOR QUESTIONNAIRE

CONFIDENTIAL

SPECIAL ANALYSIS OF THE 1985 SCREWWORM OUTBREAK

FIELD INSPECTOR QUESTIONNAIRE

(1) Name____

(2) Number of years experience with the Commission?

________________(years)

(3) Title in the commission?__________________________

(4) Please state briefly your primary functions in working on the reinfestation problem.

( ) A: inspecting animals

( ) B: treating animals

( ) C: sending in samples

( ) D: giving information to farmers

( ) E: other______________________________(specify)

( ) E.1

( ) E.2

( ) E.3

(5) How many producers did you contact during this recent infestation?

________________________________(producers)

(6) Did you receive good producer cooperation?

(1) Yes

(2) No

If no, please explain________________________________

____

(7-A) Have producers in your area changed their perceptions and attitudes about screwworms since eradication?

(1) Yes

(2) No

If yes, please explain____

____

(7-B) Did the recent outbreak cause any change in those perceptions and attitudes?

(1) Yes

(2) No

If yes, what changes occurred?________________________________

____

____

____

(8) Have any management practices changed since eradication that might make management of the screwworm more difficult with reinfestation?

(1) Yes

(2) No

If yes, please identify and discuss the changes________________

____

____

____

____

(9) What were the major problems you incurred with new reinfestation?

____

____

____

(10) In which type of animals was reinfestation most frequent?

( ) A. Cattle

( ) B. Sheep

( ) C. Goats

( ) D. Pigs

( ) E. Horses

( ) F. Poultry

( ) G. Work/Draft

(11) Based on the experience of this reinfestation, what would be the ranchers increased cost per animal if the screwworm were not re-eradicated?

Calf________________(pesos)

Cow________________(pesos)

Sheep________________(pesos)

Goat________________(pesos)

Horse________________(pesos)

Mule________________(pesos)

Pig________________(pesos)

(12) Please provide any further observations you have based on eradication effort, reinfestation, and work with producers?

____

____

____

____

(13) In your opinion, what caused this recent outbreak?

____

____

____

APPENDIX B

PRODUCER QUESTIONNAIRE

CONFIDENTIAL

SPECIAL ANALYSIS OF THE 1985 SCREWWORM OUTBREAK

PRODUCER QUESTIONNAIRE

(1) Producer Name______________________________________

(2) State____

(3) Municipio where infestation occurred_______________

____

(4) Date of your first confirmed case in this outbreak,__________

____________________, 1985.

(5-A) Did you report any other cases in this outbreak?
(Circle one)

1. Yes

2. No

(5-B) How many days later on the average did you report those cases?

______________________(days)

(6) How many animals do you own?

A. Cows (Cow/Calf) ________________

B. Cows (Stocker) ________________

C. Cows (Feedlot) ________________

D. Cows (Dairy) ________________

E. Pigs ________________

F. Sheep ________________

G. Goats ________________

H. Horses ________________

I. Poultry ________________

J. Work/Draft ________________

(7) How many animals in this outbreak:

	were infested	died	lost weight	how much weight was lost
Cow/Calf				
(A) Cows	______	(A1) ______	(A2) ______	(A3) ______
(B) Calves	______	(B1) ______	(B2) ______	(B3) ______
(C) Bulls	______	(C1) ______	(C2) ______	(C3) ______
Stocker				
(D) Cows	______	(D1) ______	(D2) ______	(D3) ______
Feedlot				
(E) Feeders	______	(E1) ______	(E2) ______	(E3) ______
Dairy				
(F) Cows	______	(F1) ______	(F2) ______	(F3) ______
(G) Calves	______	(G1) ______	(G2) ______	(G3) ______
(H) Others	______	(H1) ______	(H2) ______	(H3) ______
Pigs				
(I) Boars	______	(I1) ______	(I2) ______	(I3) ______
(J) Sows	______	(J1) ______	(J2) ______	(J3) ______
(K) Pigs	______	(K1) ______	(K2) ______	(K3) ______
Sheep				
(L) Ewes	______	(L1) ______	(L2) ______	(L3) ______
(M) Rams	______	(M1) ______	(M2) ______	(M3) ______
(N) Lambs	______	(N1) ______	(N2) ______	(N3) ______

Goats

(O) Angora__________(O1)_______(O2)________(O3)_____________

(P) Milk____________(P1)_______(P2)________(P3)_____________

(Q) Meat____________(Q1)_______(Q2)________(Q3)_____________

Horses

(R) Mares___________(R1)_______(R2)________(R3)_____________

(S) Ponies__________(S1)_______(S2)________(S3)_____________

(T) Stallions_______(T1)________(T2)_______(T3)_____________

(U) Geldings________(U1)________(U2)_______(U3)_____________

Poultry

(V) Birds___________(V1)________(V2)_______(V3)_____________

Work/Draft Animals

(W) Horses_________(W1)_________(W2)_______(W3)_____________

(X) Burros_________(X1)_________(X2)_______(X3)_____________

(Y) Oxen___________(Y1)_________(Y2)_______(Y3)_____________

(Z) Mules__________(Z1)_________(Z2)_______(Z3)_____________

(8) When was your last screwworm case prior to this outbreak?

19__________(year)

(9) Were you treating animals to prevent screwworm after eradication up to the time of this outbreak?

(1) Yes

(2) No

If yes, what were your preventive practices?

( ) (A) treat wounded animals

( ) (B) confine animals

( ) (C) change time of castration, dehorning and calving

( ) (D) application of insecticides

( ) (E) Other

Specify:

E.1 ____________________

E.2 ____________________

E.3 ____________________

(F) If no, when was the last year that you practiced preventive treatment for screwworm?

19__________(year)

(10) For the year mentioned in 9F, what practices did you use?

( ) (A) treat wounded animals

( ) (B) confine animals

( ) (C) change time of dehorning, castration and calving

( ) (D) application of insecticides

( ) (E) Other____________________

Specify:

E.1____________________

E.2____________________

E.3____________________

(11) Do you plan to continue practices which will prevent screwworm attacks?

(1) Yes

(2) No

If yes, what will those preventive practices be? (List)

( ) (A) treat wounded animals

( ) (B) confine animals

( ) (C) change time of casteration, dehorning and calving

( ) (D) application of insecticides

( ) (D) other

Specify:

E.1 ____

E.2 ____

E.3 ____

(12) What was your estimated cost to combat screwworms during this outbreak for the following items:

(A) Labor ____________________ (pesos)

(B) Medicines ________________ (pesos)

(C) Travel ___________________ (pesos)

(D) Telephone ________________ (pesos)

(E) Other ____________________ (pesos)

Specify:

E.1 _________________________ (pesos)

E.2 _________________________ (pesos)

E.3 _________________________ (pesos)

(13) Did you use extra labor to combat screwworm during this outbreak?

(1) Yes

(2) No

If yes, how many hours were for:

(A) inspection __________________ hrs.

(B) treatment ___________________ hrs.

(14) Please list the greatest problem(s) to you from this infestation.

(A)____

(B)____

(C)____

(15) Are there changes in management since eradication that made reinfestation of screwworm particularly difficult to manage?

(1) Yes

(2) No

If yes, explain__________________________________

(16) Based on this reinfestation, please estimate how much your total herd cost would increase if the screwworm were not once again eradicated?

(17) Was your treatment of screwworm during reinfestation the same as before eradication?

Specify:

(A) ______________________________________

(B) ______________________________________

(C) ______________________________________

(D) ______________________________________

(18) Please provide any other comments that you may have relative to the screworm.