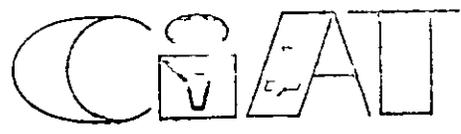


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REPORT

On The



LIVESTOCK RESEARCH AND TRAINING PROGRAM BIBLIOTECA

41593

Of

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL
(CIAT)

By The

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I FOREWORD

This is a report of the Animal Sciences Review Team invited by the Ford and Rockefeller Foundations to assist the staff of CIAT in the planning of its research and training programs in the animal sciences

This review was made during the period July 28 - August 25, 1968. Details of places visited and some examples of work observed are given in Appendix II. Briefly, seven days were spent in Colombia, three days in Ecuador, five days in Brazil, three days in Venezuela and a final six days in Bogota for discussions and preparation of this report.

The Review Team members wish to express their personal thanks and appreciation to all of those officials and staff members of institutions visited. These scientists and officials were most cooperative and helpful at all times and provided much useful information and data needed for this review. Special acknowledgement is given to Dr. Ned S. Raun, Dr. R. K. Waugh, Dr. J. H. Maner and Dr. E. D. Roberts of the Rockefeller Foundation staff and Dr. James Plaxico of the Ford Foundation in Colombia for their assistance throughout the study for their many courtesies and hospitality, and for invaluable information on the preliminary plans that have been developed for CIAT.

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II INTRODUCTION

The review was made on the assumption that the basic objective of the Animal Sciences Program of CIAT will be to contribute to increased efficiency of production of livestock and livestock products in the lowland tropical areas of the world, especially in Latin America. Further, it is assumed that major emphasis is to be given by CIAT to the animal sciences program as a part of the total inter-disciplinary approach necessary for modernization of agriculture in the underdeveloped areas of the world. This implies that allocation of resources, human and financial, and facilities will be sufficient over a period long enough for the program to have major impacts on livestock production. It is essential to recognize that with the exception of poultry and swine, results from animal research accrue more slowly than is true for soils and crops. Furthermore, animal research is more expensive than many other types of agricultural research. Large numbers of animals and adequate acreages of land are just as essential as sophisticated equipment and laboratories in providing the overall environment necessary for the acquisition of knowledge on livestock problems. Marked improvements in all aspects of feeding, breeding, management, health, and marketing of livestock must be accomplished if countries in the lowland tropics are to have efficient systems of animal production.

The role of livestock in the agricultural economy of the tropics and the importance of animal proteins in the diet have been amply reviewed in the original proposal for creating an International Institute for Agricultural Research and Training to Serve the Lowland Tropical Regions of the Americas by Dr. L. S. Hardin and Dr. L. M. Roberts. Further justification of animal research and training is given in the Proposed

Animal Science Program for CIAT prepared by the Animal Science staff of the Rockefeller Foundation, therefore, there is no need for further elaboration of the justification for livestock research in this report except as related to specific recommendations given later

III TERMS OF REFERENCE FOR REVIEW

Based on the Animal Sciences Group Review held in New York on April 23-24 1968 and from the briefings given in Bogota, the general terms of reference and objectives of the Review Team were understood to be as follows

- 1 An appraisal of present status and basic problems of the livestock industry in the lowland tropics of Latin America
- 2 Review of animal research in progress in the region, an assessment of the major gaps in knowledge and appraisal of the human and other resources available for animal research and training
- 3 Appraisal of proposals that have been developed for the Animal Sciences Program of CIAT with consideration of areas for special emphasis
- 4 Recommendations of priorities for research in animal sciences, including facilities and staff requirements, and possible locations and institutions where the work might best be carried out Also recommendations were to be given on training and extension activities

IV GENERAL OBSERVATIONS

Basic Problems of the Livestock Industry in Tropical South America

Based on observations made during the course of this review, including universities, schools of agronomy and veterinary medicine, research and livestock production stations, and commercial farms several basic problems stand out as they affect livestock production. They are summarized here under three categories:

1 Poor utilization and productivity of land resources

From discussions at the New York meeting and from its own enquiries the group fully endorses the views expressed in the CIAT Animal Sciences Proposals that the area possesses vast under-exploited tracts of land which constitute a problem and a challenge.

Many native pasture areas are characterized by low soil fertility, unfavorable seasonal rainfall distribution and marked deficiencies or excess of specific minerals involved in pasture growth. In some areas of the Llanos of Colombia and Venezuela more productive systems of utilization involving use of irrigation, fertilizers, or combined arable and pastoral farming already seem feasible. It is assumed that this limitation to livestock productivity will be the subject of a joint interdisciplinary study between the "Pasture and Forage" and "Animal Sciences" Programs of CIAT aimed at developing integrated "production systems" for these areas.

2 Low productivity of present livestock industry

One of the major factors affecting livestock production, especially beef and dairy cattle, is low reproductive efficiency. In only a few cases

did the Review Team find herds with calving efficiency above 50 percent, but some herds were observed that reported calving rates as high as 85-90 percent. The most common reasons given for low calving rates included poor nutrition especially lack of minerals, and diseases. Few mentioned general management, even though it probably is quite important. Obviously there is need for better information on the causes of low reproductive rates and every opportunity should be taken to obtain this knowledge. For example, 20 cows recently were disposed of from the Holstein herd at Palmira because of sterility. Careful studies of the reproductive tracts of these animals might have revealed worthwhile data on the causes of reproductive failures and for future research.

Other factors contributing to low animal output that were observed may be summarized under five categories especially for beef and dairy cattle.

- a) Low plane of nutrition with wide seasonal fluctuations in quality and quantity of feed supplies. Widespread seasonal drought is the cause of nutritional shortages in most of the area although in the Amazon basin annual floods cause serious feed shortages.
- b) Generally poor management and husbandry practices. In many areas there is a shortage of feed in the dry season combined with under utilization of feed during the growing season.
- c) Prevalence of diseases and parasites and lack of adequate programs in management of herds.
- d) Effects of high temperatures and high humidity on productive and reproductive performance. This is important for all species, but is most critical for dairy cattle in the hot, humid zones.

- e) Low productive performance of existing cattle breeds, with limited genetic capacity
- f) Lack of price incentives and adequate marketing systems for livestock and livestock products

These problems vary considerably in their intensity in the different areas visited. Most of them are more acute in the low altitudes and in vast areas of high temperature and humidity. They are summarized here to focus attention on some of the basic problems that should receive priority in research, graduate education, and extension.

3 Lack of trained people

a) Research level

One of the things that stood out clearly at each of the universities and research stations visited is a shortage of well-trained qualified people for high quality research in the various disciplines of animal science. Perhaps the best supply is in Colombia, but even there there are only three Colombian staff members in animal sciences in ICIV with training to the Ph D level and 20 at the M S level out of the total staff of 82 in the program. Almost without exception, the Review Team found the local staff at each station keenly interested and willing to do the job but most of them do not have the basic training necessary for good research. For example the Team was invited to participate in a seminar at Pichilingue Ecuador and the major question raised by many was 'What can CIAT do to help me get the advanced training I need to do good research?'

Because of the lack of training of the staff, many examples were observed of facilities not being utilized efficiently. In other words the facilities often are better than the formal training of the

people using them While the Team observed some praiseworthy examples of research in progress generally there was a lack of good livestock research at the stations visited

b) Technical level

There is also a lack of properly trained people at the technical and applied levels This was observed at several locations in the management of animal units

c) Coordination of effort

In some cases progress in animal research and livestock development suffers from a lack of team work and coordination of the activities of those who have the training and qualifications for high quality work For example, at one location at Maracay, Venezuela, there are four departments of animal husbandry, all located within a few blocks of each other These included separate departments in the Schools of Agronomy and Veterinary Medicine of the Central University, the Section of Zootechnia del Centro de Investigaciones Agronomicas and another animal husbandry group in the Centro de Investigaciones Veterinarias of the Ministry of Agriculture If the research and education functions of these four institutions could be coordinated in order to utilize most efficiently the human resources available, this could become an outstanding animal science center in Latin America and would provide an excellent location for cooperative research with CIAT Presently there is some cooperation between Dr Dieter Plasse of the Veterinary Faculty and the staff of the Centro de Investigaciones Agronomicas in the conduct of the best beef cattle breeding project that was observed on the entire trip

V RECOMMENDATIONS OF FIELDS OF RESEARCH AND PRIORITIES
IN THOSE FIELDS

The Review Team supports the general policy that CIAT is to give high priority to beef cattle in the Animal Sciences Program and with the proposal that complete production systems be emphasized through a multidisciplinary approach including nutrition, genetics, physiology, health and management. Since the staff and other resources will not be sufficient for a concerted effort on all livestock problems, recommendations are here presented of priorities for research for consideration by the CIAT staff as they develop specific plans for initiating their Animal Sciences Program.

A Beef Cattle Program

In general the Review Team believes that emphasis within the Beef Cattle Program should be on the exploitation of existing forage-breeding, and pasture technology, improvement in animal disease control and management and the development of more productive cattle breeds and strains.

This will rapidly transform large segments of the cattle-producing areas from a low input/low output, into a medium input/high output system, with the prospect of further sustained gains through breeding. Most of the field production studies proposed and the more detailed supporting investigations which will arise from them, will have direct application to dairy cattle enterprises.

The Team consider that the original Beef Cattle Program gave too much emphasis to research concentrated at the Palmira Center. The

primary limitations to cattle production, the biggest challenge to research workers and the best prospects for rapid technological advance, lie in the more remote and difficult grazing areas. The Team recommends that the Program should concentrate on fewer, but better production-oriented topics, most of which are such that they must be studied primarily in cattle country. Support will be needed, either concurrently or later, from fundamental work on a more limited scale using facilities which could be provided best at a center like Palmira.

The recommendations envisage substantial cooperative use of existing research facilities throughout tropical Latin America. The massive genetic and management studies proposed will require the acquisition and development of a cattle station in the eastern lowlands representing a large area of the Colombian and Venezuelan Llanos.

The overall background to the Beef Cattle Program was fully set out in the Animal Sciences proposals of June 1967. These recommendations are made within their general framework and reflect the emphasis given in the report of the New York meeting in April 1968.

1 Nutrition and Forage Utilization

a) Forage utilization

In most centers visited by the Team there are comprehensive collections of semi-tropical and tropical grasses of which the general behavior, persistence, herbage yield and chemical compositions have been measured under various conditions of soils fertilization and harvesting. There are several species which perform well but the

ranking order of the several most promising species varies with soil type and climate

In fewer cases numbers of tropical legumes have been established and studied, but only at the IRI Matao Station (Brazil) and in ICA (Colombia) (Programa de Pastos y Forrajes) has the evaluation of legumes gone beyond simple observation on small plots

Few experiments are in progress to measure the productivity and persistence of improved grass or grass/legume pasture with grazing cattle, and the only convincing demonstrations seen of the potential for beef production were non-experimental, or on private properties

Much evidence exists to show that tropical grasses, both native and improved, are generally of low digestibility and mineral and protein content. Particularly in areas which experience a long dry season, the nutritive value of tropical grasses falls well below that needed for satisfactory cattle performance for several months of the year. This is corrected in some cases by topdressing, by more frequent harvesting or grazing, or by the incorporation of legumes into the sward

1) The role of legumes in tropical pastures

It is strongly recommended that CIAT should encourage or initiate where necessary, research to exploit the opportunities that exist to correct feed deficiencies by the use of tropical legumes. Research is needed into the economics of using nitrogen fertilizers compared with legumes and phosphate on different soils and areas, and all this work should include close liaison with the Pasture and Crops Program

2) Expansion of grazing trials on grass and legume pastures

Strong support should be given to the several groups visited by the Team which seem ready to undertake grazing experiments to measure

the reproductive and growth performance of cattle grazing grass or grass and legume swards on a year-round basis. This work should be started by CIAT at Palmira, which would also be the logical site for the supporting digestion and metabolism experiments. CIAT should encourage the establishment or continuation of similar grazing experiments at the stations listed in the Proposals also at IPLAN, Belem at Uberaba Federal Station, and at appropriate sites in Venezuela. Where possible a range of stocking rates should be used, of which at least one is substantially higher than normal even if this reduces the number of replications possible. These experiments should be conducted on several areas and soils because there will probably be species x locality interactions. In all cases routine husbandry practices should include vaccinations and prophylactic use of anthelmintics, and observations should include records of liveweight, full reproductive records where appropriate, and value of stock sold or slaughtered, so that an economic analysis can be made.

There will be considerable scope for plant and animal physiological studies arising from these experiments, designed to aid in their interpretation and to indicate reasons for interactions. Most of the results will be fully applicable to dairy cattle.

3) Nutritive value of forages harvested for conservation or for green feeding

Because of the rapid decline in nutritive value of tropical forage species with age it would be most desirable to study the effect of stage of maturity on productivity of the material harvested, considering also the yield/cost relationships obtained. Such experiments should form part of a practical "production system" since

the frequency of harvesting of surplus forage obviously influences the regrowth of the crop or pasture and may thus indirectly influence later animal production

Again there could well arise problems in the utilization of these materials which would warrant more detailed nutritional metabolic or physiological study with plants or animals. These investigations too would all be relevant to dairy cow nutrition

b) Mineral nutrition

1) General It is widely felt that animal performance is often limited by inadequate mineral intake in tropical South America. The groups inquiries elicited verbal evidence of cases of bone fragility and isolated records of improved growth rate or fertility after mineral supplementation. Mineral deficiency seems quite likely to occur in this area but CIAT should clarify the nature and magnitude of the production responses through controlled experiments

2) Supplementation of mineral intakes of grazing cattle Well designed experiments with adequate controls should be initiated in various soil and climatic areas to find what specific responses are obtained to common salt phosphorus and calcium in particular and also to the minor elements known to affect animals in other countries eg sulphur iodine zinc copper cobalt selenium magnesium, manganese and perhaps molybdenum. This should be done under grazing conditions by CIAT directly or through cooperative projects

3) Specific deficiencies, metabolic parameters, mineral availability and recycling Initially attention should be given only to specific deficiencies defined as instances where a production response is

obtained after supplementation. It may later be possible to explain this, and to develop useful relationship between soil, plant, blood and tissue concentrations of minerals or enzymes and thus to increase our fundamental knowledge of mineral metabolism or biochemistry. However, many skilled groups are doing just such fundamental studies elsewhere in the world and IAI would do well not to enter this field at this time.

c) Protein Nutrition

1) General Particularly in the dry seasons, the protein content of natural and of some improved pastures falls to a level where it limits animal performance. In areas where legumes cannot be introduced consideration must be given to other means of supplying protein.

2) Evaluation of non-protein nitrogen supplementation for grazing cattle Experiments should be set up to find whether or not cattle respond to supplements of non-protein nitrogen under field conditions, in areas or seasons of low feed quality.

The response of pregnant or lactating cows should be compared with that of steers and experiments should be designed so as to find under what condition of pasture quality the best economic response is obtained.

d) Evaluation of local fodders

1) In limited areas there may be a supply of fodder, which could be used to supplement pasture at particular times or for special purposes. Crop residues, vicia, bananas, might be of local importance. In some cases collaboration between scientists in the Beef and Swine

Programs might lead to valuable comparisons of the economics of utilization of the fodder by the two species. CIAT should encourage local research institutions to evaluate such feeds using a satisfactory experimental design. CIAT facilities and staff should be used only for studies of more general importance.

2 Disease and Parasites

Improvement in animal production consists of applying modern scientific methods to the local conditions. A 'package' must be made for the locality by applying scientific principles to find the answers to local problems. The adaptive research must be carried out in the country where the problem exists. While an abundance of technology on control of animal diseases and parasites exists in the more advanced areas of the world this cannot be directly applied with any more chances of success than can be expected if you move a high producing dairy cow from the Netherlands to the tropics. This has been done successfully but only after adaptive research. In some instances technology can be applied. In other cases it must be adapted and at other times it must be researched from scratch. The idea must be instilled that you cannot compromise with diseases and parasites. We must reject the notion that diseases are inevitable. Healthy animals are essential for economic livestock production.

Veterinary medical research at the places visited is in great need of strengthening and enlargement in order to develop the information needed on mechanisms of infection, immunity, tolerance, diagnosis, prophylaxis and treatment. As individual animal units become more

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valuable the need for information on these factors will assume even greater significance

With exception of the Universidad del Valle communications between veterinary and human medicine was found to be lacking. The principles of diseases are the same in man and animals. There are a host of diseases which flow freely between man and animals each in turn serving as a reservoir for the other. Research between those concerned with animal and human diseases should be increased if we are to have a healthier and more productive life for man and animals. Cooperative research is encouraged if it can be done without diluting the primary objectives of CIAT which relate to animal production. A point at hand is vesicular stomatitis a virus disease which affects cattle, swine, sheep, goats, horses and man. The signs of infection of this disease cannot be distinguished from foot-and-mouth disease (Aftosa). One must resort to laboratory tests to distinguish them, thus the presence of vesicular stomatitis is a complicating factor in diagnosing and controlling aftosa. Like aftosa vesicular stomatitis exists throughout Latin America and causes economic losses in production of cattle and swine and brings discomfort to man in which species the disease is seldom if ever recognized.

Some recommendations follow but the list is by no means inclusive

a) Infectious Diseases

A number of infectious diseases exist in the areas visited. Those which have the greatest economic impact on livestock production include aftosa, vesicular stomatitis, rabies, hog cholera, anthrax, blackleg and equine encephalomyelitis. Where information is lacking, on the effects of these diseases on economic livestock production, CIAT

should engage in diagnosis or assessment studies and encourage such work at the national levels

The team considers the vesicular diseases, aftosa and vesicular stomatitis to be the most significant infectious disease factors limiting economic cattle production. The animal losses in the Americas due to aftosa have been estimated at 400 million U S dollars per year * This estimate does not include loss of markets for meat and other products in the countries free of the disease. They conclude that the measures necessary to prevent this toll are not being taken in the affected area. Perhaps more alarming is the fact that the areas free of the infection are not all taking measures to prevent introduction of the virus. In this connection CIAT staff should become familiar with the objectives of the International Regional Animal Health Agency OIRSA based in El Salvador. This organization was formed to help protect the Central American countries, Caribbean Islands and North America from the disease.

The team visited the Pan American Health Organization Center for Aftosa in Rio de Janeiro, Brazil, where we learned the current status of aftosa in Latin America, as shown in the following table

* Report on Foot-And-Mouth Disease Present and Future Problems on the American Continent, and the Importance of the Pan American Foot-And Mouth Disease Center - By Edgardo Seone and Carlos Palacios

Country	Virus Types	Cattle in Millions	Doses of Vacc in Millions	Outbreaks in 1967
Argentina	A O C	45	167	5000
Chile		3	6	181
Peru		3	27	11
Bolivia		16	12	
Ecuador*	A O	3	6	120
Uruguay	AOC	87	13	
Paraguay	AOC	60	15	
Venezuela*	AO	70	45	67
Colombia	AO (C?)	180	100	393
Guinea	1961 one case	25	0	
Brazil	A O, C	90	670	300

The following summary is presented and work is suggested for CIAT

1) Aftosa

a) Aftosa occurs in the whole of South America Serotypes A, O, and C, occur in some places while in others only types A and O are present

Subtypes are numerous

b) Animal disease authorities in Latin America recommend that not less than 30% of the cattle population must be vaccinated three times a year to ensure effective control

c) Venezuela and Argentina have managed to meet the vaccination level The disease continues to persist in these two countries however the incidence seems to be low in Venezuela The incidence in Argentina has decreased but is still too high

d) Paraguay Brazil, Chile, Ecuador, Bolivia and Colombia vaccinate about 40% of their cattle once a year

e) Inadequate numbers of lots of aftosa vaccine are being potency tested in cattle While such tests are carried out in guinea pigs, data collected in this species on protection is not always applicable to protection in cattle

* Types A and O only

f) In many instances those responsible for producing the vaccine also evaluate the innocuity and potency of the product. Quality control should be separated from production.

g) The Inter-American Development Bank has recently made loans in excess of 2 million U.S. dollars each to Chile and Uruguay to enable these 2 countries to begin aftosa control programs. Several other countries are in the process of making requests for loans from the same agency. All such requests funnel through the Rio Aftosa Center. CIAT staff should keep abreast of these control efforts in order to better evaluate its own input on this disease.

h) In view of the large sums of money already being spent on efforts to control aftosa in Latin America and in view of the funds being spent for basic research on the disease in North America and Europe the Team does not recommend that a comprehensive research program on aftosa be undertaken by CIAT. Such work could conceivably take all of CIAT's funds. At the same time the Team recommends that CIAT concern itself in at least a limited fashion with aftosa. Capabilities should be continued for diagnosis and assessment purposes if for no other reason than to make sure that CIAT knows what is going on in its own livestock. Because of the economic importance of aftosa to livestock production some members of CIAT staff should become familiar with every phase of this important disease in the several species which it affects. They should also become thoroughly versed on the properties of the virus and more importantly become familiar with virus and vaccine production and testing techniques.

i) The Aftosa Center was established in Rio by PAHO about 15 years ago. The purposes of this center were to provide training, technical assistance,

diagnosis and to conduct research Through the years about 500 people have been trained in various phases of aftosa at the Center Almost without exception the people now operating the various national control programs were trained there There is no question about the training they received It was good On the other hand it has not always been possible for the trainees to carry out what they learned once they returned home the reasons being economic and political The diagnostic service which the Center provides is essential Their most important function is sub-type diagnosis The research which the Center staff has conducted has varied through the years They have however made important contributions on researching live modified virus vaccine and on biological carriers Technical assistance has been rendered to countries beginning vaccine production In recent years this aspect of their program has been limited because of ^{/a} shortage of funds needed to employ the people to give the training

Even with its shortcomings, the Center has made and continues to make important contributions to the knowledge and control of aftosa CIAT staff should support and cooperate with the Center to the extent possible There should be an awareness of one another's work and should CIAT engage in aftosa research the Center staff should be informed Above all the two groups must not become antagonists They must complement one another

The Rio Center continues to be inadequately financed This responsibility appears to the Team to rest with the Nationals which the laboratory serves A new system of financing has been arranged for 1968 based on a direct country assessment It is too early to know

whether this system will bring financial stability to the Center

j) Aftosa is not now being controlled in Latin America in more than a few areas or few herds in given countries. Control in these instances has been due to judicious application of vaccines 3 and 4 times each year. Even in these instances there have been some failures due to poor vaccines, new subtypes of the virus or inadequate sanitary measures. These failures bring criticisms to those responsible for the program and further jeopardize control.

k) A better vaccine would perhaps bring about the most dramatic changes in control of this disease. Such products are being researched and should be field tested. CIAT can serve a very useful purpose in bringing about such tests. This appears to the Team to be an area in which CIAT should concern itself at an early date

Aftosa virus infects swine with almost the same facility as it does cattle. In countries where the incidence of infection has been controlled in cattle by vaccination the disease then becomes a problem in swine. The swine industry is expected to develop rapidly in Latin America and when the pig population increases the incidence of aftosa infection in this species is also expected to increase. The vaccine currently produced for use in cattle is virtually worthless in swine. In view of this it also appears appropriate for CIAT to test experimental aftosa vaccines in swine as well as in pigs.

l) Aftosa vaccines and other veterinary products more often than not, are owner administered in Latin America. The owners who are concerned in producing livestock economically probably do a good job. Those engaged in marginal or subsistence agriculture probably do a poor job. This situation has arisen because of a variety of educational, social and

economic reasons too numerous to list. If, however, aftosa or any other animal disease is to be eradicated, the program, including the vaccinations, will have to be done by other than the owners. To do otherwise is to stretch man's integrity too far.

Such a control program is not now within the economic reach of many areas of Latin America. In support of this statement one need only look at what it took to eradicate one type of aftosa virus from Mexico when it occurred there in 1946 as a result of being introduced into the country through a shipment of Zebu bulls from Brazil. It took seven years to do the job. The effort was a joint one between the U.S. and Mexico. There were as many as 1500 Americans engaged in the program and many more Mexicans. Each government spent \$132 million dollars for a total direct expenditure of \$264 million dollars. Even though the job is mammoth and there appears to be little hope of early eradication the problem must be attacked. It should be possible to reduce the incidence of the disease by judicious application of good vaccines and sanitary measures. When this is done it may then be possible to introduce the slaughter policy to eliminate virus carriers. This is obviously a long-range plan.

2) Vesicular stomatitis (VS)

This disease, because of its similarity to aftosa, complicates diagnosis. It also causes economic losses in the animals it affects especially dairy cattle. After infection with aftosa or vesicular stomatitis a dairy animal seldom if ever returns to its previous production.

Because VS virus also infects man CIAT should collaborate on such work with staff of the Cali Virus Laboratory. A fruitful area for research would be to explore methods of transmission. VSV is thought by some to

be insect transmitted, as well as by other means The Cali and CIAT staff will be uniquely situated to study this subject At the same time there may be an opportunity to get information on transmission of aftosa It is thought to be transmitted largely by contact However face and horn flies might also be a possibility

Information on the pathogenesis, immunity and prophylactic treatment would also be important contributions to the knowledge of VS

3) Rabies

This virus infection frequently causes deaths of large numbers of cattle Current vaccines are not very effective Good research is being done on vaccines in North America CIAT staff should keep informed on such studies and should not miss any opportunity to arrange vaccine trials in cattle using the newly researched products which contain tissue culture propagated rabies virus that is subsequently concentrated and inactivated Trials are currently being conducted in chimpanzees in the U S

b) Hemoparasitic diseases

Anaplasmosis, piroplasmosis, and trypanosomiasis are wide spread in cattle in the tropics CIAT should engage in studies on blood parasites and its effort might be directed at assessment of incidence, vaccine trials, search for hosts, and work on therapeutic agents for control Some work on the blood parasites is under way in Venezuela and perhaps at other places in the tropics Those engaged in research on the hemoparasites should keep abreast of these developments to avoid unnecessary duplication of efforts

c) Ecto and endo-parasites

The losses caused by ecto-parasites in the tropics were clearly evident to the Team. There was an abundance of ticks on animals we saw in many countries. Cattle such as Holstein which had been introduced were observed to have particularly high infestations. We were told at many places that endo-parasites were also widespread.

CIAT should work in this area. The treatments which are used in other countries for control of parasites are either not being applied at regular intervals or are not effective in the tropics. Studies on this problem could be conducted in a number of places without large expenditures. Often times private industry will supply the compounds for tests. CIAT should promote such studies in several areas in hopes of getting at the root of the problem. The market potential of such products is enormous and we believe private industry would cooperate. The tick infestation was particularly high in a group of pen fed Holstein calves being studied at Vicosa, Brazil. Work with different application and with different products could be done here without interfering with the other studies under way.

Management of animals and pasture rotation are also fruitful areas for investigation and often times are extremely important in controlling parasites.

d) Reproductive diseases

Diseases are only one of the many causes of breeding failures in livestock. Other important cause, nutrition and management, have been treated in other sections. Some of the diseases which cause breeding failures or abortions include brucellosis, leptospirosis, trichomoniasis, and vibriosis. Some of these are known to be problems in cattle and swine in Latin America. Some of these diseases are effectively controlled in

some part of the world by the use of vaccines. As a rule such technology may be transferred.

Vaccine failures are reported to be frequent in the control of brucellosis. The causes should be determined so that better vaccines are available.

Some of the other causes of reproduction failures: leptospirosis, trichomoniasis, vibriosis and abortions of viral origin can also be controlled after accurate diagnosis, vaccination and improved management. Research on reproductive failures is considered by the Team to be a fruitful area for investigation especially in CIAT livestock and those of its cooperators.

As in the case of many diseases, the best way to control them is to keep them out. A wide variety of tests should be applied to any and all livestock intended for use at CIAT. This is but yet another indication why the Team so strongly recommends an interdisciplinary approach to the animal systems which CIAT intends to investigate.



3 Genetics and Breeding

a) General considerations

CIAT conceivably could do for cattle and forage breeding what IRRI and CIMMYT have done for rice and wheat breeding. The economic impact for Latin America could be even greater. With the exception of recently established crossbreeding experiments in Colombia and Venezuela, practically nothing is being done of a research nature in beef breeding for the tropics. The prevailing knowledge and practice resemble that in the United States in the forties, which then had practically the same orientation as had existed for the previous century. Further, it seems unlikely that there

can be much transfer of improved beef genotypes from the temperate regions where rapid development in genetic improvement of beef is taking place. Repeatedly the temperate-climate breeds have failed in the pure form in the tropics. The Team has reviewed the recommendations from the New York meeting and should like to enlarge upon them.

At least two approaches are available to CIAT in the development of its beef cattle breeding program. The first concept will be developed at length later in the report as it is a recommendation for a large cattle-forage station in the Llanos to be operated and funded by CIAT. A second concept that did not receive as much favor is that the CIAT animal breeding-genetics group assume a coordinator role similar to that used in regional beef cattle breeding projects in the United States. In such an arrangement the animal breeder would facilitate communications between experiment stations now in existence and in the processing and publication of results. Grants for breeding research might considerably encourage complementary breeding research in the various countries. It would be difficult with the method to assure

- (1) Sustained support of topflight personnel
- (2) Continuity of personnel and projects over an extended period
- (3) Efficient herd management due to complex or inadequate budget arrangements
- (4) That a population approach with large numbers of animals of the needed kinds could be rapidly implemented

b) Specific recommendations

1) Evaluation of crosses, including indigenous and exotic breeds

In the New York report crossing of certain breeds was recommended as perhaps the major enterprise in beef cattle breeding effort for CIAT

The establishment of a sizeable herd of cattle for this purpose was suggested as approximately 3000 calves would be produced. The team in principle concurs with this. However, it now seems likely that by the time facilities may be acquired, reconsiderations of the breeds selected for crossing will need to be made. We anticipate research results from Venezuela and Colombia by that time, particularly on Charolais, Brown Swiss, Santa Gertrudis and Zebu crosses with the Criollo breeds. CIAT may find it more productive to sample less known or used breeds from tropical areas such as Africander, Australian Shorthorn, Boran, Droughtmaster, Bonsmara and even such little known breeds as the Balinese. It is suggested that the project remain open as to the breeds to be tried ultimately in the three breed crosses. The crossing would of course need to be continued until adequate comparisons had been made on the productivity of the crossbred cows. It would be expected that the primary economic traits would be routinely recorded, such as reproductive rate, viability, weaning weights and ages and weights as the beef steers or bulls approach time for slaughter. Carcass traits such as boning percentage, tenderness and acceptability of beef should be routinely recorded.

2) Preservation and improvement of the best Criollo breeds and improvement of the Zebu

Preliminary crossbreeding results in Colombia and Venezuela indicate heterosis from crosses of the Criollo breeds and the Zebu breed that exceed the performance of the parent breeds. If the current continual grading of tropical cattle to the Zebu continues, the area will find itself without Criollo breeds for crossbreeding. In view of this, it is urged that CIAT should build up and maintain sufficiently large herds of at least two Criollo breeds to insure their preservation and improvement. Decision as

to their destiny would be established after the crossbreeding data are analyzed

3) Selected and control stocks within the Criollo and Zebu

Within the purebred Zebu and Criollo herds there should be sufficient cattle for significant improvement through selection for the primary economic traits. There is disagreement with the New York Report's suggestion that improvement of milk production might reduce fertility during lactations. This needs experimental evidence. In contrast with the non-tropical breeds, recent evidence indicates that there may be considerable response to selection for fertility in the Zebu. If so, it would receive considerable emphasis in selection.

It is strongly urged that a genetic control herd of Zebu or Criollo breeds be established so that a useful genetic "benchmark" can be established. A very recent study of this by Dickerson indicates it is possibly the most efficient and also clearly understood base from which to evaluate genetic changes.

4) Ultimate development of inbred lines from the best crossing breeds

The ultimate production of hybrid vigor will emerge from the development of inbred lines of beef cattle. Thus it is suggested that plans be made for the development of inbred lines within the most productive breeds and strains. A proposed project for beef cattle breeding is given in Appendix I.

5) Water buffalo as beef animal

Two members of the Team (Lambourn and Stonaker) found a large amount of use of the water buffalo for beef and milk and work in the Belem area and were told of more herds up the Amazon Basin. This species was apparently

introduced in the early 1900's and has thrived to the point that there are said to be 50,000 on the Marajo Island and increasing numbers in the Amazon Valley. Claims were made of much higher fertility and lower age to slaughter in relation to Zebu cattle. The potentials of this species should be investigated at several locations including a new site in the Ilanos. In addition encouragement of new studies at IPEAN, Belém, Maracá and Itaituba. It is said that small herds are located also at Buenaventura in the Cauca Valley (INCORA) and in the lower Orinoco. Encouragement of research at these locations is suggested.

4 Cattle Management Research

General

In the areas which promise early increases in cattle production the wet season presents problems of excessive pasture growth or local flooding, and in the dry season feed is scarce and of poor quality for a long period. This erratic supply of feed limits the attainment of the productivity of which the pasture and animals are genetically capable. As cattle operations are intensified the importance of rational management rather than uncontrolled natural grazing and mating becomes greater.

Research should be undertaken to find what improvements in herd productivity and economics can be obtained through the procedures suggested below, in order of priority.

a) Control of breeding season

The Team has seen some evidence and heard many opinions, that the time of calving, may be of critical importance to the survival and growth of the calf and to the adequate nutrition and regular reproduction of the cow. In many areas no attempt is made to control the time or the duration

of the breeding season but it is not certain that this 'natural' time of mating and calving is the best for total herd productivity

Experiments should be carried out preferably at cooperating stations and at the proposed CIAF station to record the productive or reproductive performance of herds mated for periods of only 3-4 months. Time of mating should be chosen so that the cows calve at the middle or the end of the dry season, or at the start of the wet season

CIAF should examine the possibility of increasing conception rate of cows by withdrawing some bulls for rest and supplementary feeding in alternate weeks of the breeding season

Age of weaning and subsequent management should be studied as a second factor involved in the study concerned with time of calving

The extent to which calving percentage can be increased by provision of improved pasture or supplementary feed during pregnancy and lactation should be studied

b) Control of disease and parasites on herd scale

When facilities are available, CIAF veterinary staff should be encouraged to test management and prophylactic procedures under well controlled conditions on a herd scale. The proposed Llanos Station would provide such an opportunity



c) Design and location of fences, corrals, watering and mineral feeding points

Study of these topics would be worthwhile but they are of low priority

d) Physiology, Biochemistry and Metabolism

General In the June 1967 Animal Sciences Program Proposal considerable emphasis was given to the importance of physiological functions and malfunctions as factors needing research. There is no wish to belittle

the case presented there and it is recognized that a research program including facilities and approval to undertake fundamental studies will often be necessary to attract and retain highly qualified staff

However it is felt that considerable caution should be exercised in entering this field of research. There are many well-equipped research groups in the world studying basic aspects of reproductive, climate and ruminant physiology and many of their findings are applicable to animals in the Latin American tropics. CIAF should encourage its staff to view these as disciplines available in supporting the primary animal production experiments but should confine itself to instances where a productive failure presents unique features which are not being investigated elsewhere. Suggestions are given below for priorities among the topics suggested.

a) Reproductive physiology

1) General It is clear that the major variables like nutrition, genotype, climate and disease always influence reproductive performance of animals through physiological processes. However, we are concerned primarily with product-oriented research and it is through this that the CIAF program will make its greatest impact.

2) Low fertility in cows It has been found to be of great value in initial clarification of this problem to determine whether failure to calve is due to failure to ovulate, failure to conceive despite services by a fertile bull, early embryonic death or abortion near term. This information can be obtained by appropriate observations, genital examinations and post-mortem examination of infertile cattle under the guidance of a graduate with knowledge of reproductive physiology. Analysis of

records in consultation with a veterinarian will often suffice for tentative diagnosis

It is emphasized that much knowledge can be derived initially from accurate simple observations and that this may save a great deal of time and money by focusing detailed research effort

3) Hormonal control or augmentation of fertility

As mentioned earlier this work has been progressing for many years in many places without notable success and should not be undertaken by CIAT staff should keep abreast of current research in case there does arise a real need to use one of the existing procedures within the genetic or management program

4) Climate Physiology

It may be questioned whether the best approach to cattle improvement is to work from locally adapted cattle or to modify the environment to enable exotic cattle to produce well. The degree to which climate can be modified for beef cattle is limited to provision of shade, shelter and water at suitable points but the willingness of cattle to graze in high temperatures or humidity or the interaction between heat production in the rumen, ambient temperature and food and water intake, would probably repay study. This too should start with intensive work in the field rather than rely on sophisticated laboratory equipment

5) Ruminal physiology

This is a subject which is under intensive study in many places, including many where feeds under test are comparable to those available in the South American tropics. Provisionally it would be wise to await evidence from production experiments of the existence of metabolic

troubles before entering this field

However if the forage program envisages substantial use of 'in vitro' digestion determination it would be helpful to provide facilities and some expertise in rumen physiology to assist in this as well as to develop animal studies when needed

6 Need for a Tropical Beef Cattle Research Center

The Team feels strongly that the important problems facing beef cattle production in the tropics cannot be adequately solved in the environment at Palmira. Many needed projects in all disciplines relate to increasing reproductive rate. This requires manyfold the numbers needed in growth studies, with steers widely used in livestock research. The obvious needs for large numbers of breeding animals for genetic research under stress conditions typical of extensive tropical pasture regions has been documented earlier in this report. Ultimate development of a breeding herd of approximately 4,500 cows is suggested which would be associated with a total cattle inventory of about 10,000 animals. This would provide one of the few research herds of sufficient size in the world to cope adequately with the population aspects necessary not only in cattle genetics but also in other areas, particularly pasture nutrition, ^{cattle} health and management. Few research establishments have land and cattle facilities in this magnitude thus unusual opportunities exist to obtain the necessary land and cattle inexpensively in the relatively undeveloped Llanos.

It is recommended that this center be located in one of the difficult environments commonly found in the region. Obviously the land area required would depend upon the site. If for example, 10

hectares are required per animal unit, the land area would be 9 to 10 thousand hectares. If acquired in more than one block it would be highly advisable that there be samples of poorly drained wet pasture lands as well as some of the better soil types. Proximity of the areas to one another would be essential.

Somewhat different budget requirements will exist for this type of station. Within six years, much of the operating budget would be offset by cattle sales. This has been the experience of cattle stations such as the U.S. Livestock and Range Station at Miles City, Montana. Decisions involving budget planning must take account of this aspect of livestock research costs. The Team felt that a capital investment of about two million dollars could establish the station. Since the investment would be primarily in cattle and cattle handling facilities, the assets are much more highly recoverable than those in usual capital investments in buildings and laboratories required for research.

The Team acknowledges complications and difficulties in the establishment of a large cattle-forage station in this frontier area. However, it is anticipated that air travel and good communications can make the effort workable. Compromise proposals for cattle research in CIAT lack the boldness necessary to make a real advance, such as that achieved in the Foundation's earlier rice and maize work. The team thus urges CIAT to seek a suitable area of land for a major center for cattle studies of great international importance.

B Dairy Program

The proposed dairy research program of CIAT has been developed by the staff with the objective of solving, or overcoming, the problems which limit efficiency of milk production in the tropics. It is recognized these problems increase in their intensity in the low hot tropical areas compared with the higher elevations and sub-tropical climates.

Some observations

To supplement the general observations presented earlier, a few comments on dairy operations visited by the Review Team are given here.

- a) The Holstein dairy herd at Palmira has a very low conception rate (35-40%) 50% of cows have mastitis. Milk yields are fairly satisfactory. Better management might be effective in controlling mastitis and in improving the breeding efficiency.
- b) Pure Holstein and Brown Swiss at Turipana have a low breeding efficiency, compared with Costeño con Cuernos (CCC) and Holstein X CCC crosser. Milk yields of Holstein, Brown Swiss and crossbreeds are about equal (iv 1535 to 1953 Kg /lactation) and much higher than the CCC (300 Kg /lactation). Perhaps the yields can be improved through better management. The Team believes that continuing presence of aftosa in this herd has permanently reduced the potential milk yield capacity of individual animals.
- c) Most of the milk produced in the Gulf coast area of Colombia comes from Criollo cows that have several crosses to Zebu bulls. Cows are milked once or twice daily and milk supply is shared with calf. Average yields are 2-3 liters per day.
- d) In the dairy cattle project at Vicosa, Brazil, crossbreeds (Holstein

X Zebu (Gir)) are producing better than pure Holsteins. The plan is to produce an animal that is 5/8 Holstein and 3/8 Gir to overcome the environmental problems of high temperatures and humidity, lack of adequate feed and ticks.

e) In the sub-tropical climate at the Uberaba station in Minas Gerais, Brazil quite satisfactory milk yields are being obtained under good feeding and management from a selected milking strain of Zebu cattle, mostly Gir breeding. Average lactations are 294 days with $8\frac{1}{2}$ Kg /day or average of 2400 Kg. Some individual lactation records are up to 3900 Kg.

f) At the Federal Station (IPLAN) at Belem crossbreeding of Jerseys and Red Sindhi has given good results. A herd of water buffalo is maintained for milk and is favored over cattle for milk production for that environment.

g) The best dairy cattle breeding and nutrition projects and the greatest depth in high quality personnel were observed at Maracay, Venezuela in the Zootecnia Section del Centro de Investigaciones Agronómicas and the Facultad de Zootecnia of the Central University. Experiments with Criollos, Brown Swiss and Holstein cows, and with crossbreds have been in progress for more than 10 years. Analyses of records of several herds of Criollos in the State of Zulia have been made. Of particular interest is a herd of 100 purebred Holsteins recently imported as calves by the Facultad de Agronomia. A high breeding efficiency was obtained for first calving and 49 lactating 2 years olds at all stages of lactation to date have averaged 23 liters/day under good conditions of feeding and management.

if dairying is to develop to efficient levels in the climatically unfavorable areas it must be economically competitive with other agricultural enterprises especially with other species of livestock in those countries like Colombia where there is a wide range in climate from temperate to the hot tropical zones it is possible that funds and efforts put into dairy cattle improvement at the higher and more favorable elevations might yield a far greater return for the region than would research in the hot climates It might be more economical to produce the milk in the more favorable environments and ship it in some form to the less favorable areas than to try and produce it there

If one assumes however that the basic biological and technical problems can be solved through research and extension, thorough evaluation of economic factors involved in production and marketing must be made Successful expansion of dairying in the hot humid tropics will depend upon favorable price incentives to the producer consumer demands, availability of markets and marketing systems, and the ability of farmers to overcome the feed disease and climatic problems and to operate and manage their dairy cattle operations on an economical and profitable basis

It appears to the Review Team that in planning its research with dairy cattle the CIAT staff should consider carefully the opportunities for cooperative projects with one or more of the animal husbandry groups in Maracay Venezuela and with the IIAN Station in Belem, Brazil Further opportunities may be afforded for worthwhile cooperative projects with Estacao Experimental de Uberaba Uberaba Brazil It is assumed that projects already in progress in ICA at Palmira and Turipana will be continued on a project basis cooperative with CIAT

Priorities in Dairy Cattle Research

It appears to the Review team that the program planned by CIAT is more extensive than can be carried out successfully with the limited resources, both in funds and personnel that are likely to be allocated to dairy cattle. It is desirable, therefore, insofar as possible, that research projects with beef cattle dealing with pastures and forages, animal physiology and to disease and parasite control be so designed that the results will be as applicable as possible to both beef and dairy cattle. It is essential that all senior scientists of CIAT including all disciplines in animal sciences, soils, crops and agricultural economics, be involved in the planning, in the design and in the conduct of all major research projects.

1) In the judgment of the Review team, priority should be given to nutrition and feeding problems of dairy cattle especially studies on utilization of pastures and forages.

a) An example of badly needed research is the effect of stage of maturity at grazing or harvesting on nutritive value as discussed more fully earlier.

b) Other priority projects should include the nutritive value of local sources of energy such as cassava and bananas, and economics of concentrate feeding at different levels of intensity.

2) Emphasis need to be given to animal physiology and to disease and parasite control problems.

a) Reproductive failures in dairy cattle should receive special attention.

This is an area where there are all sorts of opinions and very few facts available for the guidance of dairy farmers. In addition to the physiological aspects, this problem involves nutrition and management and husbandry practices.

b) Lactation physiology A great deal of knowledge has been gained in laboratories in the advanced dairying countries, which suggests that the mechanisms of milk ejection are common to all mammals. The evident belief among milk producers that Criollo and Zebu cows will not release their milk without the stimulus of the calf is thus open to question. Since this could be important in selecting of stock for the development of an adapted milking breed this field is one that would justify early study at a physiological level.

3) Research on improvement of genetic capacity of animals for milk production in the lowland tropics already is in progress at Turipaná and Venezuela. If further experimentation demonstrates consistently the value of Criollo breeds in crosses with milking strains of Zebus and other exotic breeds in producing heterosis and improved breeding efficiency, someone will need to give greater attention to the preservation and improvement of the 'pure' Criollo breeds for use in crossbreeding. Practical observations lead one to believe some of the Criollo breeds in Venezuela are superior in milk producing ability to the Costeño con Cuerno Cattle in Colombia.

C Swine Program

Major limitations to the production of swine in the tropical areas are found in the fields of nutrition, management and diseases. Swine research has been limited and although some of the studies that have been conducted supply good information this has not been extended. There has been a lack of communications and coordination among institutions conducting research.

The swine producer in the tropics has at his disposal a great variety of feedstuffs of very different chemical composition. Information on their nutritive value is very limited. There is a great need for studies on the

best form in which to store these materials and the extent to which their nutritive value is affected by these practices. A serious limitation to swine development in the tropics is still the education of the producer and this aspect should also receive prime consideration in the CIAT program.

A number of research stations are already working on applied aspects of swine nutrition. The work recommended for CIAT support deals with more fundamental aspects.

Recommended Areas of Work

The profitability of a swine enterprise is determined largely by the number of pigs reared per sow per year and the cost of feeding them to market weight. Study of the efficiency of utilization of the main energy and protein feeds available seems to offer the greatest probability of developing an efficient production system. Much of the overseas research on reproduction, genetics, and physiology is directly transferrable to the tropics and these subjects therefore have lower priority.

1) Nutrition

a) Protein This aspect of nutrition is perhaps the most limiting factor in swine production in tropical and subtropical areas. Protein supplements are scarce. Abundance of high energy-low protein sources such as molasses, yuca, banana and rice makes this problem more critical quantitatively and qualitatively. From this point of view, available information on protein requirements can lead to wastage of good quality protein and inefficient use of the energy sources. Research in this field can produce valuable information for humans since the pig is the animal that most closely resembles man in nutritional requirements. It is expected that collaborative work will develop with local groups

Information is needed on

- (1) Evaluation of sources of protein as supplements for cereal and low energy materials
- (2) Evaluation of protein quality of cereal grains (opaque-2 corn, sorghums, etc)
- (3) Value of pasture and forages for pigs of different breeds at different stages of development

b) Energy Available feedstuffs such as yuca molasses and bananas offer a great potential as energy sources. However due to their low protein content they require a different approach when combined with protein supplements. At the present time these energy sources are frequently inefficiently utilized. Possible changes in the carbohydrate and protein make-up of these products may occur when breeding for high yields or other characteristics. These changes in chemical composition and nutritive value should be studied.

Main areas of work should be

- (1) Effect of breeding crops for high yields and other characteristics on the carbohydrate composition and nutritive value of these products for pigs
- (2) Effect of processing and form in which these products are fed on the performance of pigs

c) Minerals and vitamins Topics that should be considered

- (1) Requirements of these elements for different phases of the pigs' development
- (2) Evaluation of local products as sources of these elements for swine (Content and availability)

2) Management

There is a great deficiency in the information regarding building and equipment plans and the best and most economic local materials to be utilized. Information is lacking on the real value of some management practices to counteract a tropical environment for example spraying and shading.

Other possible areas of research

- a) Building and equipment designs
- b) Herd size as related to efficiency of production
- c) Effect of processing and handling on the nutritive value of ingredients e.g. ripe vs green bananas, value of cooked potatoes fresh vs dried yuca, ground corn with and without cobs vs shelled corn
- d) Study of management factors affecting consumption of protein supplements e.g. consistency of the ingredients, amount of water available, distance from waterer to feeder

3) Diseases and Parasites

Diseases and parasites are also limiting factors in economic production of swine. Where specific treatments are available they should be applied to control endo and ecto-parasites. Research is needed on the effects of management in the control of parasites. Some of the infectious diseases which should be controlled through testing, treatment, vaccination or management include brucellosis, leptospirosis, hog cholera, transmissible gastro-enteritis and influenza. Aftosa is also a problem in swine and the vaccine used in cattle is generally considered to be less effective in this species. CIAT should also be on the alert to try experimental aftosa vaccine in pigs. As the number of pigs increases the problem is expected to increase in its intensity.

4) Economics and marketing

The industry is characterized by inefficient marketing systems, inadequate handling and processing of the meat. Other institutions doing swine work in Ecuador, Brazil, Venezuela and Colombia are less equipped to do this type of work. As a result swine marketing systems should deserve special attention and study by the economics staff at CIAT.

There is also a need for studies of the economics of building and

equipment design and the selection of materials e g brick vs metal
or vs bamboo

5) Training

Attention is called to the fact that the swine program offers the
greatest possibilities for short term research projects on nutrition,
management and genetics and therefore it can play a main role in the
practical training of personnel at all levels

VI TRAINING

Because of the critical shortage of qualified people at all levels of training in animal science throughout Latin America, it is extremely important for CIAT to establish active training programs.

Degree Level

CIAT should serve as a clearing house for assisting and encouraging scholarships to the M.S. and Ph.D. levels. It is particularly urged that scholarships be arranged so that interruptions in the graduate study be avoided or minimized. These interruptions have led to expensive delays in the past in getting research programs to a productive level and absorb too many years from the young scientist's effective working life. Many 'young' scientists visited are approaching their forties without actually having completed their doctorates. They still plan and hope to do this.

There should be particular emphasis at this time in encouraging graduates to go into the variety of disciplines available in the animal sciences. This is difficult since there are few professors in these fields at South American university centers, who would ordinarily encourage entrance into such fields as nutrition, breeding management and physiology. Research workers in animal health too are in short supply but there is a larger base of students and professors upon which to draw.

Need For Indigenous Graduate Schools

The impact of foreign graduate school on research and on the

widespread development of research establishments in Latin America is a viable and concrete example of an enormous contribution to agricultural development in the area. There is no question but that the U S graduate schools have provided the major portion of this development. It may well be the most effective and acceptable form of foreign assistance. Repeatedly the Team visited with scientists who warmly recalled their professors and graduate days and undoubtedly much of the hospitality extended to the Team was a reflection of this gratitude.

However, it seems obvious that as the area's research and educational institutions develop and mature they will increasingly assume the responsibilities for graduate training. The relatively virgin territory of research opportunities in the Latin American tropics provides a rich source of thesis research. Further the contribution of this research to the development of agriculture can be immense. Other advantages to education and research in the region seem obvious. Pressure on U S graduate schools from increasing numbers of U S students further indicates the need for development of graduate schools in Latin America. Presently there are only a few Latin American institutions which offer an M S degree in the animal sciences.

It appeared to the Team that there is a splendid opportunity for CIAT to encourage and participate in the development of graduate training at Ialmora in conjunction with the rapidly developing Universidad del Valle and with the National University's program there in Agronomy. If the research staff of CIAT develops association with a graduate program it can do much to enhance their research and the general intellectual development of those associated with the institutions involved.

In Service Training

The concept of short term appointments particularly in junior positions to the CIAT staff should greatly enhance two types of training. First it will offer the opportunity for governments and universities to send their scientists to CIAT for specific training. Further the trainees will bring to CIAT new ideas and with current developments and contributions from their home institutions. The Team encourages this arrangement.

Short Courses

It would appear that within a few years of its establishment, CIAT will begin to find demand for many types of intensive short courses to serve extension, teaching and research personnel, industry groups and farm operators. Thus, we strongly support the plans for providing facilities for these people at Ialmia in the building program of CIAT and that livestock facilities be such that they can be available and adapted to special training courses as may be indicated. Short courses in health nutrition management breeding artificial insemination are some with which the Team has had successful experiences and recommends for consideration.

VII RELATION OF CIAT TO OTHER INTERNATIONAL AGENCIES

In due course it is conceivable that CIAT will be viewed internationally as a Center or focal point for information, advice and guidance on a variety of subjects dealing with the agricultural sciences. How quickly this develops will depend upon many factors, an important one being the level of expertise of CIAT staff.

At present large sums of money are being spent in Central and South America, as well as other places in the world on the animal sciences. In most instances the reasons for such expenditures are based on the desire to increase productivity of crops and animals to bring about greater income and to produce adequate food of high nutritive value for the world's growing population. The problems are enormous and the available funds to do the jobs are limited. For this reason alone, all investments concerned with increasing animal productivity should be carefully planned and based on the best available information. More importantly the work should be carried out with the most exacting efforts and there should be a continuing assessment of such programs. Some of the international organizations making investments in animal sciences at present include FAO of the United Nations, AID of the U. S. A., the USDA through P. L. 480, PAHO of Organization of American States, Ford Rockefeller and Kellogg Foundation and international lending agencies such as the Inter-American Development Bank and World Bank. Too frequently those responsible for committing funds for this purpose are at a loss to obtain guidance which is free of bias or politics. The availability

of such information often results in failure of development of worthwhile programs. On other occasions when ill-advised programs are started the limited resources which are available are wasted.

It is not suggested that CIAT set itself up as a watchdog of all investments in the animal sciences in Latin America and the tropics. Obviously this would not be possible. It is suggested however that CIAT keep this service in mind and to the extent possible maintain the staff to do the job. If this is done the competence and reputation of CIAT will come known and its services and advice will be sought.

This is but another example of why CIAT must remain international in scope and guard against allying itself too closely with any national program.

VIII RELATED SERVICES

In any research installation there are certain common needs of all members of the staff, which may often be met better and more economically if they are shared. These may include production of laboratory animals, media preparation, glassware washing, tissue culture production, illustrative and photographic tilling, of soil planting and harvesting of crops, custodians, maintenance and plant operations, as well as those major matters dealt with below.

1) Library

A well stocked library is a necessary tool for any researcher, and a research library is different from an ordinary lending library. For this reason consideration should be given to the formation of a library committee including senior scientific staff whose responsibility it will be to assist the librarian in selecting acquisitions and planning the library services such as journal display and circulation photocopying reprint handling locations and checking of references, which efficient research work requires.

The CIAT library is viewed as a technical library thus an effort should be made to recruit staff with subject matter competency as well as training in library sciences. Knowledge of several languages would also be an asset.

The library should at once develop connections with libraries in other countries so that an effective exchange or lending service may be put into effect. Considerable assistance could be given to the rather understocked libraries in some institutes in the CIAT area.

Since CIAT will have a large proportion of temporary staff a system of recording or logging data should be devised to ensure that all copies of original measurements do not go back to the parent country when a visiting worker leaves.

2) Economics Research

CIAT may often be engaged in feasibility studies not only in relation

to its own program but in connection with related programs, throughout the world. For this reason we support the plans to include economists on the staff who can advise on the economics of production systems, research activities and control programs. Unbiased facts on economics are currently not available in Latin America on many programs. For example, it may be queried whether aftosa vaccine and other biologicals are being produced in Federal laboratories more cheaply than they could be by private industry.

3) Biometrical Services

Although training in statistics is an integral part of a scientist's graduate training the subject is continually developing and most scientists benefit by having their program reviewed by someone trained in depth in experimental design. All programs of CIAT should receive such a review and the biometrician should be a member of the team planning every research project. The review of data by him following completion of the work is often of little benefit. The services of biometricians can best be utilized when the work is planned. More and more researchers are turning to the computer to assist in analysis of data. Few researchers have sufficient knowledge of computers to write a program whereby data may be analyzed by this method. The biometrician can assist here too. On the other hand small, inexpensive, desk-top computers have come into being during the last two years. These machines are adequate for many of the projects to be conducted at CIAT. Their primary advantage is to bring basic computer functions to the laboratory where the scientist and his technician can use them. Consideration should be given to use of this modern research tool at CIAT from the beginning. Those who have begun using this equipment are

no longer awe-stricken by the computer, and the use of the machine has generally elevated the level of work. Another side benefit is the fact that to use the computer one must plan a program.

4) Analytical Laboratories

It is recommended that considerations be given to establishing a central analytical laboratory where samples may be referred. The equipment for such work is expensive and specialized training is required to conduct certain of the analytical tests. Many of the places where CIAT will conduct cooperative research will not have facilities, equipment or personnel to do definitive studies of soil and feed samples. Such analytical work could best be done at CIAT until such time as the cooperators obtained the necessary training and experience. Such cooperation would be a worthwhile input for CIAT.

SUMMARY

This review was made by a Team of Animal Scientists during the period July 28 August 25 1968. Animal Science Programs were studied at Universities Schools of Agriculture and Veterinary Medicine, Government Experiment Stations and commercial farm operations in Colombia Ecuador Brazil and Venezuela. About one-half of the research stations visited are in the lowland tropics and the others are in the sub-tropical and more temperate areas of the Latin American tropics.

The objectives of this review were to make an appraisal of the present status of the livestock industry in the lowland tropics of Latin America of animal research in progress in relation to the problems and needs and of the human and other resources available for animal research and training. Proposals developed for the Animal Science Program of CIAT were critically appraised and recommendations made of priorities for research and location and institutions where the work might best be conducted.

It was understood that the Animal Sciences Program of CIAT was intended to contribute to increased efficiency of livestock production in the lowland tropics especially in Latin America. Also it was assumed that major emphasis will be given by CIAT to animal sciences and that the location of resources would be sufficient and over a long enough period for the program to have major impacts in agricultural development in the lowland tropics. It was understood further that the central unit of CIAT will be near Palmira Colombia and that research and training would be conducted on a cooperative basis with other agencies and governments at other sites.

Several basic problems affecting livestock production in the Latin American tropics may be summarized in three categories: (a) poor utilization

and productivity of land resources, (b) low productivity of present livestock industry, and (c) lack of trained people at all levels

The Review Team agrees that CIAT should give high priority to beef cattle in the Animal Sciences Program and that complete production systems be emphasized through a multidisciplinary approach including nutrition health genetics physiology and management. The plans for strong complementary programs in dairy cattle and swine are strongly supported.

Recommendations

Beef Cattle

1 There is concern by the Review Team that the plans for the Animal Sciences Program may be too wide in scope to make rapid progress with the resources that are likely to be available. As a result, it is suggested that the program concentrate on fewer but better production oriented topics, most of which are such that they must be studied primarily in the areas where the problems are located.

2 While much valuable research can be done at the Palmira Center, the important problems facing beef cattle production in the lowland tropics cannot be solved in this location and environment. It is urged, therefore, that CIAT seek a suitable area of land for a major Beef Cattle Research Station of sufficient size to provide for approximately 10,000 cattle, including 4500 breeding cows. Interdisciplinary research can be conducted that will provide new knowledge on beef cattle production systems. Preferably such a station should be located in the Llanos region which includes so much of the land area of Colombia and Venezuela.

In making this recommendation due consideration was given to the coastal regions as a possible site however the potentials of the Llanos for utilization by beef cattle have not been subjected to experimental investigation. Results obtained at such a location will also have

application in the vast Campo Cerrado areas in Brazil

3 Primary emphasis should be given to nutrition and forage utilization the role of legumes in tropical pastures and grazing trials on grass and legumes mixture Studies are needed on harvested forages mineral and protein nutrition and utilization of local fodders and crop residues these investigations all will be relevant to dairy cattle

4 The team recognizes the importance of control of disease and parasites in the animal production systems which are contemplated and CIAT is urged to investigate these problems

Aftosa is a drawback to economic production of livestock in Latin America Some of the factors that complicate control include ability of the virus to infect cattle swine sheep and goats the ability to survive under adverse environmental conditions and to mutate and produce variants

The problems of aftosa are so enormous that CIAT should be careful not to become so engrossed in aftosa that the rest of the disease and parasite program is neglected The team recommends that CIAT maintain a capability of diagnosing aftosa and vesicular stomatitis Identification and classification of subtypes should be left to the PAHO Aftosa Center in Rio CIAT should cooperate with the Center and give it moral support The Team recommends that CIAT become engaged in field trials of experimental vaccines and undertake research on methods of transmission of aftosa and vesicular stomatitis

The reproductive diseases are causing problems in livestock production and are thus considered appropriate for investigation

CIAT should provide leadership in studying treatments of ecto- and endo-parasites the effects of management on parasite control and be on

the alert to observe genetic or breed resistance to parasites

Effective treatments for all hemoparasitic diseases in Latin America are not available. These diseases should continue to be studied along with experimental vaccine, therapeutic agents, and effects of control of vectors.

CIAT should have Veterinary personnel qualified to conduct diagnostic and research investigations on diseases. Because of the problem of vaccines and therapeutic agents, CIAT staff must also be knowledgeable of vaccine production and testing techniques. The team also recommends that CIAT continue to have veterinary practitioners on its staff.

5. Beef breeding research should be directed at insuring the preservation and improvement of at least two Criollo breeds because of their probable usefulness in crossbreeding with Zebu and other exotic breeds. A comprehensive crossbreeding experiment is recommended as this should produce needed information quickly.

Selection programs for the improvement of the Zebu and Criollo^{cattle} should be initiated and, in addition, part of these herds should be set aside as genetic controls for the necessary experimental benchmarks. Ultimate development of inbred lines from the best crossing breeds also is recommended as a most productive area of investigation. These plans hinge upon the establishment of a Beef-Cattle Research Station.

Cooperation with regional beef breeding researchers in their programs is recommended. These include such agencies as ICA at La Libertad and Turipana, several stations in Venezuela, Uberaba and Belem in Brazil, and Pichilingue in Ecuador.

6. Management offers an area of productive research work on control of breeding, calving in relation to wet and dry seasons, calving efficiency, grazing and pasture management, and facilities for handling, selecting,

transporting and marketing of cattle

7. Physiology should be viewed as a supporting discipline and emphasis should be given only to reproductive physiology and field work on climatic adaptability until problems arise in production experiments

Dairy Cattle

8. In many of the basic problems that are the same for beef and dairy cattle it is highly essential that research projects dealing with pastures and forages, animal physiology and to disease and parasite control be so designed that the results will be applicable to both species. Further, it is essential that all senior scientists of CIAT, including all disciplines in animal sciences, soil, crops, and agricultural economists, be involved in the planning, design and conduct of all major research projects.

9. Priority in dairy cattle research should be given to nutrition and feeding problems, especially studies on maximum and efficient utilization of pasture and other forages, economics of concentrate feeding at different levels of intensity, and value of local feeds as sources of energy.

10. Major emphasis also needs to be given to disease and parasite problems, including reproductive failure.

11. A program of research to improve the genetic capacity for milk production in the lowland tropics is necessary before dairying will become an important industry in the region. Crossbreeding experiments between Criollo and exotic breeds have produced heterosis and improved breeding efficiency. Research by CIAT in this area in cooperation with ICA at Iquijana and other centers in Mexico, Venezuela, and at Belém, Brazil, should be an important part of the dairy program. Preservation and

improvement of the best milking Crillo breeds is essential for this research.

Swine

12. Research in nutrition appears to be the most promising area as a source of results that can stimulate a rapid and efficient growth of the swine industry. Within this field, protein and energy nutrition deserve top priority.

13. Management is the second limiting factor to development of swine production. Areas such as building and equipment design, use of protein supplements and effect of processing and handling on the nutritive value of ingredients should be given special attention.

14. Infectious, parasitic and reproductive diseases of swine should receive attention for their importance will increase when the industry expands.

15. It is expected that with time the problems of nutrition and management will diminish in importance and CIAT could then give its attention to genetics and breeding, physiology, biomedical research, and more fundamental aspects of nutrition and management.

Training

16. The Review Team strongly supports the plans for training of scientific and agricultural technologists as an important function of CIAT. Because of the critical shortage of qualified people at all levels of training in animal sciences throughout Latin America, we urge special emphasis on this discipline.

17. CIAT should make an effort to expand the opportunities for Latin American students to obtain advanced training to the Ph.D. level to prepare

them for leadership in research. It is recommended that opportunities be worked out for young potential scientists to do part of their graduate training in the United States and to return to CIAT for their thesis research under the tropical environment.

CIAT facilities and staff will provide unusual opportunities for training in Latin America of several types of scientists and technicians in animal sciences. These include advanced training in research, in-service training, and short courses. Within Latin America CIAT can play a most effective role in fostering the growth and development of graduate schools where students can obtain advanced training initially at the M.S. level and eventually to the Ph.D. in Animal Sciences. This will require strong disciplines in the basic sciences, biological and physical, as well as in Veterinary Science, Agronomy, and other agricultural disciplines.

Related Services and Functions

The Team believes that CIAT will be called upon increasingly to give guidance and to make recommendations to international organizations engaged in assisting in improving all phases of agriculture. We would support this role for CIAT for such unbiased assistance is not now available. To function in this capacity CIAT must guard against close national alliances.

The staff at CIAT and the cooperating groups will all need certain related services. Thus we support the plans to establish a good library, biometrical services, competency in agricultural economics, research records archives, information duplicating, illustrative and photographic service, and a central farming and maintenance operation.

PROPOSED PROGRAM IN BEEF CATTLE BREEDING

Appendix I

A total cow herd of 7360 cows would be ultimately provided for. In addition there would be required about 200 bulls, 1000 heifer replacement and 4000 steer or facilities for about 10,260 animals.

A) For the crossbreeding and genetic control herds, a total cow herd of 500 cows is recommended, 250 of these would be grade San Martinico and 250 would be Zebu. The crossbred heifers produced would be maintained for later incorporation into three breed crosses (See outline of proposed mating plan Table I.)

1) Each year 1 to be crossed on the test cows would be recommended by a minimum of six bulls. Sixty bulls would be tested concurrently, with 2 bulls per breed per year.

2) Randomly selected from each of the two control herds of cows each year there would be 125 cows to produce replacements for the control herd. These cows would be bred to randomly chosen bulls from their own herd and the genetic population of bulls would be maintained and mating of that related animal would be followed so that the inbreeding would be less than that in a randomly mated population of this size. The control herd would thus have a genetic base consisting of 250 cows of each breed San Martinico and Zebu (approximately one half of which would be used for crossing each year and eight to ten bulls of their breed, approximately half of which would be used for heifers).

3) Cross bred heifers produced in the matings would be retained until a cross bred cow herd of about 500 cows is developed. The breeding of these cows would be such as to test the combining abilities of third breed in crosses and particularly of measuring the usefulness of the various combinations of first cross cows in the beef herd. At the end of 2 years a first generation would probably be formed from premium animals out of the cross bred herd.

4) Independently of the above small herd of 60 water buffalo should be established for study as a potential beef animal for the area.

B) The development of genetically improved stocks of 3 breeds It is suggested that the Simmentaler, Zebu and the more breed be chosen for the long time selection and inbred line development studies. The breeds should have indication of high adaptability to the area and yet represent diverse genetic origins (see mating plans, Table 2)

1) One population of highly selected cattle 600 cow and 20 sires could be used within each of the breeds. Inbreeding would be held low selection pressures would be increased through the use of A I*. 600 cows would produce approximately 200 bull calves per year - a number which should give an opportunity to increase selection pressure with A I about 50% over that possible with natural breeding. Beyond this the diminishing returns make heavier selection pressure very costly. About 14 bulls including those used in A I would be used annually within the large mass selection herd. This would make it possible to keep inbreeding at a reasonably low level for many generations.

Even with A I an effective male population would not fall below 8. Genetic and economic parameters would be extracted as early

*Artificial Insemination

is possible and appropriate selection program developed

2) 1800 additional cows could be allocated to the development of 60 single sire inbred lines. These would probably be of the three breeds used in the first selected population. But since the results of inbred lines are difficult to accurately compare with the control herd and other natural and semi-inbred populations, it should not be necessarily essential to restrict the lines to those breeds. In time, some of the lines become candidates for culling as information on their usefulness becomes available. Introduction of milk herd of promising exotic breeds as replacements for culled lines should be considered.

3) As the number of breeds worthy of testing in the control and crossbred herd begins to diminish, these control and crossbred herd will be used as a source for a goodly testing of lines from the selected dominant herd and from the inbred lines.

4) One of the sires produced through the years can provide a large gene pool from which an inbred or lines could be developed.

(C) Anticipated Results

Within five years it would be expected that there would have developed sufficient superior stock to give us useful cow stock for much of the east province and of tinian, the tropics and sub-tropics. The improvement could be rapidly dispersed through milk herds and through semen and sire bull from the program. The cost of the program is not very high, but it is estimated that about 12 years would be required to attain a situation in which a well managed herd could be run like a low cost of charge if it is

manyfold that currently taking place. Further the changes are cumulative and permanent until counter selection occurs.

It would be anticipated that the screening of new germ plasma and its use in the hybridizing would result in more dramatic improvement particularly in higher reproductive rate and lowered mortality rate.

D) Anticipated rate of return on research investment

It would be anticipated that this would be much higher than the estimate made by Schultz for agricultural research in the U.S. This would be due to the low net annual cost for the operational facilities in an area such as in Illinois, where land and labor costs for cattle production are probably currently among the lowest cost cattle producing areas in the world. The costs of scientists would be no greater than for other forms of research. Perhaps the greatest significance in a return on investment is the utilization of land and associated massive support of the economy of Colombia and other Latin American countries that stems from the beef industry. The required elements of time and size of facility keep this area of research relatively uncrowded considering its potential contribution.

Table 1

Mating program for the First Three Years - Crossbreds and Controls

Breeds of bulls	Bulls* Identity	Year 1		Bulls	Year 2		Bulls	Year 3		Year 4
		S in M Cows	ebu Cows		S in M Cows	ebu Cows		S Cows	ebu Cows	Bull
Simmental Control	1,2,3	100	0	5 6 10	100	0	15 16	0	0	4,-
	8 9, 0			15 16,17			2			10 11
ebu Control	1 2,3	0	100	8,9 10	0	100	15 16 17	1	1	22 23 24
	8 9 10			15 16,17			22 23 24			30 31
Crossbred Friesian	1	13	12		13	12	5	12	12	Australian 1
	2	12	13		12	13	6	12	13	Shorthorn 2
Balines	1	13	12	3	13	12	5	12	12	1
	2	12	13	4	12	13	6	12	13	Scottish 2
Bonsmara	1	13	12	3	13	12	5	12	12	1
	2	12	13	4	12	13	6	12	13	2
Brown Swiss	1	13	12	3	13	12	5	12	12	Brangus 1
	2	12	13	4	12	13	6	12	13	2
Chiana	1	13	12	3	13	12	5	12	12	Santa 1
	2	12	13	4	12	13	6	12	13	2
Sahival	1	13	12	3	13	12	5	12	12	Conradis 1
	2	12	13	4	12	13	6	12	13	2

Use a 1. if possible for the first 75 days of the breeding season after which cows would be bred naturally to bulls of their own breed

** Beginning in the fourth year crossbred females would be included. These would be built up to make up 1/3 of the test cows

Table 2

Mating Programs for Mass Selection Herds and for
Inbred Lines

San Martinero	Mass Selection Herd	Bulls 14 Cows 600		
	Inbred Herd	Line 1 Line 2	Bull 1 Bull 2	Cows 30 Cows 30
		Line 20	20	
Cebu	Mass Selection Herd	Bulls 14 Cows 600		
	Inbred Herd	Line 1 Line 2	Bull 1 Bull 2	Cows 30 Cows 30
		Line 20	20	
Breed	Repeat programs as indicated above			

Approximately 50% of the cows in the mass selection herds would be bred to the best bulls. The remainder would be bred naturally to the 10 best young bulls each year. Hold the relationship between males as low as possible. For the first five years select on weaning weight. During this time develop selection index for both of the breeds.

APPENDIX I

<u>Places Visited</u>	<u>Contacts Made</u>	<u>Examples of work and facilities observed</u>
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COLOMBIACIAT - Rockefeller Foundation

R K Waugh Associate Local Director
 N S Raun Animal Scientist Director Animal Sciences Program (ICA)
 J H Maner Director, National Swine Program (ICA)
 E D Roberts Veterinary Pathologist (ICA)

Ford Foundation

James Plaxico, Representative

National University, BogotaFaculty of Veterinary Medicine and Animal Husbandry

Ricardo Sandino Dean

LIM ICA

Gustavo Henrique Acting Director
 Rockefeller Foundation

Research and training laboratory - diagnosis function research on
 arthropod viruses hemoparasites Venezuelan equine encephalomyelitis,
 etc

Tibaitata - ICA

Canuto Cardona Director
 Jaime Morales Pineda Animal Husbandman (Dairy)
 Luis Oswaldo Acosta Asst. Director Dairy Program

Nutrition and physiology laboratory
 Holstein dairy herd
 Swine Breeding and research herd
 Steer feeding trials
 Swine feeding experiments
 Distillation trials on termites (shuf)

Zooprolifacico

Manera Technical Director

Peñan Barrial (Cereals) Director

Int. Prod. in v. c. n. production

Medellin

School of Agronomy (Natl. University) Dept. of An. Husbandry

Miguel Hernandez Dean
 Amador de la Cruz Assistant

Live stock research
Dept. of Veterinary Medicine (College of Veterinary)

Turbo Os

Cereté - (Turipana) - C

Alfredo Serrano Director in Charge
 Darío González Dairy Program
 Jaime Vergara Beef Program

Crossbreeding (CFC x "H) steers)
 Crossbreeding (zeru x loro)
 Grazing trials
 Pasture production
 Silage production
 Flight over Choco and Turbo (get way to animal diseases in Central
 America) Observ. d. plant. (c. banana) and (c. yuca)

Barranquilla

INCRAT (facility for beef exports) Rafael Verano
 INDUGAN (municipal slaughter house)
 GILFICO (Milk coop) Dr. Hettinga Margarita

Palmará - C

Julian Buitrage Swine Program
 Horacio Ayala Beef Cattle Program
 Ernesto Huerta Dairy Cattle Program

Swine	Animal expts Molasses and mineral expt Wet and dry feeding trials
Beef Cattle - (Int. Prod.)	Corn vs sorghum silage Int. expts - rotational vs continuous grazing Molasses and cottonseed supplements
Dairy Cattle	Management experiment - costs of feeding Evaluation of tropical grasses Calf raising expts
Commercial swine farm	feeding cachaza (by-product of cane sugar refining)
Dept. of Veterinary Medicine (School of Agronomy)	

University of Vall, Cali

an Martin Director of Virologists
Guy D. Hayes Rockefeller Foundation

ecological orientation of viruses
Well-trained dedicated faculty with strong biological science
departments

Relationship with Nat'l Univ for graduate study in Agr Eng and
Agric Econ

La Finca El - 10A

Francisco Gonzalez Animal Husbandman

Crossbreeding Program (San Martinero x zebu)
(San Martinero x Charolais)

Expt on carrying capacity of different grasses
Mineral v no minerals on pasture

Flight over part of hills
visited ranch El Lirio - fattening cattle on pasture
forage plots mineral supplement trial

EcuadorINIAP

Abian Portilla Director - Central

Santa Catalina

Eduardo Herbas Swine Program
swine feeding expt Molasses
Dutch Dairy Training Center - Several kinds of trainees
1) Farm Mgrs and foreman (6mo)
2) Young farmers
3) Veterinarians (4 wk)

Santo Domingo

Victor Napoles, Director
Alfonso Calles, Swine Program
Hector Clavijo, Swine Program

African Oil Palm
Maize production program
Forage collection - 120 varieties of grasses (5 or 6 good ones)
Swine expt with bananas

Hacienda San Antonio

Large herd of 300 of criollo cattle also purebred Charolais, Angus and
zebu Very good management and excellent pastures 75% calf crop
to all cattle

Pichilingue

Enrique Ampuero, Director
Fausto Cevallos Pastures and forages

Forage and pastures - excellent collection of grasses
Crosses of Criollos x (Santa Gertrudis, Zebu and Brangus) on pasture
Producing 1000 lb plus steers at yrs of age on pasture alone, no
supplement except salt 93% calf crop in cow herds

BRAZILCentro Panamericano de Fiebre Aftosa -

Carlos A. Palacios Director
Mario Fernandez Technical Director

Training Center
Diagnosis
Research
Technical Assistance

Escritorio de Pesquisas e Experimentacao (LRF)

Ayrton Zanon Director
R. F. Buller, Director of Research IRI Research Institute
Alvaro Barcellos Fagundes member of CIAI Board of Trustees

Belo Horizonte

Veterinary Faculty - Jose de Alencar Carneiro Viana, Dean
12 member of Animal Husbandry Faculty

Vicosa

Edson Potsche Magalhaes, Rector
Geraldo Martins Chaves, Director, School of Agriculture
Cliff Spies Chief of Party Purdue
Joaquim Campos, Head An Science
Jose A. Gomide Director of Research

Agricultural University of the state of Minas Gerais
Purdue University - AID contract program
4 graduate programs
Pasture expts - fertilization responses (K)
Crossbreeding dairy cattle (Holstein x Zebu)
(Gir)

Estacao Experimental de Uberaba, Uberaba

Crispino Elias de Aguiar
Luiz de Fátima de Sá Pees Director

Economics of milk production (milk producing strain of Gir)
Performance trials (wt gains)

Good Pasture expts with IRI
 Excellent forage collection
 Regional Afrosa laborator,

IRI Training Center - Matao

Marcos C. Pereira Director
 Hans Steenmeyer Animal Nutrition
 Jürgen Rein Information and Coordination
 Luis Prieto, Soils
 Tochiuko Tanaka Horticulture

Intensive course - 2 (over) year 5th mos. in length

a) English

b) Tech work

c) Subject matter

Other hort courses

Grazing trials: cat tails 14 grasses
 common vs Taiwan Pangola

Silage expt - 2 different conc mixtures

Nova Odessa

(IRI Coop with State
 Ministr. of Agr)

Gerardo Lema de Rocha Director of Center
 Dinzil Martinelli Pasture Program
 E. H. Schneider Animal nutritionist IRI-VID

Nutrition research center

(US work coop with Piracicaba)

grazing trials - height of grazing

yield trial of grasses

wit - Opique ' corn

B-lem

Federal Station (IPIAN) *

Alfonso Wisniewski Director
 Emanuel Seirao Agronomist
 C. Coleman IRI Veterinarian

Crossbreeding Jersey x Red Sindh

1st a buffalo herd for milk production (different breeds)
 (stress tropical conditions)

forage collection - species comparisons

stage of cutting

fertilizer responses

simulated grazing

Major grazing experiment to compare 4 grass species

Forage crop production grain crop

Industrial crops

starch crops (maiz)

School of Agronomy of the MinistryVENEZUELAMaracay

Claudio Chacco Chief An Prod Section
 Viodisco An Nutrition

Centro de Investigaciones Agronomicas (An Prod Section)
 (Review of work in progress at several stations)
 Expt - 4 planes of Nutrition (Economics of milk production)

Facultad de Agronomia

Manuel Benerra Dean

Nutrition Teaching and Research Center
 Animal Husbandry Institute
 Expt on protein and energy levels
 Breeding herds
 Holstein dairy cattle,
 Brown Swiss Dairy cattle swine and sheep

Facultad de Ciencias Veterinarias

Felix Irzabal Dean
 Dieter Plasse Animal Breedin
 Nelson Marquez

Facultad de Investigaciones Veterinarias

Carlos Eduardo Leon R Sub-Director
 Juan Montilla
 Carlos Quiroz, Poultry Lab

Aftosa Vaccine Production
 Diagnostic Laboratory

Estacion Experimental de los Llanos (Calabozo)

Dieter Plasse

Crossbreeding criollos 2 types to Zebu , Santa Gertrudis Charolais
 Red Polled
 Br Swiss
 Planning expts with rice by-products
 Excellent laboratories for chemical work

Centro de Recria San Carlos' (breeding station of MAC)

Breeding herds of Gir and Nellore cattle - good records
 Good Pastures - Pangola Jaragua

La Herreña, La Aparición (private farm)

G. Ciferri

Field Application of performance testing in Zebu cattle
 (good environment conditions)

Hacienda Palo Gordo, Acariqua

Frank Lowry, Manager

Grade Santa Gertrudis Herd - grading up from Criollo
 Milking strains
 Excelente pastures well managed farm

Swine Farms

Three commercial farms (2 absentee owners) - Varying degrees of management

Hacienda Punta Larga (near Maricay)

Grade holstein dairy herd of about 300 head for commercial milk production
 Buys replacement - no breeding program

Seminar

- Discussion with representatives from several educational and research institutions