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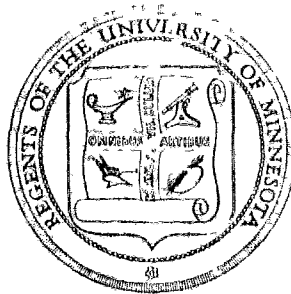
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POTENTIAL ECONOMIC CONSEQUENCES OF AFRICAN SWINE FEVER AND ITS CONTROL IN THE UNITED STATES

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AND ITS CONTROL IN THE UNITED STATES

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POTENTIAL ECONOMIC CONSEQUENCES OF AFRICAN SWINE FEVER
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E. H. McCauley and W. B. Sundquist

The possibility that African Swine Fever (ASF)^{1/} could be introduced to the U.S. is approaching reality due to the recent outbreaks in Brazil and, more threateningly, in the Dominican Republic. The disease became widespread in these countries within a period of only a few months. Simply by its nature of high case fatality (50 to 95 percent) and the present inability to develop a vaccine against it, ASF is truly one of the most economically dangerous of animal diseases. Given the threat close to us, we are now in the position of having to take some action. By having an understanding of the potential impact of ASF for U.S. producers and consumers, decision makers can be assisted in allocating funds and taking other actions within a framework of predicted economic consequences.

This brief report presents estimates of the economic impact of ASF in the U.S. under three conditions (scenarios) of control strategies which encompass several possible situations following a hypothetical introduction of ASF:

Scenario 1: A small outbreak or series of outbreaks which are controlled and the disease successfully eradicated in a short time by immediate slaughter and sanitary disposition of pigs on infected and exposed premises and by stringent quarantine of a relatively small area followed by thorough on-going surveillance.

Scenario 2: Widespread outbreaks which result in the quarantine of a larger area (one state) and for a longer time (three years), while an eradication program is carried on.

* The study reported here was conducted with the financial and technical support of APHIS, USDA. The authors alone, however, are responsible for the content of this report.

^{1/}African Swine Fever (ASF) is an acute disease of swine. Certain wild pig species are inapparent carriers and the disease may be transmitted by certain ticks. The virus causes signs very similar to Hog Cholera and is the only strain of a class that infects mammals. The other members of this class infect insects and reptiles. ASF was restricted to Africa until recently when it has spread to Italy, Spain, Portugal, France, Cuba, Brazil, Dominican Republic and Haiti. In France and Italy, ASF has been eradicated. The signs of the disease: acute fever, hemorrhage in all tissues and generally death in a few days, result from the virus damaging the integrity of the vasculature. There is no treatment or preventive vaccination for ASF.

One of the practical problems with the disease is that Hog Cholera and ASF are easily confused in the early stages of an outbreak. The consequences of ASF are so much more grave, so that if the resolution of this confusion is not achieved and proper control measures initiated promptly, a disastrous epidemic could result.

Scenario 3: The situation in which the U.S. has to "live with" endemic ASF, at least for several years, under conditions of a program to reduce its incidence such as is done in Spain now, or as was done in the U.S. and Great Britain, in working toward the eradication of Hog Cholera.

SCENARIO 1: THE SUCCESSFULLY ERADICATED SMALL OUTBREAK

Outbreaks of ASF have been controlled and the disease eradicated by immediate slaughter and quarantine in France (1961, 1962, 1963 and 1974), in Italy (1967), and in Cuba (1971). As for these countries, this method of control is clearly the first option for the U.S. and not until it becomes evident that such an approach is infeasible would it be abandoned.

In light of the population of Dominicans in New York (some 400 thousand) and Miami (some 200 thousand), it seems reasonable to postulate that ASF might first be introduced near these cities, possibly through some pork product being brought in from the Dominican Republic. The seriously high degree of this possibility can be appreciated by considering the travel of people between the U.S. and the Dominican Republic and other countries of Latin America. Table 1 shows data for 1976 as reported by the U.S. Immigration Services for all ports of entry.

Table 1

TRAVEL OF PEOPLE BETWEEN THE U.S., THE DOMINICAN REPUBLIC
AND OTHER COUNTRIES IN LATIN AMERICA IN 1976

| Type of Travel | Origin of Travel | | | |
|---------------------------------|--------------------|---------------------|--------|---------------|
| | Dominican Republic | Caribbean Countries | Brazil | South America |
| Temporary Visitors to the U.S. | 60,688 | 329,892 | 99,784 | 410,218 |
| Immigrants Admitted to the U.S. | 12,526 | 67,393 | 1,038 | 22,699 |

In addition to this type of travel, data from the U.S. Customs shows that a total of 415,922 people returned to U.S. airports from the Dominican Republic in 1977.

In 1976, the U.S. successfully eradicated Hog Cholera from outbreaks in New Jersey, Massachusetts and Rhode Island. Because of the potential similarity of location circumstances and the similarity of Hog Cholera disease with ASF, this experience probably provides the best basis for estimating the economic impact

of the successfully eradicated small outbreak. In that program, the U.S. spent \$2,934 million to indemnify owners of sacrificed pigs and approximately \$2.2 million in other program costs. The program took about five months during which time 24,038 pigs were depopulated on 17 confirmed infected and 43 exposed premises.^{2/}

If we accept the hypothesis that an ASF outbreak would have similar technical dimensions as the Hog Cholera eradication campaign, then the program cost to the U.S. to eradicate it would be at least \$5.1 million and in all probability higher since the quarantine and surveillance procedures would have to be more stringent because we can expect countries which import our pork products to request us to be more thorough in the eradication of ASF than of Hog Cholera. The greater resistance of the ASF virus itself and the possibility that tick species capable of being reservoirs and vectors of the virus exist in North America as they do in Spain and East Africa are important additional reasons to expect control programs to be more stringent and costly than those against Hog Cholera. To account for this, we have arbitrarily doubled the program costs to \$4.4 million which results in an estimate of about \$7.3 million to successfully eradicate a small outbreak of ASF.

There would be some temporary upset to the business operations of the affected producers and even to some producers not directly affected by the disease. Consumer pork prices would probably not be affected in a major way. We would, however, likely lose all or most of our pork product export market temporarily. The heaviest impact on U.S. exports of pork and related products would occur if the disease became endemic (Scenario 3). And, we have provided an estimate of the magnitude of this potential impact in considering the endemic situation later in this report.

Other adverse economic effects, perhaps more significant than the loss of pork product exports, could result from restrictions on export sales of other agricultural products. Presently, countries which buy our grain require us to certify that we are free of Foot-and-Mouth Disease, Rinderpest and Contagious Pleuro Pneumonia. Also, states in the U.S. are supposed to have an affidavit on file that grain products come from areas that are free of a variety of other diseases such as Anthrax and Bluetongue. If ASF were to be introduced, we could expect that this restrictive mechanism would be tightened. It is difficult, however, to project the degree of restriction and the dimensions of its effect on export sales of U.S. agricultural products.

SCENARIO 2: ERADICATION BY QUARANTINE OF A LARGER AREA

For analysis pertaining to this situation, we have assumed that outbreaks are so numerous and widespread in a large area that an entire state has to be quarantined for three years. During the first year, 20 percent of the pigs are depopulated because they are on infected or exposed premises. This is reduced to five percent the second year and none the third year. Thus, the third year is a surveillance year needed to assure that eradication has been achieved.

^{2/}Young, S.H. and Walker, J.W., "Status of the State-Federal Hog Cholera Eradication Program." U.S. Animal Health Association Proceedings of the 80th Annual Meeting, 1976.

The State of Minnesota was selected as the geographical entity for this estimate. And, though the quarantine might more probably occur for an east coast state or states rather than for Minnesota, the seriousness of this size of an outbreak in economic terms is well exemplified by the Minnesota case. Table 2 shows the expenditure amounts estimated for quarantine, surveillance, depopulation and indemnity should ASF become widespread in Minnesota.

Certainly, there would be other adverse economic effects on producers and agri-business firms in Minnesota and even nationally. Some producers would shift production output to cash crops and other livestock. There would be indirect (secondary) losses to agri-business firms, for example, in the form of reduced feed sales and pork marketing, processing and retailing. In general, however, these effects would be transient. And, national consumer prices for pork products should not be greatly affected by this situation. Serious questions must be raised, however, as to the technical and political feasibility of containing one state under such an intense eradication program. As in all three scenarios which we have considered, there would be an adverse effect from loss of export markets.

Table 2

ESTIMATED DIRECT COSTS TO ERADICATE AFRICAN SWINE FEVER IN MINNESOTA
DEPOPULATION AND QUARANTINE OVER A THREE-YEAR PERIOD*

| <u>Item and Description</u> | <u>Cost</u> (million dollars) |
|--|----------------------------------|
| A. Quarantine - (personnel, vehicles, barriers, etc.) | \$ 7.542 |
| B. Depopulation - 20 percent in the first year, 5 percent in the second year, and 0 percent in the third year. 984 thousand pigs based on 1977 inventory. Estimates include cost to bury carcasses and disinfect premises. | 23.616 |
| C. Indemnity - Based on average market price (1977) of \$64 per head for pigs slaughtered | 62.926 |
| D. Surveillance - District, state and federal personnel for a three-year period in which time 25 percent of the pigs are serologically tested | 20.137 |
| E. Laboratory Diagnosis of Samples - 25 percent of pigs depopulated @ \$2.50 per sample | 5.992 |
| F. Diagnostic Service Cost of samples taken at slaughter plants ("market testing") if appropriate | 31.402 |
| Total Direct Costs | <u>\$151.615</u> |

*Calculated by Dr. John New from his study of costs to eradicate Foot-and-Mouth Disease by quarantining a seven-state area as part of the Study for Potential Economic Impact of Foot-and-Mouth Disease in the United States. Dr. New makes the following additional points in considering these estimates:

1. Depopulation costs include costs of diagnosis, premise quarantine, appraisal, carcass disposal, cleaning, disinfection and final inspection.
2. Indemnity figures include cost of payment to producers for animals destroyed, but not cost of destruction.
3. The indemnity figure is "commercial slaughter price" for all hogs slaughtered and does not include a price premium for breeding animals (including purebred hogs) for which there are no market price quotations. The per head indemnity figure is affected significantly by the high incidence of piglets and lower weight classes in the total hog population.
4. The 25 percent rate of serologic testing for surveillance is based on the intensity of such surveillance as carried out in the 1976 outbreaks of Hog Cholera in New England.

SCENARIO 3: ENDEMIC AFRICAN SWINE FEVER IN THE U.S.

Many aspects of the situation of endemic ASF which we have analyzed here can be likened to the historical situation when Hog Cholera was endemic in the U.S. The economic consequences of ASF are much more serious, however, because of the need for more intensive surveillance, diagnostic and quarantine programs. Also, the swine production industry now interacts much more intensively (than at the time of endemic Hog Cholera) with a broad agri-business sector and U.S. agricultural exports have increased several fold to their current level of over \$25 billion annually.

Assumptions:

The epidemiologic conditions leading to the endemic ASF situation would probably be that the disease would have become so rapidly widespread that eradication efforts would be overwhelmed. We have assumed that the initial year of the endemic period would be one in which high losses due to the disease itself would occur in the U.S. swine population. In the years following this initial year, we assume that a control program would be in effect aimed at reducing incidence of the disease and that at some point the incidence would be low enough to make the start of an eradication effort feasible.

Economic impacts for endemic ASF are assessed for two situations; one requires a five-year duration for control programs and the second requires 10 years. For both situations the initial year results in infection of 20 percent of the swine herds in the U.S. with a 50 percent average fatality. No indemnity program is in effect for this initial year. In years two and three a control program is in effect and losses are reduced to two percent of the swine population. These losses are mainly due to depopulation of infected and exposed herds and are indemnified. In years four and five (for both situations) 0.8 percent of the swine population is indemnified. In the case of the 10-year control program, this 0.8 percent indemnification rate continues through the 10th year. All losses from disease or indemnification (and destruction) are assumed to occur once during the year to any herd involved and apply equally to all age, weight and sex categories of swine.

In our judgement, there are potentially four major economic impacts deriving from endemic ASF. These are:

- (1) Production and (possibly) income losses to swine producers and related agri-business firms,
- (2) Direct program costs associated with surveillance, diagnosis, depopulation, disinfection, quarantine and indemnity programs,
- (3) Loss of export markets for pork and related products and
- (4) Losses to consumers in the form of (a) higher retail prices for pork and related products and (b) reduced consumer choice.

After the initial year of losses due to the disease, major producer losses are compensated for through indemnification payments and the economic losses of agri-business firms are not great with swine population losses of only two percent or less. Even during the first year, aggregate losses to producers in the form of annual death loss may be largely offset income-wise by the higher per unit prices resulting from reduced supplies of pork. Also, reduction in consumer choice (aside from that due to the impact of higher prices) is not substantial after the initial year. And, since supplies of some substitutes, particularly poultry, will be increased quickly in response to higher prices, even the consumer price impacts occur mainly in year one of the disease. As a result of the above considerations, we believe that the major economic impacts of endemic ASF are captured under the following three categories: direct control program costs, loss of export markets and higher retail prices to consumers.

Direct Program Costs:

Estimates of direct program costs are shown in Table 3.

Table 3

ESTIMATED DIRECT CONTROL PROGRAM COSTS OF 5-YEAR
AND 10-YEAR ENDEMIC AFRICAN SWINE FEVER SITUATIONS

| <u>Item and Description</u> | <u>Cost</u> (million dollars) | |
|--|----------------------------------|-----------------|
| | <u>5 Years</u> | <u>10 Years</u> |
| A. Surveillance, diagnosis, quarantine and depopulation ¹ | 78.6 | 196.6 |
| B. Indemnity costs ² | 211 | 362 |
| Total Direct Costs | 289.6 | 558.6 |

¹Based on doubling the costs of Hog Cholera eradication program

²Based on an estimated annual U.S. swine population of almost 58 million animals. The 5-year program involves indemnification of about 3.25 million head of swine and the 10-year program about 5.5 million head.

The cumulative value of total direct program costs is estimated to be \$289.6 million for the five-year program and \$558.6 million for the 10-year program.

Impact on Consumer Prices:

It is estimated that an initial year loss of 10 percent of the U.S. swine population would result in about a 12¢ per pound increase in the retail price of about 12,330 million pounds carcass weight of pork. This results in an expected increased retail cost to consumers for pork products of \$1.48 billion in that year. This estimate is based on the demand elasticities incorporated in an annual economic model of the U.S. livestock sector. In addition, retail prices of substitute products, particularly beef, are estimated to increase by an amount of about \$600 million in this initial year for a total increase in consumer prices of over \$2 billion. Because of the ability to increase production of substitute meat products, particularly poultry, increased consumer costs at retail would drop to about \$75 million per year in years two and three and would average only about \$10 million for the remaining years. The cumulative value of these increased retail prices for pork and substitute products totals to about \$2.25 billion for the five-year endemic situation and \$2.3 billion for the 10-year situation with most of the price increase in the first year of the endemic disease when death losses in swine are high. In the event that export markets for pork and related products were lost as a result of endemic ASF, some, but not all, of the supplies normally entering export markets would be diverted to the domestic retail market. This would effectively reduce prices in this market and shift a part of the losses from U.S. consumers to U.S. producers in the form of lower hog prices.

Impacts on Export Markets:

Export markets for U.S. pork and related products would be adversely affected to some extent by even a small outbreak of ASF in the U.S. We have estimated such losses, however, only for the endemic ASF scenario. On the assumption that we could export little, if any, pork should ASF become endemic in the U.S., the cumulative value of losses in exports of pork and related products is estimated to be more than \$1.5 billion for the five-year endemic ASF situation and more than \$3 billion for the 10-year situation. The biggest single loss item in exports is fresh and frozen pork for which annual exports are currently in the \$200 - \$250 million range. Pork livers and pork offals are also major export items running in the \$30 - \$40 million per year range and lard exports are slightly higher at \$35 - \$40 million. Processed pork products such as ham, bacon, cured pork, etc., are fairly minor export items.

In addition to the loss of exports for pork and related products should ASF become endemic in the U.S., some countries, particularly those with a domestic swine population of their own, are likely to place partial or complete embargoes on the imports of other agricultural products from the U.S. for fear that these products may serve as carriers of ASF to their swine populations. Though it is difficult to isolate and quantify the magnitude of such potential losses, U.S. agricultural exports, among which grains, soybeans, cotton and animal products predominate, currently total to about \$25 billion annually. With this large dollar volume they constitute a major factor in total U.S. exports and in the aggregate balance of trade for the U.S.

BENEFIT-COST APPRAISAL

It is clear that because of the large size of the U.S. swine production industry and the large volume of domestic consumption and export marketings of pork and related products, economic impacts of endemic ASF will quickly run into the billions of dollars. In fact, the impact of endemic ASF in terms of higher consumer prices alone is estimated at \$2.25 billion or more. In addition, a large (possibly a multi-billion dollar) loss of export markets would need to be absorbed by the U.S. economy. Other things equal, this major loss in exports to the U.S. would increase our trade deficit beyond its current level and thus, would further increase domestic inflationary pressures.

One procedure for evaluating the benefit-cost ratio for controlling ASF in the U.S. is to compare the Net Present Value (NPV) ratio of program benefits to program costs. This can be done by computing the Net Present Value of the long term impact of letting the disease become endemic and comparing this impact with the Net Present Value of the cost of individual control programs.^{3/}

In Scenario 1, the successfully eradicated small outbreak, total program costs (\$7.3 million) occur in the first year. If successful, this control program generates benefits with an estimated NPV of \$4.9 billion by avoiding the adverse effects of the 10-year endemic ASF situation (Scenario 3) along with its major program costs, consumer price impacts and losses of export markets. This generates an extremely high benefit-cost ratio (670).

In Scenario 2, the Net Present Value of program costs for a successfully managed one-state, three-year program total to \$144.4 million. Matched against the same value for the Net Present Value of benefits as for Scenario 1, the benefit-cost ratio is still very high (about 40).

The benefit-cost ratio for Scenario 3 (endemic ASF) is more difficult to calculate because major program costs occur simultaneously over an extended period in conjunction with the price impacts and export losses resulting from the disease. Even with these and other complications, however, one can be assured that a control program against endemic ASF would have a highly favorable benefit-cost ratio because program success, if achieved at the end of year 10, would match a total estimated NPV of losses from the disease of \$4,280 million against a total NPV of program costs of slightly over \$600 million. Thus, the economic returns to expenditures for control programs to eliminate ASF, should it become endemic, are of the magnitude of several hundred percent.

APHIS is presently engaged in efforts to keep ASF out of the United States. These activities include increased customs surveillance at ports of entry, increased awareness through information programs, a higher priority for ASF research in the U.S., and technical assistance to and monitoring of epidemiologic ASF situations in Caribbean and South American countries. In addition, certain

^{3/} Assumes an annual discount rate of 10 percent and assumes that the major consumer price impacts occur in the first year of the disease but that export losses continue throughout the 10-year period. These are rather simplified assumptions regarding a very complex phenomenon. But, they do provide a feasible framework for estimation of the general magnitude of the benefit-cost ratios for control programs.

international development agencies, particularly USAID, IDB, PAHO and UNDP/FAO are initiating support for ASF control efforts in ASF endemic countries. There is a need for more basic information on vector transmission of ASF virus and the immunologic aspects of the host-parasite relationship leading to the possible development of a vaccine or other ways of producing immunity to ASF. Research efforts in other countries, such as Spain and Kenya, where the disease is endemic and qualified scientists have been working with these problems, justify attention and support. All of the aforementioned efforts to prevent ASF from occurring in the United States are well directed and can be reasonably expected to yield high returns to investment.

APPENDIX A

E. H. McCauley

Notes on the Epidemiologic and Economic Aspects of African Swine Fever
Outbreaks in Spain, Brazil, Dominican Republic and CubaSPAIN

Spain has been carrying out a control program against African Swine Fever (ASF) since 1960. Conditions and financial resources and the high incidence of ASF in Portugal have not allowed an eradication effort to take place. Under the control program, the pigs on the outbreak premises or group of premises are slaughtered and disinfection and quarantine measures carried out. Certain dimensions of their situation are shown in the table below:^{1/}

| <u>Year</u> | <u>Pig Population (1000's)</u> | <u>Number of Cases (Outbreaks)</u> | <u>Pigs Slaughtered</u> | <u>Indemnity Paid (Pesetas)</u> | <u>Program^{2/} Cost (Pesetas)</u> |
|-------------|--|--|-----------------------------|---|--|
| 1974 | 8,308 | 233 | 176,000 | 417,500,000 | 25,516,256 |
| 1975 | 7,865 | 683 | 205,300 | 529,500,000 | 67,936,256 |
| 1976 | 8,838 | 1,115 | 150,000 | 317,500,000 | 42,396,256 |

In an interview with Drs. Prieto and Marcos, they estimated that it presently costs Spain about one billion pesetas per year^{3/} (\$14.3 million) to run a program in which some 350 thousand pigs have to be slaughtered annually from some 1200 outbreaks per year in a swine population of 10 million head. Further, they think that they could eradicate ASF from Spain (the major source of ASF spread in the world, they say) under a rigorous six months, selected-area depopulation effort at a cost of 10 billion pesetas (\$143 million). The major part of that would be for indemnification at a rate of 90 percent of market price rather than the 40 percent now paid which is causing producers "to hide" the disease. Costs of repopulation and indirect losses are probably not included in this estimate.

^{1/} Taken from memo of Dr. Reichard to Dr. Mouton, telegram from Ag Attache, Madrid, to Dr. Reichard and memo of Dr. Gray to Dr. Mulhern.

^{2/} Program costs are the sum of 120 pta./pig indemnified for diagnostic service; 2,718,000 pta./yr. for personnel salaries; 1,191,300 pta./yr. for per diem; 486,956 pta./yr. for vehicles.

^{3/} Exchange rate used - 70 pesetas = 1 dollar.

DOMINICAN REPUBLIC^{4/}

Information from the recent spread of ASF in the Dominican Republic is scarce. Apparently the disease was introduced in early 1978. It is presently unknown if ASF has occurred in Haiti, but this seems to be a likely possibility. By early September 1978, there had been 90 confirmed outbreaks in various locations and slaughter and quarantine measures are being carried out. The epidemiologic data associated with these outbreaks and the control effort are scarce and presently efforts are being made to collect such data. The problem is complicated by the inauguration of a new president who inherits a problem which the previous administration didn't deal with promptly. There was confusion in the minds of the new administration officials at various levels about what their policy should be regardless of the cost or source of funds. They allocated 10 million pesos^{5/} for indemnification and owners are paid with "bonos" (promissory instruments). Since then, they have prepared a plan calling for slaughter of pigs on infected and exposed premises and for depopulation of pigs in a five kilometer area surrounding such outbreaks. There is indication that financial and technical assistance will be provided by certain international development organizations.

One interesting aspect of the problem there is that many of the people are afraid to eat pork even though it is widely publicized that ASF does not infect humans. The market price has dropped some 20 to 50 percent in recent weeks, depending on location and class of pig. The previous price was 1.20 pesos/kg for a No. 1 market pig and about 1.00 pesos/kg for a lesser quality pig.

At this time the questions of "What to do?" "How much will it cost?" "How much is it worth?" and "Who's going to do it?" are paramount. On a preliminary basis, a brief framework of the economic consequences of three options was prepared. The following basic information was used in the estimates shown in table A-1.

1. Pig population - two million head. The census shows 1.4 million, but field personnel think it is higher mainly because of the number of pigs that are managed on a scavenging basis by the poorer farmers that were not counted accurately in the census. On the other hand, some people think it may be closer to one million head.
2. Level of indemnification - about 50 pesos per pig "across the board."
3. Eradication program costs - 10 million pesos.
4. Repopulation costs - 10 million pesos.
5. Incidence and case fatality of endemic ASF with no control program - 20 percent of all pigs per year infected with 50 percent case fatality.

^{4/}Based on findings during a visit to Dominican Republic by the author, August 11-18, 1978.

^{5/}The official exchange rate is one peso for one dollar.

6. Incidence and case fatality under a Spanish type of control program - 200 thousand pigs infected per year with 100 thousand case fatalities. This loss would be mainly in undetected outbreaks on premises of the poorer pig owners. Because of significant differences in basic infrastructure, such a program is estimated to be effective only for about half the pig population. For this estimation it is assumed that this half of the pig population is owned by small holders who have from one to 10 pigs. They may have one or two sows farrowing from three to 12 pigs per year or a few weaner pigs in their backyards. In this one million pig population held by some 400 thousand small holder families there could be outbreaks on 20 percent of the locations or in 200 thousand pigs per year with fatality of 100 thousand pigs.
7. Number of pigs slaughtered and indemnified under Spanish type of control program - 35 thousand head/year.

In the case of pigs held by commercial farmers (25 to 400 pigs per premises; total of 600 thousand pigs) and larger producers (400 to 17,000 pigs per premises; total of 400 thousand pigs), the pigs on outbreak and exposed premises would be slaughtered and the owner indemnified. If we take 1/10 of the 350 thousand figure estimated by Spaniards, then 35 thousand pigs would be slaughtered per year.

8. Cost of a control program similar to that in Spain - 2.9 million pesos per year. Roughly estimated as 1/5 (the relative pig population) of the \$14.3 million estimated by Spanish officials.

CUBA^{6/}

In 1971, outbreaks of ASF occurred in the province of Havana. The Cubans carried out a successful eradication campaign by way of an immediate and rigorous quarantine of Havana province and sacrifice of some 430 thousand pigs, followed by a period of surveillance and clean-up and the repopulation. Some of the data from the Cuban experience:

1. 20,351 pigs on premises infected by ASF were slaughtered and buried. Prior to this, 12,173 pigs on these premises died of ASF.
2. 205,652 pigs were sacrificed and eaten by their owners. The heads, viscera and bones were buried in many cases.
3. 29,923 pigs on state farms were sacrificed.
4. 177,670 pigs were indemnified and processed into canned and sterilized meat by the state.
5. Census figures showed 463,322 pigs in Havana province.

^{6/} These brief notes were taken from "Reporte Preliminar del Brote de Fiebre Procino Africano in Cuba" by the Instituto Nacional de Medicina Veterinaria, Habana. July 25, 1971.

BRAZIL^{7/}

ASF was found on a farm and then in the slums near Rio de Janeiro in May 1978. Evidence indicates that the virus was introduced from garbage from the airport being fed to pigs. Since that time, ASF has been "tentatively" confirmed in eight states of Brazil and it is generally conceded that ASF is out of control there and that it will be endemic for the foreseeable future. In certain areas where commercial producers predominate it is conceivable that a "disease-free zone" approach might be carried out.

^{7/}From Dr. Bob Page and the draft report of the FAO/PAHO Emergency Consultation on the Prevention and Control of African Swine Fever in Latin America. July 1978.

APPENDIX B

E. H. McCauley

Notes on the Epidemiologic and Economic Aspects of Hog Cholera
Control and Eradication in the United States and Great Britain

These notes were collected from various sources in the process of establishing bases for estimates of the economic consequences of African Swine Fever introduction to the U.S.

- A. From the estimate used in the PPB program prepared by various APHIS staff members for Hog Cholera in the U.S.
1. Prior to the start of the eradication program in 1960-1962, losses to producers are estimated at \$50 million per year for death loss and costs of vaccination (\$40 million/year).
 2. In 1962, there were 4,195 suspicious outbreaks. Of these, 70 percent are judged to be confirmed. It must be taken into account that unreported outbreaks occur due to limitations in reporting. It is estimated that two times the confirmed outbreaks represents a reasonable estimate of actual outbreak numbers.
 3. In infected herds a 75 percent mortality rate is estimated.
 4. In 1965, when most states were in Phase II of the eradication program there were 1,110 outbreaks. Phase II represents a maximum control effort.
 5. In 1887, 1896, 1913 and 1926, extensive outbreaks with greater than average losses occurred. The 1896 outbreak caused losses of 13 percent of the pigs in the U.S.
- B. From the USDA/ARS "Supplement to the History of Hog Cholera Research in the U.S." 1962.

Fourteen counties in 14 states were surveyed under conditions of no-program in 1912 and then under an experimental program of providing free Hog Cholera serum administered by Bureau of Animal Health veterinarians in 1913, 1914 and 1915.

| Year | Hogs Raised | Hogs Died from Hog Cholera | Percent Died |
|------|-------------|-------------------------------|--------------|
| 1912 | 856,910 | 152,236 | 17.7 |
| 1913 | 1,052,408 | 179,125 | 17.0 |
| 1914 | 1,121,229 | 59,863 | 5.3 |
| 1915 | 1,334,644 | 30,965 | 2.2 |

The results demonstrated the benefits of a concerted control program. However, it was concluded to be impractical to extend it to larger portions of even one state.

C. From "An Economic Evaluation of the Swine Fever Eradication Programme in Great Britain" by Peter R. Ellis, University of Reading.

1. It was concluded that the average mortality attributed to Swine Fever (Hog Cholera) among all pigs on premises during Hog Cholera outbreaks including those born or moved during the quarantine period, was 20.4 percent.
2. Between 1955 and 1962 about one percent of pig holding premises had confirmed outbreaks of Hog Cholera and Hog Cholera was confirmed on such holdings at an annual rate of 0.2 holdings per 1000 pigs in the total population.
3. From 1920 to the year 1947, the year when crystal violet vaccine was first permitted to be used, the confirmed Hog Cholera outbreaks occurred at an annual rate of 0.21 outbreaks to 1.38 per 1000 pigs in population. Information on the number of pigs affected by each outbreak was not available..
4. Beginning in 1951, better data on the number of pigs per holding became available. During the period of 1951 to 1962 (while vaccination was still being permitted), the annual rate of pigs on holdings with confirmed Hog Cholera outbreaks ranged from 1.48 to 6.34 pigs (in 1962) per 1000 pigs in total population.
5. Under the eradication program during the 1963 to 1966 period, the total number of confirmed cases (premises on which Hog Cholera had been confirmed) dwindled from 1,243 to 25 per year. No outbreak occurred after 1966 until one was confirmed in 1971 and none has occurred since then.
6. Based on the analysis used in this study, the eradication approach used during 1963-1966, compared to two less rigorous hypothesized programs, yielded a benefit-cost ratio of 4.03:1 and 2.62:1 for a projected period of 1963 through 1975.

APPENDIX C

E. H. McCauley

State and Federal Hog Cholera Eradication
Program and Indemnity Costs: 1962-1976¹

| Fiscal Year | Total Program Costs Only (Million Dollars) | Indemnity Paid in Addition to Program Costs (Million Dollars) |
|-------------------|--|--|
| 1962 | 1.156 | Nil |
| 1963 | 3.975 | 0.075 |
| 1964 | 4.708 | 0.056 |
| 1965 | 5.436 | 0.130 |
| 1966 | 6.320 | 0.122 |
| 1967 | 5.881 | 0.836 |
| 1968 | 6.082 | 1.764 |
| 1969 ² | 6.119 | 3.217 |
| 1970 ² | 8.023 | 6.392 |
| 1971 | 11.969 | 4.173 |
| 1972 | 11.431 | 1.146 |
| 1973 | 12.909 | 4.371 |
| 1974 | 8.964 | 0.156 |
| 1975 | 8.470 | 0 |
| 1976 | 6.631 | 0.479 |

¹ Data supplied by APHIS.

² Prior to 1970, there was considerable variation among states as to their status in Hog Cholera eradication. From 1970 to 1976, most states were in the same eradication phase. Therefore, the figures for this seven-year period, 1970 through 1976, are considered to represent the costs of a uniform national program against Hog Cholera. The annual average state and federal program costs (not including indemnity) for this period are \$9,830 million.

Program costs are expenditures for accomplishing the various activities of inspection, diagnostic services, quarantine, slaughter, surveillance, exposed animal traceback, carcass burial and garbage inspection. The specific amounts for each activity varied from year to year depending on the epidemiologic situations existing

at different times. To a degree, this variation is due to the number of outbreaks and pigs slaughtered and indemnified. However, as can be noted by the indemnity costs, many of these activities had to be carried out even though indemnification payments were low. This reflects the need to maintain epidemiologic surveillance in the final stages of an eradication program to assure that the large investment in previous years is protected, i.e., that the virus has been eradicated from the environment and that outbreaks don't start occurring again due to lack of vigilance. These activities are being continued.

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