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Purdue University

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Annual Report

9. ABSTRACT

The over-all purpose of this project is the development of a computerized model of the Guyanese livestock industry. By the end of this reporting year, a working computer model had been made, some preliminary tuning had been done to reproduce more closely the current status of the livestock industry, and the model had been examined and criticized by other members of the project consortium. Additional field work was conducted in Guyana, Belize, and Mexico; to acquire additional production and marketing data relative to the Guyanese livestock industry; to discuss with Guyanese officials policy objectives, instruments, and criteria for valuation of policy; and to evaluate the livestock situation in other countries which are potential competitors in the Caribbean market. In Mexico, data were obtained on the feeding of sugar cane to cattle in confinement, and discussions were held with members of the Mexican Government who have attempted to utilize computerized sector models in policymaking.

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DEPARTMENT OF AGRICULTURAL ECONOMICS

Purdue University

Lafayette, Indiana

211(d) Annual Report

Purdue University

June 30, 1975

211(d) Annual Report
June 30, 1975

Title: Expansion of Competence in the Design and Execution of Ruminant Livestock Development Programs for the Tropics: With Emphasis on the Analysis of Systems of Production and Marketing.

Grantee: Purdue University, Lafayette, Indiana

Director: T. Kelley White

A. Statistical Summary:

Period of Grant: June 29, 1972 to June 28, 1977

Amount of Grant: $400,000

Expenditures: For current year 1974-75, $104,705
Accumulated, $176,988
Anticipated for next year, $110,000

B. Narrative Summary:

The 1974-75 year can best be characterized as one of progress for the Purdue 211(d) team. Following the delays, extended negotiations, and frustrations of the first two years of the grant 1974-75 saw the Consortium in general and Purdue specifically having achieved good working relationships with the Government of Guyana, with USAID and within the Consortium itself. We began the year with an accumulation of basic information about the Guyanese Livestock Industry, with a preliminary conceptual modeling framework on hand and with a much better understanding within the Consortium of the systems modeling concept. This foundation allowed us to concentrate on development and testing of a model of the Guyanese Livestock Industry and implementation of the systems approach to livestock industry problems.

The major thrust of the Purdue effort was focused on development of a computerized model of the Guyanese livestock industry. By the end of the year a working computer model had been achieved, some preliminary tuning had been done to more nearly reproduce the current status of the livestock industry, and the model had been exposed to criticism by other members of the Consortium. Additional field work was conducted in Guyana, Belize, and Mexico. The purpose of this field work was to acquire additional production and marketing data relative to the Guyanese livestock industry, to interact with Guyanese officials concerning policy objectives, instruments and criteria for valuation of policy, and to evaluate the livestock situation in other countries who are potential competitors in the Caribbean market. In Mexico data were obtained on the feeding of sugar cane to cattle in confinement. Also, we interacted with members of the Mexican government who have attempted to utilize computerized sector models in policymaking.

A collaborative research effort was undertaken between Purdue University and a member of the faculty of Economics of the University of Guyana. This research effort involved the conduct of a household survey of meat consumption and acquisition of data necessary for estimation of demand relationships for beef.

Grant funds were utilized to support continued development of a more efficient linear programming algorithm. This algorithm will facilitate the use of linear programming for large problems such as those encountered in modeling of livestock production-marketing systems. Funds were also used to support modification of an existing model of the economic development process to increase the compatability of this model with computer facilities in the less developed countries of the world.

Purdue's capability for data transmission and remote computer operation was expanded through the acquisition of a second tape storage unit and an automatic device control for our second computer terminal. This remote computer operation capability will allow us to utilize the computer facility on the Purdue campus in Guyana and in other countries through telephone hook-up. This capability was tested during the field work in Guyana. The test was successful.

Acquisitions for our library of materials relevant for tropical livestock analysis and systems modeling were continued. Additions were also made to our collection of slides based on grant sponsored travel in tropical countries.

Expertise gained by the Purdue faculty through our 211(d) activitie was drawn upon extensively by the African Bureau of USAID during the year.

A modeling workshop was held at Purdue for members of the Consortium, representatives of USAID and invited faculty from other departments at Purdue University. The purpose of this workshop was to review the Purdue industry model and the Texas A&M herd model and to solicit criticisms and suggestions from other members present.

The Purdue project leader, Professor White, served as chairman of the 211(d) Consortium for the year. The chairman initiated contacts through the African Bureau of USAID with representatives of the Government of Kenya with respect to future Consortium activity in that country.

C. Detailed Report

I. General Background and Purpose of the Grant

The overall purpose of Purdue's 211(d) grant is well summarized in the following quote from the original grant document.

Purdue's grant is one of four that, "would explore the livestock industry from a total systems viewpoint, on the assumption that piecemeal attacks on a complex problem (nutrition, breeding, disease control, or credit) have been inadequate."

The primary objective of Purdue's grant is to strengthen our capability "to identify opportunities for significant livestock developments in LDC's, to analyze constraints to, and reasons for, such developments and to design programs to overcome constraints through an integrated, multi-disciplinary team approach."

Purdue was awarded a supplemental grant in the amount of $150,000 for the three year period beginning July 1, 1974. This supplemental funding was provided to allow Purdue, in its role as the economic and marketing component of the Consortium, to better support the biological production expertise provided by Texas A&M, Tuskegee Institute and the University of Florida. Four specific areas requiring expanded Purdue input were recognized. These are:

1. Expansion of the scope of the industry modeling activity to give greater emphasis to factor and product markets faced by livestock producers;

2. To participate in a Consortium effort to apply the system approach to livestock development problems in a second country;

3. To exercise the integrator-catalyst role that is implicit in the industry modeling activity and;

4. To provide additional economics and systems modeling support to other Consortium members.

II. Objectives of the Grant

1. Objectives Restated

The objective of the grant is to improve the capacity of Purdue University to assist AID, other developmental agencies, and countries in the analysis of ruminant livestock production and marketing systems in the different environments of the LCD's. Such analysis should describe the system, indicate the factors that most seriously limit development, and suggest alternative policies and programs to remove limiting factors.

Steps to be taken to achieve these objectives include:

a. adapt systems approach to a specific tropical ruminant livestock production situation,

b. improve our analytical methodology,

c. increase the number of faculty with relevant experience (in systems analysis and tropical ruminant livestock production),

d. to select a country, and

e. analyze its livestock industry so as to achieve(a through c above).

2. Review of Objectives

A third year has reinforced the recognition, which was discussed in detail in the 1973-74 Annual Report, that the objective set for the Purdue 211(d) team is multi-dimensional. That is, that there are USAID objectives, Consortium objectives and Purdue objectives. It has become increasingly evident that these three sets of objectives are interrelated, and that the achievement of any one sub-set of objectives necessarily will require satisfaction of the other sub-sets. It has become increasingly apparent that the goal of developing a

truly integrated, multi-disciplinary approach to the analysis and solution of livestock development problems within a multi-institutional framework cannot be fully attained through informal voluntary interactio All members of the Consortium appear to recognize that the most difficult of the Consortium's tasks may well be the development of this truly multi-disciplinary team approach. Thus increasing emphasis must be given achievement of this objective during the remainder of the grant. It is also recognized that this will require significantly more formal, structured interaction on the parts of all members of the Consortium.

III. Accomplishments

Accomplishments under the 211(d) grant will be discuss under the headings of steps a through e presented in Section II.1, and under the heading "integration of 211(d) experience" and "involvement of other Consortium members and host country."

a. Adapt systems approach to a specific tropical ruminant livestock production situation (estimated expenses $10,000).

Staff members White, McCarl, and Schrader visited Guyana, Belize, and Mexico during the year for the purpose of collecting additional data and observations to improve the adaptation of the systems model being developed by Purdue to the Guyanese Livestock Industry. In Guyana visits were made to a number of coastal production units for the specific purposes of obtaining additional data for small-and medium-size beef producers and for mixed dairy-beef production. A number of wholesale and retail meat marketing firms were interviewed to obtain data on the structure and performance of the marketing

institutions in the country. Information concerning the governments policy objectives, available policy instruments and criteria used in evaluating policy for the Guyanese Livestock Industry was obtained through interviews with personnel of the Ministry of Agriculture.

Most informed observers of the Caribbean region believe that Belize is the country other than Guyana with the best potential fo developing its livestock industry to the point that significant beef exports would be feasible. Therefore, the group visited Belize to observe the current level of development for livestock production, to determine the country's development objectives and policies with respect to the livestock industry, and finally to evaluate the export potential of the livestock industry.

In Chetumal, Mexico the group visited a confinement feeding experiment conducted by Dr. Preston. This confinement feeding operation is based on the feeding of sugar cane as the primary energy source. This experimental work was of interest because of its potential applicability in the Guyanese situation.

Mexico has for a number of years had at its disposal a computerized model of the agriculural sector of the country and has made some use of this model in policy evaluation. Personnel in the Mexican government with responsibilities for utilization of the agricultural sector model were interviewed to obtain information concerning their experience in the utilization of sector models for policy evaluation. It is hopeful that their experience will help in designing a more useful model for the Guyanese Livestock Industry.

A report of the activities of team members in Guyana, Belize, and Mexico is presented as Appendix A in this report.

One of the areas in which the knowledge base for developing a model of the Guyanese Livestock Industry has been most deficient is that of the nature of the demand for beef. While in Guyana, an agreement was reached with Mr. John Dukhia of the University of Guyana whereby he would conduct field work to provide additional information concerning beef demand. Mr. Dukhia conducted a household consumption survey utilizing a survey jointly developed with members of the Purdue team. He has also written a paper in which he discusses the state of knowledge concerning the demand for beef in Guyana and provides some basic time series for demand estimation. The questionnaire used in the household survey is attached as Appendix B. The paper by Mr. Dukhia on beef demand in Guyana is attached as Appendix C.

b. Improved analytical methodology (estimated expenses $44,700)

A major part of the Purdue effort during the 1974-75 year has been focused on development of a computerized systems model of the Guyanese livestock industry which would provide an improved framework for the analysis of policy alternatives confronting decision makers in the livestock industry. An operating model was achieved prior to the end of the fiscal year. Tuning and validation of this model is continuing, and it is expected that prior to the end of calendar year 1975 the model will have been validated in policy analysis. The model will be documented in the Ph.D. thesis being written by Mr. Ralph May. Appendix D contains a discussion of the conceptual basis for the model and Appendix E contains a brief outline of the model structure.

Mr. Pete Wenstrand, a student in the joint program between the rannert School of Administration and the Purdue Agricultural Economics epartment, developed, as a special problem, a paper treating the easibility analysis for slaughter facilities in less developed countries of the tropics. A preliminary draft of his paper is attached as Appendix F.

Funds provided by the 211(d) Grant were utilized to support continued development of an improved linear programming solver. This solver is designed to handle large-scale linear programming problems and is being utilized as the solution algorithm for the Guyanese livestock industry model. Funds were also utilized to partially support the modification of an existing computer model of the economic development process to increase the adaptability of this model to computer facilities available in less developed countries of the world.

One of the more important variables in determining the demand for beef is per capita income level. Likewise the export demand faced by a livestock producing country is affected by changes in the exchange rate between the currencies of the exporting and importing countries. Preliminary work was begun to incorporate an endogenous income and exchange rate shifter into the demand equation formulation of the Guyanese Livestock Industry model.

c. Faculty with relevant experience (estimated expenses $10,000)

There were two changes in the faculty involvement in the 211(d) project during the year. First, Dr. Bill Morris who had been on leave with USAID in the Ivory Coast returned to campus and resumed his involvement in the 211(d) work. Dr. Arlo Minden who had been on

leave with USAID in Washington resigned from the University. The five permanent faculty members composing the 211(d) team at Purdue represent a broad spectrum of interest and expertise. The areas of expertise include production, marketing, price analysis, economic development, quantitative method, and systems modeling. The entire team is closely involved in the application of systems modeling to the Guyanese Livestock Industry through the development and application of the computerized systems model of the Guyanese industry. All members of this team have had the opportunity, through the 211(d) project, to travel abroad with the exception of one man. This exposure to the livestock industry of foreign countries not only adds to the expertise directly applicable to less developed countries' livestock sectors but also helps to add perspective to their work in domestic programs.

Dr. Morris since returning to campus from his year of leave in the Ivory Coast has had a number of opportunities to work in Africa as a consultant to the African Bureau of the USAID. This experience is being integrated into the 211(d) project by the development of a monograph on the livestock sector of Central West Africa. Two of his consulting trips to Africa were extended by a number of days and per diem provided by 211(d) funds to obtain information for his monograph. A rough draft on the paper of the livestock sector in the Ivory Coast is attached as Appendix G. A summary of Dr. Morris's activities in Africa and their integration into the 211(d) is presented in Appendix H.

d. Choice of location for work (estimated expenses $1,000)

The Consortium through its chairman, Professor White, of Purdue, initiated efforts to choose a second country for systems modeling application. Professors White and Morris met with personnel of the

African Bureau of USAID in Washington to discuss possibilities in that continent for 211(d) activity. The consensus was that Kenya offered the best possibility. A meeting was held with Mr. Harold Jones of AID-Kenya to discuss the Consortium interest in such work. A formal expression of interest by the Consortium was made through a letter to Mr. Jones. AID-Kenya asked for a tentative plan of work and an evaluation of the AID and government of Kenya resources that would be required to support our activity. Appendix H contains the Consortium response to this request.

e. Analysis of livestock industry (estimated expenses $30,000)

Several types of livestock industry analyses were initiated during the year. First, the computer model of the Guyana livestock industry has been used in an attempt to reproduce the current situation as a means of validation of the model. This process is nearing completion. As a second approach to validation of the behavior of the model some preliminary attempts have been made to evaluate development policies. While validation and tuning of the model are not complete, the preliminary results are quite encouraging with respect to the future utility of the model as a policy analysis instrument. On the basis of discussions with Guyanese Ministry of Agriculture a set of development alternatives have been selected for evaluation in Mr. Ralph May's thesis. These analyses will be documented as a part of the thesis.

A second type of livestock industry analysis which was undertaken involved the household consumption survey and acquisition of time series data for use in demand function estimation. Data taken from the questionnaire used in the household consumption survey have been

coded and punched to facilitate computer manipulation. Some preliminary summaries have been developed and the indications are that this survey is giving results which are consistent with previous studies available on beef consumption in the country. Attempts have been made to estimate demand elasticities from time series data for Guyana. These efforts have resulted in unacceptable coefficients thus far. Therefore, we have requested from Mr. Dukhia time series for additional variables and will, during the coming year, continue our attempts to get good estimates of demand coefficients for beef.

The monograph on the livestock industry in Central West Africa, which is being prepared by Bill Morris, is an additional effort in the area of livestock industry analysis. We see this as an excellent means of gaining complementarity between his role in servicing USAID and the 211(d) project.

f. Integration of 211(d) experience into ongoing program (estimated expenses $4,000)

The 211(d) experience is being integrated into the department's ongoing teaching, research and service programs in a number of ways. Additional acquisitions of library material relevant to systems modeling, tropical livestock production, and economic development have been made and will become a part of our library resource. A list of materials acquired this year is presented in Appendix I. Additions were also made to our library of slides based on staff travel in tropical countries. These are available for use in the classroom, for seminars and for the extension program.

The teaching staff involved in the 211(d) project has increased the incorporation of 211(d) experience as examples and illustrations

in their lectures. This is especially true for our courses in mathematical programming and modeling, and our course in agricultural production economics. Those members of the project team who have extension responsibility have incorporated the 211(d) experience into their evaluation of the environment within which the U.S. livestock industry functions. Thus their 211(d) experience has added breadth and perspective to their domestic extension activity.

Dr. Sharples, a USDA-ERS cooperative agent in our department, is involved in a sector modeling project in the Philippines. He has drawn extensively on our experience in Guyana in this phase of his program. One of our graduate students from Canada is developing, as his thesis research project, a model of the Canadian livestock industry. He has interacted extensively with members of the project team in developing his thesis approach. A second U.S. graduate student is developing a computer model of forage production and the beef enterprise at the firm level for an analysis of alternative forage harvesting systems under variable weather conditions. Our experience in 211(d) has been useful in designing this research project, and we anticipate that the results of his thesis research will contribute to future work under 211(d).

During the year Professor White has presented a number of seminars and participated in a televised panel discussion of the World Food Situation. His experience with the 211(d) project has added significant to his knowledge and understanding of the food situation in the world. One of the seminar papers presented is attached as Appendix J.

An effort has been made during the year to involve members of the Animal Science and Agronomy Departments at Purdue University. Faculty

members from these two departments were invited to participate in the modeling workshop held by the Consortium at Purdue University in June. Based on their participation in this workshop we anticipate closer working relationships with these departments during the remainder of the 211(d) project.

g. Involvement of other Consortium members and host country (estimated expenses $5,000)

Other Consortium members have been involved in several ways. The most effective involvement was gained through the Guyana modeling workshop held at Purdue. This was the first time that we had had a working model which could be used to demonstrate for each member of the Consortium the importance of their input into the development of a meaningful model of the livestock industry of a country. Throughout the year close contact was maintained between the Texas A&M and Purdue modeling teams. We are optimistic that this close communication has resulted in the development of two models which are compatible and which in the future can be directly linked in their operation. The producer survey conducted in Guyana by personnel from Tuskegee was made available to Purdue, and the data were utilized in specification of our industry model.

Professor White was invited to present a seminar at Tuskegee on Economic Development in the Tropics. The text of this seminar is presented in Appendix K.

Involvement by the Guyanese in the Purdue 211(d) activity during the year was obtained in several ways. The household consumption and demand study for Guyana has been a joint effort between Purdue staff members and Mr. Dukhia of Guyana. Team members McCarl, Schrader and

White, while in Guyana, interacted extensively with personnel of the Ministry in attempting to identify policy objectives, policy instruments available, and evaluation criteria for choosing among alternative policies. Ministry of Agriculture personnel cooperated extensively in arranging and conducting interviews with livestock producers and marketing institutions. The potential for long run feedback to Guyana from the 211(d) has been enhanced by the admission of Mr. John Ford of Guyana as a Ph.D. student in our department. His thesis research will be supported by and contribute to the 211(d) activity in that country.

The addition to our remote computer capability has increased our ability to interact with both other team members and with the Guyanese in model refinement and application. We anticipate that this increased capability will be extremely important during the application phase of the model during the coming year.

IV. Development of Institutional Capabilities

The impact of the 211(d) grant on Purdue's capabilities has been concentrated primarily on the human resource of the Department of Agricultural Economics. During the first three years of the grant eight individual faculty members have had direct involvement in grant supported activities. Seven of these staff members have been provided the opportunity to observe and study livestock production and marketing systems in one or more tropical LDC's. This exposure combined with experience in developing and utilizing a computer model of the livestock industry of a particular country has not only increased the awareness of the faculty and its knowledge of tropical livestock problems and potential, but has also greatly expanded the capability for analysis of problems associated with livestock production.

Unfortunately two faculty members who have had important involvement in the 211(d) grant activities have left the Purdue faculty for assignments in other institutions. Their contribution to Purdue's institutional capability is not totally lost as a consequence of their departure, however. We have continued to utilize the services of Will Candler as a consultant in our 211(d) project. By maintaining contacts with the individuals in their new institutional environments the potential pool of resources available to be drawn upon in future work is expanded.

In addition to the eight faculty members who have been directly involved as team members, a number of other faculty members within the Department of Agricultural Economics and in other departments of the University have been drawn into grant activities. Thus, they have developed additional expertise and awareness of the importance of tropical livestock in the world economy. As we enter the application phase of our systems modeling activity it is anticipated that there will be more opportunity for involving a larger number of faculty members.

We feel that our success in operating as a research team on the 211(d) project has had a beneficial impact on our faculty. Given the increasing complexity of problems confronting researchers, it becomes more and more difficult for one man to adequately research an important problem. Thus teams of researchers bringing together diverse experience and knowledge are becoming increasingly important to the conduct of good research. We choose to take the team approach in the 211(d) and feel that we have been successful. It has been noted that, increasingly, members of the faculty, when planning research, are taking the team approach - especially when external funding is being sought.

Grant funds have provided resources for adding to our library in the area of systems modeling and computer applications as well as the area of economic development. This added resource makes Purdue a stronger institution for applied international agricultural economics research and training. Use of grant funds to support the development of better linear programming algorithms has increased our ability to solve large linear programming problems. This will have an impact not only on our capability in the area of specific emphasis of the 211(d) grant,but also, to the solution of many types of economic and planning problems. The acquisition of remote computer terminals with taping capability has greatly increased the degree of mobility we have in application of our computer models to the analysis of policy and planning alternatives. The importance of such computer mobility is being recognized not only for international work but by those members of our staff working in domestic extension programs. We are receiving an increasing number of requests to borrow our terminals for use in extension programs out in the states. A proposal has been submitted to a funding agency to establish a network of remote terminals for use in extension activities.

The 211(d) grant, therefore, has not only had an important impact on those individual faculty members directly involved, but has also influenced the thinking of a large segment of the faculty. Not only has the level of knowledge with respect to livestock production and marketing in tropical countries of the world expanded, but also our ability to deliver this expertise to various parts of the world has also been increased.

V. Utilization of Institutional Resources in Development

A significant proportion of the School of Agriculture's international activities has been involved in assisting the development of the livestock sector in developing nations. These efforts are capsulized in the following paragraphs.

AID Contract 639 - Purdue-Brazil Technical Assistance Project

Since the early 1950's, staff from Purdue's Department of Animal Sciences have played an important role in initiating and developing teaching, research, and extension programs in animal sciences at the Federal University of Vicosa (UFV). This has included work in animal genetics, nutrition, production management, and range pasture management. In the early 1950's the UFV (then the UREMG) 1/ initiated a Master of Science program in Animal Sciences. In 1973 a Ph.D. program was begun in this discipline. Eleven members of the Purdue staff have been directly involved in these successful efforts. Under the participant training program several Brazilians have received M.S. and/or Ph.D. degrees at Purdue and other U.S. universities. Most of these have returned to the UFV where they are engaged in teaching and research activities.

Instituto de Lacitcinios "Candido Tostes" (Dairy Technical School) at Juiz de Fora

Under the auspices of the AID Contract 639, Purdue's School of Agriculture also provided assistance to this post-secondary technical school. This assistance was provided in recognition of the acute shortage of trained Brazilian manpower in the area of dairy product processing and handling. Purdue staff assisted in curriculum developme

1/ Universidade Rural do Estado de Minas Gerais.

teaching and initiation of a very applied research effort. New processing equipment was purchased, installed and the staff students trained in its proper use. In cooperation with the dairy industry a successful work study program was begun. As in the case of the UFV project, a major emphasis was placed on staff development with several participants receiving B.S. and graduate training in the U.S. A member of the Instituto staff (Mr. Samuel Hosken) received an M.S. in Agricultural Economics.

Ford Foundation Grant - Institutional Development Program at the National University of the South, Argentina

An important objective of this grant was to assist the Faculty of Agronomy of this university in developing a teaching and research program in range and pasture management and animal nutrition. Four Purdue staff members were involved in this endeavor. Much of the research dealt with the potential of introducing and establishing improved varieties of grasses that would increase the carrying capacity of pastures in this semi-arid region. Funds made available by this project, the Organization of American States and various other sources supported the graduate study of several students from the University of the South at selected universities in the United States, Australia, and Europe.

Bureau of the Census Contract-Population as a Variable in the Economic Development Process with Special Emphasis on Relationships with the Agricultural Sector.

The objective of this contract was to develop a conceptual model of economic development and demographic change and the interrelationship between the two. The conceptual model was then transformed into an

operational computer model. The agricultural sector, in the model, is disaggregated to provide for separate treatment of the livestock sub-sector. It is anticipated that the general structure of this model will be used as a basis for modeling specific LDC situations by the Bureau of the Census. The large scale systems modeling experience gained in this project is useful in 211(d) modeling.

Foreign Graduate Student Training

During the past 20 years the Agricultural Economics Department at Purdue has made an important contribution to the economic development of many countries by providing advanced degree training to their students. Evidence of that Purdue is recognized as an important center of higher education for students from other countries is provided by the fact, that we receive applications from some forty foreign countries. During the 1974-75 academic year we had students enrolled from Brazil, Canada, Sweden, Mexico, Nigeria, Japan, Saudia Arabia, Iraq, Guyana, Nicaraqua, Philippines, Malaysia, Peru, and Ethiopia. Among students who will enter our program this fall are representatives from Philippines, Spain, Nicaraqua, India, and Brazil. During 1974-75 several thesis were completed which treat various aspects of livestock production or marketing either in developing or developed countries of the world. These are:

Smith, John L., M.S., A Linear Programming Model for the Optimization of Management Decisions on the Dairy Farm.

Barton, David G., Ph.D., Physical Distribution System Design: An Application of Mixed Integer Programming to Meat Distribution,

Boehm, William T., Ph.D., An Economic Analysis of the Household Demand for Major Dairy Products.

Lattimore, Ralph G., Ph.D., An Econometric Study of the Brazilian Beef Sector.

Schwab, Gerald D., Ph.D., A Computerized Decision-Making Model for the Beef/Forage Enterprise.

Utilization of Departmental Expertise by USAID and Other Institutions

During the past year the African Bureau of USAID has made extensive use of departmental expertise in the area of tropical livestock development by calling upon Dr. Morris as a consultant in program planning and evaluation in a number of countries in Central West Africa. Professor White has been called upon to participate in seminars and workshops in New York, at Michigan State University, and on campus at Purdue University. These seminars and workshops dealt with the problems of world food supply to meet the needs of an increasing population. Expertise gained trhough 211(d) activities has contributed significantly to our ability to participate in these kinds of endeavors.

VI. Other Resources for Grant Related Activities

Physical facilities and general administrative overhead are provided by the University without charge. Incidental consulting with other staff members is also provided as a University contribution.

VII. Next Year's Plan of Work and Anticipated Expenditures

The following activities are planned for 1975-76:

a. Complete tuning and validation of model of Guyanese livestock industry (estimated expenditure $20,000).
Validation of the computer model of the Guyana livestock industry, which was operating at the end of 1974-75, will require a number of runs. The results of these runs will be compared with data on past performance of the industry and adjustments in input coefficients and possibly other modifications to model structure will be required to simulate actual industry performance. Other members of the Consortium and Guyanese will be involved in this validation and tuning process through workshops to be held during the first few months of the fiscal year.

b. Application of the model and analysis of policy alternatives in Guyana. (Estimated expenditure $25,000).
In consultation with representatives of the Guyanese Ministry of Agriculture an initial set of policy alternatives for evaluation has been chosen. These policy alternatives will be evaluated and the results incorporated in Mr. May's thesis. A formal workshop in Georgetown will be scheduled for late in calendar year 1975 or early 1976. In this workshop a joint Guyanese - Consortium effort in policy evaluation will be undertaken. Following the workshop additional policy alternatives will be identified in corporations with the Guyanese and analysis undertaken. The results of these policy evaluations will be made available to the Government of Guyana.

c. Seminar series in tropical livestock development and systems modeling (Estimated expenditure $2,000).
Grant resources will be used to support a series of departmental seminars dealing with various aspects of tropical livestock development in the world. Representatives of other Consortium member institutions will be invited to present some of the seminars. Authorities, American and foreign with experience in various parts of the world will be invited to give seminars. Other departments of Purdue's school of Agriculture will be invited to participate.

d. Extension of the Guyana livestock industry model (Estimated expenditure $34,500).
It is anticipated that an effort will be initiated to extend the Guyana model to incorporate linkages between the livestock industry and the rest of the economy. This effort will serve as a thesis for Mr. Ford who is a Ph.D. student from Guyana. Other modifications will also be made to link it to the Texas A&M model.

e. Graduate student support (Estimated expenditure $15,000).
Two Ph.D. students will be funded to conduct research which will contribute to 211(d) objectives. One of these students is Guyanese, the other is U.S.

f. Library support (Estimated expenditure $500.00).
Materials relevant to the tropical livestock, economic development, and systems modeling will be acquired for the departmental collection.

g. Second country (Estimated expenditure $13,000).
Based on the Consortium's decision with respect to a second country effort, Purdue will participate in whatever activity is selected. Should a second country effort be deemed advisable, it is anticipated that considerable international travel will be involved.

Table I. Distribution of 211(d) Grant Funds and Contributions From Other Sources of Funding

Review Period 1 July, 1973 to 30 June, 1974

Grant Related Activities	Period Under Review	Cumulative Total	211(d) Expenditures Projected Next Year	211(d) Expenditures Projected to End of Grant	Non 211(d) Funding Amount
Research	87,700	147,700	81,000	313,000	55,000
Teaching	10,000	13,000	12,000	40,000	20,000
Libraries	500	850	500	2,000	6,000
Publication Duplication	1,500	2,120	1,500	5,000	5,000
Seminar, Workshop and Conferences	5,000	13,330	15,000	40,000	
TOTAL	104,700	177,000	110,000	400,000	

Table II. Expenditure Report

Under Institutional Grant #AID/csd 211(d) 3675

Review Period 1 July, 1974 to 30 June, 1975

Line Item	Expenditure to Date		Projected Expenditures Year		
	Period Under Review	Cumulative Total	4	5	Total
Salaries	72,818	113,722	73,700	76,378	263,800
Fringe Benefits	6,903	11,603	7,300	7,600	26,503
Travel	8,828	25,198	15,000	15,000	55,198
Data Processing service & equip.	9,749	15,966	9,000	9,034	34,000
Supplies	6,407	10,499	5,000	5,000	20,499
TOTAL	104,705	176,988	110,000	113,012	400,000

LIST OF APPENDICES

Appendix A	Trip Notes -- Visit to Guyana, Belize and Mexico, T.K. White, B.A. McCarl and L.F. Schrader, February 1-11, 1975.
Appendix B	Questionnaire for Household Survey of Beef Consumption in Guyana, prepared by Mr. John Dukhia.
Appendix C	Marketing Arrangements and the Demand for Beef in Guyana.
Appendix D	Conceptual Basis for the Guyana Cattle Sector Model.
Appendix E	Outline of Structure of Linear Programming Model of Guyanese Livestock Industry.
Appendix F	Some General Requirements for Abattoir in Developing Countries.
Appendix G	Livestock Sector for the Ivory Coast.
Appendix H	A Summary of Dr. Morris's Activities in Africa and Their Integration Into 211(d).
Appendix I	Tentative Consortium Work Plan for Consideration by Kenya.
Appendix J	Library Materials Acquired July 1, 1974-June 30, 1975.
Appendix K	Seminar on Economics of World Food Situation.
Appendix L	Seminar Presented at Tuskegee, "The Economic Development Process and the Tropics."

APPENDIX A

Trip Notes
Visit to Guyana, Belize and Mexico
February 1-11, 1975

T. K. White, L. F. Schrader and B. A. McCarl

Notes by L. F. Schrader and B. A. McCarl

The first day in Guyana consisted of visits to coastal cattle producers.

Kabawer Ranch Guyana-Coastal Area

Kabawer ranch is a subsidiary of Bookers Ltd one of the largest business firms in Guyana. The principal activity of Bookers is Sugar estates and the ranch is one of the estates which is approximately 60 miles east of Georgetown. The ranch is divided into two major productior units; one at Goldsprings, and one extensive operation. Our visit to the ranch was principally at Goldsprings where a feeding and improved pasture operation exists. The Purdue party was accompanied by several Guyanese and met with Mr. Dhaniram, the ranch manager, who gave us the following information.

A definite preference for Bramhan cattle mixtues was expressed. The desired breed was two-thirds Bramhan and one-third Charolais. Improved pasture will handle one head per acre with .5 head per acre on unfertilized pastures. Development of improved pasture involves seeding with improved grasses and fertilization at the rate of 150 lbs. of urea per acre four times during the year depending on the rainfall pattern.

Total ranch includes 3,000 acres run by 12 men plus supervisor. It was not clear whether this includes Golddiggings (600 acres) or not. Most of the cowboys come from the Rupununi area and are presently getting about $30 per week plus meat and housing.

Seven hundred pound liveweight per head has been achieved in two years using improved pasture for the last year.

Research was underway on the feeding of urea/molasses mixed (3, 6 and 9%) at Golddiggings. Present indications are that steers on 3% urea mixture were doing better than those on 6%. The 6% mixture was more effective during the dry season than during the wet season. Molasses-urea was estimated to cost 60¢* per gallon with one-half gallon fed per head per day.

Mr. Dhaniram estimated 60% calving rate of which they may lose 15% during the first year. Annual death loss on adult animals now averages less than 2% per year.

All cattle are sold to Bookers Supermarket but slaughtered at the municipal abattoir with present marketing at the rate of about 12 head per week.

Use of native pastures without supplementary feed will result in an average liveweight of 457 lbs for four year old animals.

Fraser Operations

The second coastal producer visit was to the Fraser ranches approximately 20 miles east of Georgetown. Both ranches owned by Fraser with a resident manager on each ranch. These operations are closer to Georgetown and near the road and cattle theft is a much larger problem. The combination of cattle stealing and the attraction of rice as an alternate crop has resulted in people in these areas reducing herd size. On one operation there were 174 head of cattle on 300 acres of open pasture. Cattle were also grazing on rice straw after the rice harvest under a one crop rice

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*All prices local unless stated otherwise. $1 G - $.45 US; $1 B - $.625 US.

program. The same farm included 150 acres of rice and 300 acres of coconut groves. The coconut groves also provide supplemental grazing for cattle.

This operation considered the major product to be milk, however, cattle were not being fed in addition to pasture for the stated reason that prepared feed prices are now too high to justify supplemental feeding. Cattle graze only during the day and are brought to the house at night where they are fed some grain, and rice straw at night. These cattle were not dairy types but a combination of Zebu and Santa Gerdrudis.

In Georgetown milk retails at 25¢ a pint and the farmer was receiving 12-1/2¢ a pint at the farm. Milk is picked up at the farm by a "collector," transported to a collection point and then to Georgetown by truck.

With 64 cows in the herd there were 41 calves born in 1974 with 12 calf deaths.

Milk production was quite low with the cattle milked once a day getting 326 pints of milk from 10 to 12 cows in a week.

Bull calves are castrated and sold at 3 to 4 years. This brings them to approximately 400 lbs. carcass weight. Cattle are sold to GMC and to C&I market. All sales from this farm are on a carcass weight basis.

Danger of stealing requires that cattle brought in every night which considerably limits forage intake.

The cattle operation on this farm is run by the cow manager plus two boys with an additional helper during rice harvest.

A third ranch of a Hindustani farmer was visited, however, no significant information was gathered.

Meat Marketing in Guyana

On the second day the Purdue team visited meat marketing firms.

Meat market limited is the largest meat wholesaler in the country. Meat for the firm comes principally from the Rupununi area of Guyana through the Lethem slaughterhouse.

All meat is bought and paid for on a carcass weight basis at Letham and sold in quarters in the Municipal Abattoir in Georgetown. All the meat is transported by air from Letham in 6000-6500 pound loads via Guyana Airways DC 3's. The trip represents 7 to 8 hours with 3 hours to get it on the plane, 1-1/2 hours from Letham to Georgetown and 2-1/2 hours by truck to the Municipal Abattoir. Air freight rate to the shipper is 5-1/2¢ per lb. with the government paying a 5-1/2¢ subsidy.

Meat Marketing Limited represents cattle producers and any profits are reflected back to the producers in proportion to the amount of beef marketed. Present prices are $1.12 paid in Letham and $1.35 selling price in Georgetown.

Recently the procedure has been to slaughter to order--the cattle are not killed unless Meat Marketing Limited has orders in Georgetown at that point. MML says coastal beef sells for more because it is younger and somewhat better quality than Rupununi beef. Profits returned to producers represented 8% in first half of '74 and 16% in second half of '74. Prices to producers are held relatively constant and, it appears, at the moment are being held below the competitive price level. One of the reasons given is the fear of governmental control if the price goes very high. Recent price history (Letham) is as follows: 55¢ for 1972; 60¢ for part of 1973 and 65¢ for part of the year going to 75¢ in September 1973; December 1973 went to $1.05 and January 1975 the prices has gone to $1.12 (the current level).

Meat Marketing Limited estimates they handle 90% of the Letham slaughter and this represents 60% of the Goergetown beef.

Meat Marketing Limited sells to all the supermarkets in Georgetown (51.2%), to the market butchers in the Municipal markets (26.2%), and the outside butcher shops (15.4%). The share sold through supermarkets is increasing with six supermarkets in Georgetown at the present time.

The seasonal distribution of demand incudes peaks at Christmas, Easter, and the August Holidays. 1973 and 1974 shipments were interrupted by foot and mouth disease quarantine. The number of plane loads of meat marketed during 1973 and 1974 by month are as follows:

	1973	1974
January	22	3
February	16	8
March	20	14
April	23	8
May	15	4
June	16	10
July	21	12
August	23	13
September	11	14
October	--	20
November	--	28
December	--	26

MML indicates that more beef could be sold in Georgetown at present prices. Notes conflict but seem to be an estimate that 10% more Rupununi beef could be sold at the present price relationships.

MML buys cows at $1.05 (vs 1.12 for steers) but the cow carcasses are sold at the same price ($1.12). There are grades in existence but are not used because all the beef which is available can be sold regardless of quality. All carcasses are sold at one price however, the obviously lower

quality carcasses are distributed among the customers. Two to three cull cows mixed with 10 good steer carcasses can be moved without a discount at this point.

Market Butcher

In Guyana there are several municipal markets. At these markets there are numerous butcher stalls. The Purdue team interviewed one of the 21 butchers at the Borda Market.

When asked, the butcher indicated that beef is beef and that the price is about $1.85 per pound. When pursued further, however, he indicated a willingness to differentiate between the various cuts and will provide the cut that customers order. Some of the prices that we were able to obtain include $2.25 for boneless beef, $1.80 with bone and filet at $3.00.

The one butcher interviewed bought all his cattle direct from farmers on a unit basis without weighing and expressed no desire to change that buying procedure. Typically the cattle are kept at the abattoir to be killed whenever it is needed in the market. The hot meat is brought directly from the abattoir to be hung in the market. The unsold meat at the end of the day is placed in the freezer over night, brought back out and thawed the next day for continued selling off the carcass. His cost includes $6.00 per head slaughter fee plus $5.00 fee for the abattoir. It appeared that the owner of the cow kept the hide however we did not obtain the hide price. Another $5 to $6 per head is involved in hauling the cattle from the farm and $1.25 to $1.50 to bring the carcass from the abattoir to the market. One interesting item mentioned by the buthcer is the consumers preference for hot meat. Consumers do not want refrigerated meat.

Supermarkets

The Purdue party visited 3 supermarkets (Bookers, Frasers and the Coop Market). The following notes summarize the information.

Friday and Saturday are the heaviest shopping days and the time when most of the meat is sold. Both pork and chicken prices are controlled wit the current price level discouraging production and it was typical to find the poultry counter empty. Part of the reason for this is the large poultry producers have their own retail outlets and supermarkets may sell a relatively small portion of the poultry.

Markets are aiming for a 20% mark-up on beef but feel that it average closer to 10% because of inventory shrink. Supermarkets, like the small butchers, sell the entire carcass, bones and all. Supermarket prices are on a prepackaged cut basis with prices clearly posted.

Other sources had indicated that supermarkets served the upper classes and not many of the low income pople. Supermarket managers disputed this with a claim that they were serving a cross section of the Georgetown population.

Policy Issues

The afternoon of the third day consisted of discussions with Minstry of Agriculture people in Guyana (Fernandes, Carter and Hing) on the beef program).

The following objectives outlined a beef development program

1. To diversify agriculture supplementing rice and sugar as export crops.
2. To develop the economy of other regions within the country (interior principally).
3. To make more beef available to consumers at a reasonable price.
4. To provide employment for people. Addition to income secondary to employment.

5. To add to the economy through the production of by-products such as leather, and meat and bone meal.
6. To increase export earnings.
7. To stabilize prices.

Guyana expects to feed not only itself but a share of the Central American market. Guyana and Belize are viewed as the best potential countries for export beef production in the area.

The development of a beef cattle industry must be complementary to existing activities and not a replacement. Thus it is natural to attempt to expand beef production in inland areas rather than where rice and sugar can be grown. They cannot afford to give up anything in order to obtain additional beef production. It is believed that it is not necessary to give up anything to obtain additional beef.

The government of Guyana is presently involved in policies which induce production in the agricultural sector. Among these are subsidies on transport of meat from the Rupununi area to Georgetown and duty concessions on equipment and fertilizer for agricultural purposes. There is a subsidy on veterinary services which are provided by the government and in some cases encouragement in the form of favorable land rental agreements. The normal situation is for land not to be owned in fee simple but as a 33 year lease which is renewable if the land is "beneficially occupied".

When asked how to measure regional impacts of development the GOG officials suggested employment, infra-structure, industry support and income as performance measures.

Capital is not presently a restraint on cattle development. More money is available in the form of loans than there are qualified takers. Foreign investment is not being encouraged.

If the project was dairy production then the major policy objectives should be viewed as:

1. Self sufficiency,
2. Export earnings, and
3. Additional employment.

Implementation Issues

Policy instruments or tools which are available to obtain these ectives include the following tools:

a) Presence of World Bank loan program which provides credit at low interest and long maturity to livestock producers.

b) Formation of the livestock development group to provide better farm management information.

c) Formation of livestock development company a 70% government owned company presently operating two ranches--one in the Rupununi and will take over operations at Ebini.

d) Presence of regional training center established to provide better veterinary assistance and to train extension people.

e) Continuation of government sponsored research stations in various areas of the country.

f) Improvement of slaughter facilities.

g) Institution of production subsidies.

At present the terms of a World Bank loan being used to develop the cattle industry precludes price controls on beef except in case of national emergency.

A major problem restraining agricultural development in Guyana is the fact agricultural labor is considered to be demeaning and therefore is unattractive as an alternative, even for the unemployed presently living in

Georgetown. The National Service Corps is a major effort run by the military to get people on to the land and to develop new areas.

It is expected to operate both as a means to familiarize the people involved with agriculture and agriculture's potential as well as serving as a demonstration of feasibility to other pioneers and settlers.

During the stay in Guyana several miscellaneous activities were carried out.

USAID

The Purdue party met with Mr. George Eason and Fred Marti to discuss briefly the Guyana livestock Industry.

John Duhkia

A contract for the study of beef demand in Guyana was reviewed with the contractee, John Dukhia of the University of Guyana. The proposed contract was signed and Dukhia and Schrader proceeded to discuss the details of data to be provided and received the questionnaire to be used in a survey of Guyanese households.

Computer Terminal

One of the objectives of the trip was to test remote computer communication between Guyana and Purdue. A Texas Instruments computer terminal equipped with cassette capability was transported to Guyana for the trials. This terminal was to communicate with an identical terminal at Purdue. The first attempted on February 2 was frustrated by the size of Guyanese telephones. The headset is approximately 3/4 of an inch longer than a US telephone and would not fit into our accoustic coupler. The second attempt was after Guyanese Telephone officials had installed a telephone we had brought along. This attempt was successful with 200 lines of characters sent with only 2 characters improperly transmitted. Thus on site

demonstrations of models were judged possible.

Cattle Industry in Belize

From Guyana the party moved on to Belize. In Belize the objective was to briefly survey Guyana's major competitor for potential export market. Thought the Belize stay the Purdue party was accompanied by H. Harri Choran. Discussion below is summarized from meetings with government officials, large producers and experiment station workers.

There are presently approximately 40,000 head of cattle in Belize with the herd relatively static at that level. There is retail price control at a relatively low level ($1.00 per pound) which is probably discouraging production at this point. At least it would seem to provide little incentive to expand production.

Belize has USDA clearance for export to the U.S., however none can be exported at this point because of reduced importation by the U.S. The presence of vesicular stomatitis precludes export to rest of CARICOM. This restriction has been relaxed to the extent that cattle from unaffected areas may be exported. However, a recent outbreak in the middle of a heavy cattle area has essentially precluded export from that area at this time.

There are laws which prohibit the slaughter of females except if barren or undesirable as breeding animals. There is also a minimum slaughter weight of 600 lbs. live. However there are real problems in enforcing this law in areas where there is a lack of refrigeration and where small carcasses are desirable.

There are four veterinarians covering the major livestock areas in the country. There is a TB and Banks eradication program about to begin. There are also programs to eradicate vampire bats. There are no parasites or diseases which are considered to be major barriers to livestock development.

Rough estimates are that 40% of the cattle are located in Cayo District, 25% in Orange Walk, 20% in Belize with the balance of the cattle in the other three districts. Each district town has a municipal slaughter house and all have trained meat inspectors. Under the British system inspection is by a Public Health Officer and not by a veterinarian. Only the packing plant located near the Belize City airport has veterinary inspectors acceptable to the USDA.

The municipal slaughter house in Belize is presently doing all of the slaughtering in Belize City. It was characterized as an inadequate facility with major sanitation problems. The meat packing plant, indispensible to the development of export markets, is presently virtually shut down and losing money. Political pressures prevent closing the inadequate abattoir and may well result in bankruptcy of the meat packing plant.

Farmers can slaughter animals on their own farm but it is illegal to sell uninspected meat.

Cattle stealing was a growing problem at a time when the fine being levied for cattle stealing was relatively low ($20 to $30). Enforcement of existing laws requiring a mandatory prison sentence for cattle stealing has resulted in a material reduction in the amount of cattle stealing.

There are no grades on beef in the country and therefore there is no effective way to communicate the desires of the export market for higher quality beef to the producer. High quality beef can be produced but it cannot be delivered now because of the relatively low price. Farm price of cattle is 42¢ for any grade.

At the present time there are no specialized dairy cattle to speak of and all dairy products are imported to the country. There is a desire to develop a dairy industry. Some cattle in the beef herds are milked for home use, however, this is not an important factor.

Beef production systems in use vary from a very casual production system on the Pine Ridge which may produce an animal of 600 lbs. in two years to production using selected animals on approved pasture which may weigh 500 lbs. at weaning.

Vast areas of the country are unused for any purpose at this time. A UN survey some years ago estimated that the cattle production capacity of the country was two to three million head.

The government does its best to keep the cost of food down and this has operated to the disadvantage of developing the beef industry. The government of Belize is the largest single employer in the country and all basic food items are controlled. Import duties and entry taxes on fertilizer, chemicals, machinery and other items used in farming are waived. There are some efforts being made to institute minimum prices at cost plus some reasonable margin for agricultural products. The government is committed to an extensive system of control. The development of agriculture is an item of high priority and development of the livestock industry is a high priority item within the general agricultural development objective.

Government maintains a Central Farm, as a research facility and as a source of breeding cattle, a source of finance and technical assistance for cattle production.

Ministry officials estimated the cost of clearing, seeding, fencing and developing water sources as $500 an acre for land with a carrying capacity of 1.5 to one acre per cow. Some work is being done with the use of fodder sorghums to supplement pasture feed. Some 200 to 300 lbs. per acre of fertilizer (mostly urea) are required to produce sorghum. Urea presently costs about $800 per ton.

The major constraint on livestock development in Belize is getting land cleared for pasture. The cheapest clearing method is hand clearing where local small farmers are allowed to use the land for one year in return for the initial slash and burn clearing operation. Native grass which will appear in cleared areas will carry about one cow per four acres.

Central Farm Research

Research work is underway to find legumes suitable for incorporation into pasture forage. From a botanical standpoint there appears to be a future for legumes in the area. However, it has not yet been possible to find a variety which will maintain a stand during the entire year or to compete effectively with grasses.

Some 400 animals are involved in the research program involving cross breeding between European breeds and Brahman stock. They are convinced the Brahman base is necessary to thrive in the tropical situation. At present Charolais-Brahman cross looks best but this is a tentative conclusion.

They are presently experiencing an 80% calving rate which can be improved and achieving weaning weights of 400 to 450 lbs. in 8 months. An 800-pound plus animal can be marketed at 24 months on grass alone. This is on improved pasture receiving as much as 400 lbs. of urea per year. Improved Pangola grass pastures have yielded as much as 560 lbs. of beef per acre at 1.38 animals per acre and 775 lbs. per acre with 2 animals per acre with 35 pounds of nitrogen fertilizer applied per acre. Native pastures stop growing in the dry season and the animals may lose weight during that period. On improved pasture gains continue during the dry season. The dry season runs from 4 to 6 months with 3 of those characterized as really dry.

The typical stocking rate approaches 2 to 4 acres per head with 800 to 1,000 lb. steers in 3 years and over. An average calving rate runs near 50%. Under current conditions the limits are feed, management, and breed.

There is an extension service but it involves people with limited training and its effectiveness has been limited.

A research station being developed at Orange Walk involves a thousand acres now in the process of being developed. Present land clearing costs are about $90 per acre to push down and windrow the brush. Contractors are now asking $50 an hour for the equipment and depending on the density of the bush may take 2-1/2 hours per acre to do the job. It was estimated the costs would be $200 an acre before fencing. The statement was made several times that hand clearing is probably cheaper than machine clearing but it is too slow and the labor to do extensive hand clearing is not available even though the unemployment rate in the city may be quite high. The estimated cost for fencing was $1,300 to $1,500 per mile with posts 9 feet apart. Some good trees can be salvaged, however, all the land was logged before and little good lumber remains. Land is presently being fenced into 40 and 80 acre pastures.

Approximately 6 months is required to establish pastures and the initial cost of land purchased from the government may run in the area of $7.50 per acre for the Pine Ridge and $24 per acre for better land. Land tenure seems to be somewhere between fee simple ownership and straight leasing programs. But it is less than fee simple ownership. Outside investment is allowed. Once ownership or leashold on land is established taxes are assessed to encourage development and to discourage speculation.

Commercial Operations

Norland Farm operated by Mr. Frank Norris, originally from Illinois but in Belize since 1949, represents an operation carved out of the native bush. It presently consists of 1,600 acres most of which was cleared by machinery 16 to 18 years ago. He's presently achieving 425 lbs. weaning weight going to about 750 lbs. on grass and then into feedlot with corn silage and sorghum silage with some grain and molasses and urea feeding. This herd is pure Santa Gertrudis. Most of his pastures have not been fertilized or reseeded and are presently carrying one cow per acre with a pasture rotation and weed cutting program. He estimates the land can support three cows per acre if row cropped. All the relatively high quality beef produced is presently being marketed through delicatessens or through the meat packing plant in Belize City.

He has constructed a meat cutting and retail selling facility on the farm and expects to sell the entire output of high quality beef from this roadside operation. The farm is a relatively short distance from Belmopan and any additional development there will contribute to the success of this relatively sophisticated roadside stand.

BSI sugar maintains a ranching operation involving 2,000 head of Brahman/Charolais cattle on 4,000 acres of old sugar land. This operation represents an attempt to hold sugar land which is presently located too far from the sugar plant (which has adequate supplies of cane nearby). The management system on this relatively sophisticated operation provides for a calving season during December-May with approximately 80% calving rate. Calves are weaned at approximately 350 to 380 lbs. for the lower quality portion of the herd and about 420 to 450 lbs. at 7 to 8 months in the best section of the herd.

They use 600 lbs. of ammonium suphate fertilizer to get the new grass seed started and expect to have the entire 4,000 acres improved at some point. Presently approximately 2,000 acres are improved and 2,000 acres are native. Present estimates are $50 per acre to get the grass started and $1,000 per mile for a 4-strand fence. Pasture is supplemented with molasses feeding and steers are reaching 1,000 lbs. in 20 months.

All cattle are marketed locally to dealers who move the cattle to Belize City for slaughter.

The range is divided into 30 and 40 acre paddocks with a rotation system depending on conditions at the time. Twenty employees are involved at about $4.50 per man per day.

Mexico

Following the Belize visit we went into Mexico at Chetumal. We were scheduled to spend three days in Chetumal, however, due to air connections we spent one. Activities in Mexico were to visit T. R. Preston sugar feeding operation and to visit government officials on their sector modeling experiences.

Sugar Cane Feeding

Much of what is known about feeding cane to cattle is probably involved in the activities in the experimental station at Chetumal, Mexico under the direction of T. R. Preston has extensive experience with sugar feeding and is running an experimental operation with approximately 1000 head. What appears below is summarized from discussion with Preston and his wife.

The reasons for feeding cane are (1) a very high energy output per unit of land, and (2) a crop that needs a minimum of technical ability or management in order to maintain. It's simply a matter of getting the cane started and waiting for it to grow. Many of the farmers simply do not have the training necessary to grow maize but can handle sugar cane.

The major problem is that the sugar content of the cane drops so low during the wet season that the cattle are barely able to maintain weight.

While the work at the Station is concentrating on attempts to make silage for feeding during the wet season the most obvious reaction is to suggest that cane feeding be used to supplement pastures during the dry season to take advantage of the best of both. Such a program is probably feasible on the basis of methods now known.

Preston's work indicates that chopped whole cane is equal to comfith as cattle feed. Much less power and less expensive equipment are needed to chop whole cane.

Mexican Officals

Over the last 4 years the World Bank and the Mexican government have been engaged in a collaboration agreement to create an agricultural sectoral model. This model, now operational, is called CHAC. The Purdue party went to Mexico City to meet with members of a Presidential Advisory group which works with CHAC. The following notes are from that discussion.

The Mexicans involvement in the sectoral meodeling effort is a reset of policy goals of:

1) Economic growth
2) Employment
3) Export growth
4) Desire for improvement of income distribution
5) Ag Sector growth.

Thus in their involvement with CHAC the Mexicans were seeking aid in formulating policies to help in the above decisions.

Perceived shortcomings of the model were:

1) Heroic assumptions about economic processes particularly labor distribution, mobility and child labor,
2) Static model without transitional behavior
3) Aggregation too broad
4) Investment analysis difficult
5) Competitive framework not correct

Positive influences of CHAC were:

1) Good capability for price simulations particularly with respect to product substitution.
2) Pointed out where data were necessary

Although the model was designed for use with investment and employment policies the Mexicans do not use these features.

The Mexicans related many studies which they were interested in to supplement and complement their CHAC efforts:

1) Subsistence studies and competitive settin[illegible], [illegible] processes, risk uncertainty and information
2) Affects of government set minimum price laws
3) Investigation of the reports of basic crops
4) Investigation of land reform and possible model expansion to examine and account for lows.
5) Inclusion of livestock and accompanying
   a) export policy
   b) grading standards
   c) dual purpose from crop-harvest
   d) livestock cooperatives
6) Competition between efficiency and equity objectives

7) Reorganizational possibilities within farms

8) Expansion of CHAC objective to account for efficiency and equity

9) Investigations into project implementation from an extension viewpoint both existing and future

10) Dissaggregation of model to an irrigation district level

11) Livestock versus human tradeoffs in use of inputs

Government Role

Conversations with technicians in government, farmers and rancher and food processors in the three countries leave one with the distinct feeling that government actions have tended to impede agricultural development despite the best of intentions. Without exception, the twin goals of more and better food and cheap food are in direct conflict.

One can find many examples to indicate that farmers do respond to price (profit) incentives--at least when they are negative. Governments appear unwilling or unable to follow a policy of using long run policy decisions based on partial analysis is layers of controls and subsidies at least half of which are directed toward problems caused by other policy measures.

The prime example is maximum meat prices at retail which preclude livestock profits. This results in the slaughter of breeding herds for which the answer is laws to prevent the slaughter of productive females. Basically none of these laws are enforceable under present conditions. They simply add to bureaucracy, increase risk and keep the honest citizen out of the business.

A second example involves Mexican land tenure laws. Maximum size of private holdings of grazing land is larger than the maximum for cultivated land. Thus, private land suitable for corn production (nominally more profitable) is held in grass for if converted to crops a significant portion

of the land would be taken by government for redistribution to small farmers in whose hands it may be even less productive than in grass.

One is tempted to conclude that better economic analysis and bigger models might help. All that is needed is a valid, detailed model which the politicians (and public) believe is valid. Apparently the first of these is yet to be built.

APPENDIX B

UNIVERSITY OF GUYANA

DEPARTMENT OF ECONOMICS

SURVEY OF BEEF CONSUMPTION IN GUYANA

SECTION I

- DEMOGRAPHIC CHARACTERISTICS -

1. Name of Respondent .....

2. Address.....Urban.....
   .....Rural.....

3. Educational Attainment:

   1. Incomplete Primary ( )
   2. Complete Primary ( )
   3. Incomplete Secondary ( )
   4. Complete Secondary ( )
   5. Higher Education (state) .....

4. Size of Household:
   No. of Adults: .....Ages.....
   No. of children.....Ages.....

SECTION II

- SOCIAL, CULTURAL, RELIGIOUS, BACKGROUN

1. What is the occupation of the Head of Household
   Professional ( )
   Sub-professional ( )
   Skilled ( )
   Unskilled ( )
   Labourer ( )
   Self-employed ( )

2. What is the ethnic origin of the household -

African ( )
East Indian ( )
Chinese ( )
Amerindian ( )
Portuguese ( )
European ( )
Other ( )

3. What is the religious persuasion of the household: -

Christian ( )
Hindu ( )
Muslim ( )
Other ( )

4. What is the total income of the household :-

less than $2,500 per annum ( )
$2,500 - $6,000 ( )
$6,000 + ( )

5. What is the household total expenditure on food per week? .....
6. How much of this is spent on meat? .....
7. Is there electricity in your area? .....
8. Do you own: (a) refrigerator
(b) deep freeze

9. How often do you buy meat? .....

SECTION III CONSUMPTION PATTERN

1. Does every member of the household consume meat -

( ) No ( ) Yes

Does every member of the household consume beef:-

( ) No ( ) Yes

2. If no to the above question - How many .....
   For what reason:.....
   Religious
   Taste
   Custom
3. How much beef did you purchase during the past week .....
4. Do you think that beef is a differentiated product, that is, are there different cuts of meat?
   ( ) Yes ( ) No

5. How much of the following cuts of beef did you purchase during the past week? -
   Brisket .....
   Stew Beef .....
   Steak, sirloin .....
   Steak other .....
   Salted beef.....

6. How much of the following meat did you purchase during the past ~~month~~ week?
   Pork:
   Leg Pork .....
   Pork chops.....
   Shoulder pork .....
   Pork spare ribs .....
   Pork fillet .....
   Mutton.....
   Poultry:
   Chicken.....
   Duck.....
   Turkey.....

7. How would you rank these in order of your preference:

Beef .....

Pork .....

Mutton.....

Poultry.....

order of preference to be randomly listed.

8. Why do you prefer beef to other meats:

Reason:

Appearance ( )

Taste ( )

Nutrient ( )

Custom ( )

9. Should you find the price of beef too high, which meat would you resort to:

Pork ( )

Mutton ( )

Poultry ( )

10. Should your income increase, would you consume:

more beef ( )

same amount of beef ( )

less beef ( )

11. If your income changes by $10 per week how much more beef would you consume per week? ..... lbs.

12. Are there seasonal variations in your consumption pattern - Do you consume more beef during

the Christmans holidays .....

Easter holidays .....

August holidays .....

Any other time - state .....

SECTION IV - PURCHASING PATTERNS -

1. From whom do you purchase beef?

   Meat centre .....

   Supermarket .....

   The Grocery .....

   The Market.....

   The Butchershop.....

2. Does your dealer have refrigeration facilities

   No ( ) Yes ( )

3. Are you satisfied with the level of sanitation of your dealer's premises.

   Very satisfied ( )

   Satisfied ( )

   Unsatisfied ( )

4. Are you satisfied with the quality of beef generally available

   Very satisfied ( )

   Satisfied ( )

   Unsatisfied ( )

5. Are the following costs of meat readily available?

	NO	YES
Brisket		
Stew Beef		
Steak, sirloin		
Steak, fillet		
Steak, other		

6. What are the prices of the following cuts -

	At present	6 months ago	1 year ago
Brisket			
Stew beef			
Steak, Sirloin			
Steak, fillet			
Steak, other			

7. What is the price of beef at present? .....

8. What are the prices of the following:

Pork .....

Mutton .....

Poultry .....

9. Do you think that the price of beef is:

Too high .....

High .....

Just right.....

Low .....

10. Should the price of beef fall, would you

more .....

the same amount .....

less.....

11. Should the price of beef increase by 20¢ per pound, would you buy less?

Yes ( ) No ( )

How much less?.....lbs.

12. Should the price of beef decrease by 20¢ per pound, would you buy more?

Yes ( ) No ( )

How much more? .....lbs.

* * *

* *

*

APPENDIX C

MARKETING ARRANGEMENTS AND THE DEMAND FOR BEEF IN GUYANA

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MARKETING ARRANGEMENTS AND THE DEMAND FOR BEEF IN GUYANA

INTRODUCTION

Throughout the Caribbean there has been continuing discussion on the very important subject of import substitution and the achievement of higher levels of agricultural self sufficiency. It is no surprise that the theme of this conference is "Maximizing Regional Self Sufficiency in Food in the Commonwealth Caribbean". In Guyana, Government has embarked on a policy of agricultural self sufficiency by 1976. "Feeding Ourselves" has become a common parlance in the national vocabulary. It seems, however, that we should not only be thinking of agricultural self sufficiency in quantitative terms but also in qualitative terms. In other words the food composition of the population must in the least conform to certaim minimum nutritional requirements.

A comparison of per caput disappearance of meat and meat products between Guyana and, what is generally referred to as the more developed CARICOM countries would be appropriate. This is presented in the following table for the year, 1967, a year for which comparable statistics were readily available. The table clearly demonstrates that Guyana has the lowest per capita consumption of meat among these countries. This is

rather paradoxical since it is generally argued that Guyana has the potential of being the food basket of the Caribbean.

TABLE SHOWING PER CAPUT DISAPPEARANCE OF MEAT (LBS) FOR THE MORE DEVELOPED CARICOM COUNTRIES FOR 1967

	Trinidad	Barbados	Jamaica	Guyana
Beef & Veal	8.86	18.12	17.05	15.23
Pork & Pork products	9.81	25.01	6.39	4.97
Lamb	1.16	2.57	3.67	.36
Poultry	22.54	21.55	14.52	8.52
	42.42	67.25	41.63	28.08

Mayes J.M.: Meat Production andConsumption Statistics of the Commonwealth Caribbean - (Occasional Series No. 5 - Department of Agricultural Economics, U.W.I.).

The National Food and Nutrition Survey of Guyana[1], undertaken in 1971 reveals that the protein intake of thirty nine percent of the population was inadequate, while for nineteen percent, it was on the border line. (See diagram 1 in the Appendix). It is not difficult to appreciate therefore that the following was one of the recommendations of the Survey - "To focus particular attention on the expansion of production and distribution of

sheep, goats, and fishery resources so as to upgrade the quality of national protein supplies".

Given the low per caput consumption of meat and meat products, the inadequate protein intake of more than half the population, and the phenomenally high prices of meat, what stronger justification can there be for an expanded and more viable livestock sector. With this as the background, the objective of this paper is to discuss the marketing arrangements for beef; to analyse the demand for beef in Guyana and to provide a comprehensive range of statistics relating to per caput disappearance of various types of meat, the prices of meat, and other related economic variables. These are found in the Statistical Appendix. The final section attempts to indicate some policy implications that derive from the demand study. These are merely initial considerations and serve only to indicate the scope of, and the gains to be capitalised from, an expanded beef sector.

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1. The National Population Nutrition Survey of Guyana took place in 1971 through the collaborative efforts of the Government of Guyana, and the Caribbean Food and Nutrition Institute.

THE BEEF MARKETING SYSTEM

In analysing the demand for any product it is necessary that we understand the characteristics and goals of the marketing system. According to Bressler and King[2], the direct and fundamental goals for the marketing system are:-

(i) To provide efficient and economical services and ownership transfers in the movement of commodities from producer to consumer, and (ii) To provide an effective and efficient price making mechanism. Only in so far that the prices that are established through the marketing system transmit the demands of consumers back to producers and transmit the supply conditions forwards to consumers with a minimum of lags, imperfections, and distortions, can the economy achieve the efficient allocation and the economical use of resources in satisfying wants.

The structure of the Marketing System will determine which factors should be used as instruments to balance supply and demand. For instance when consumers demand is price-inelastic, there is less need to use price as a marketing instrument as compared with a price elastic consumer demand. In the former situation, product development and promotion might become more important in the marketing plan.

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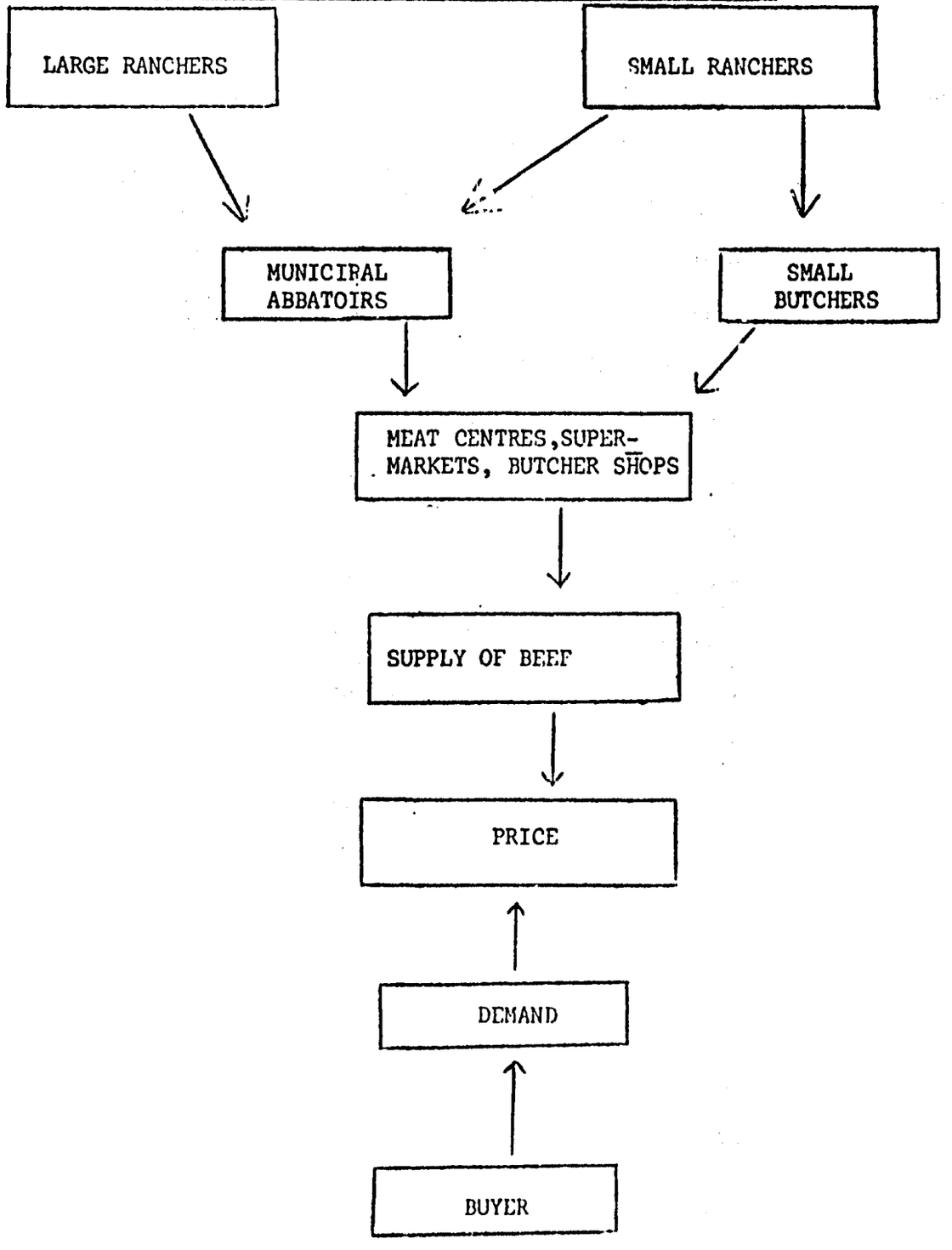
2. Bressler, R.G., and King R.A., Markets, Prices, and Interregional Trade, John Wiley and Sons, 1970.

The following diagram attempts to show the marketing arrangements for beef in Guyana. The following section then gives a brief assessment of the marketing system in terms of the goals and characteristics of the system.

A DIAGRAMATIC REPRESENTATION OF THE BEEF MARKETING SYSTEM



The greater majority of animals are slaughtered at the established abbatoirs located in Georgetown, Lethem and New Amsterdam. As a result of this it is not too difficult to obtain data on the weights of officially slaughtered animals. These are collected on a weekly basis by the Ministry of Agriculture and then aggregated. However, for the dressed carcass weights of unofficial slaughtered animals, it is more difficult to obtain data as these operations are scattered throughout the rural areas and accurate records are not kept. As a result, it was necessary to make estimates for these (See Appendix for method of estimation.)

The distribution centres for meat consist of the meat centres, the Supermarkets, and what are generally called the 'Butcher Shops'. The largest retail outlet would consist of the "Butcher Shops" which are primarily localted in the municipal markets. Generally, sanitary conditions and methods of meat handling are far from desirable. To quote from the Elmer's Report:

> "A review of the report will show that currently the Meat Industry in Guyana is in its infancy. Livestock is slaughtered and the carcasses passed into trade channels for sale as fresh meat. Methods, tools, and techniques are primitive. There is a minimum of meat processing and this is done in a very crude manner. The industry standards of sanitation and disease inspection is totally inadequate".

It seems that the primary objective of the beef marketing system in Guyana ought to provide consumers with a regular supply of high quality beef at reasonable prices while at the sametime making production sufficiently attractive so that producers will be willing to expand. Important elements of the system's environment would constitute consumers, competitors, marketing channels, laws, regulations, and their impact on retail prices. For example in Guyana one would like to quantify the impact of the recent legislation dealing with slaughter on the present retail prices of beef. The resources of a marketing system to be used in order to realise a particular goal are product, price, promotion, and distribution. For that reason, it is important to understand how price interferes with product, promotion, and quality. Finally, the management of the marketing system is crucial. It calls for formal structures in which farmers, the processing industry, and the marketing firms must of necessity cooperate. This has been sadly lacking in Guyana with respect to the beef sector.

The present beef marketing system in Guyana has not performed well. Performance of the marketing system may be evaluated on such criteria as:

(i) how well has it satisfied consumer wants

(ii) level of profits

(iii) efficiency of resources use

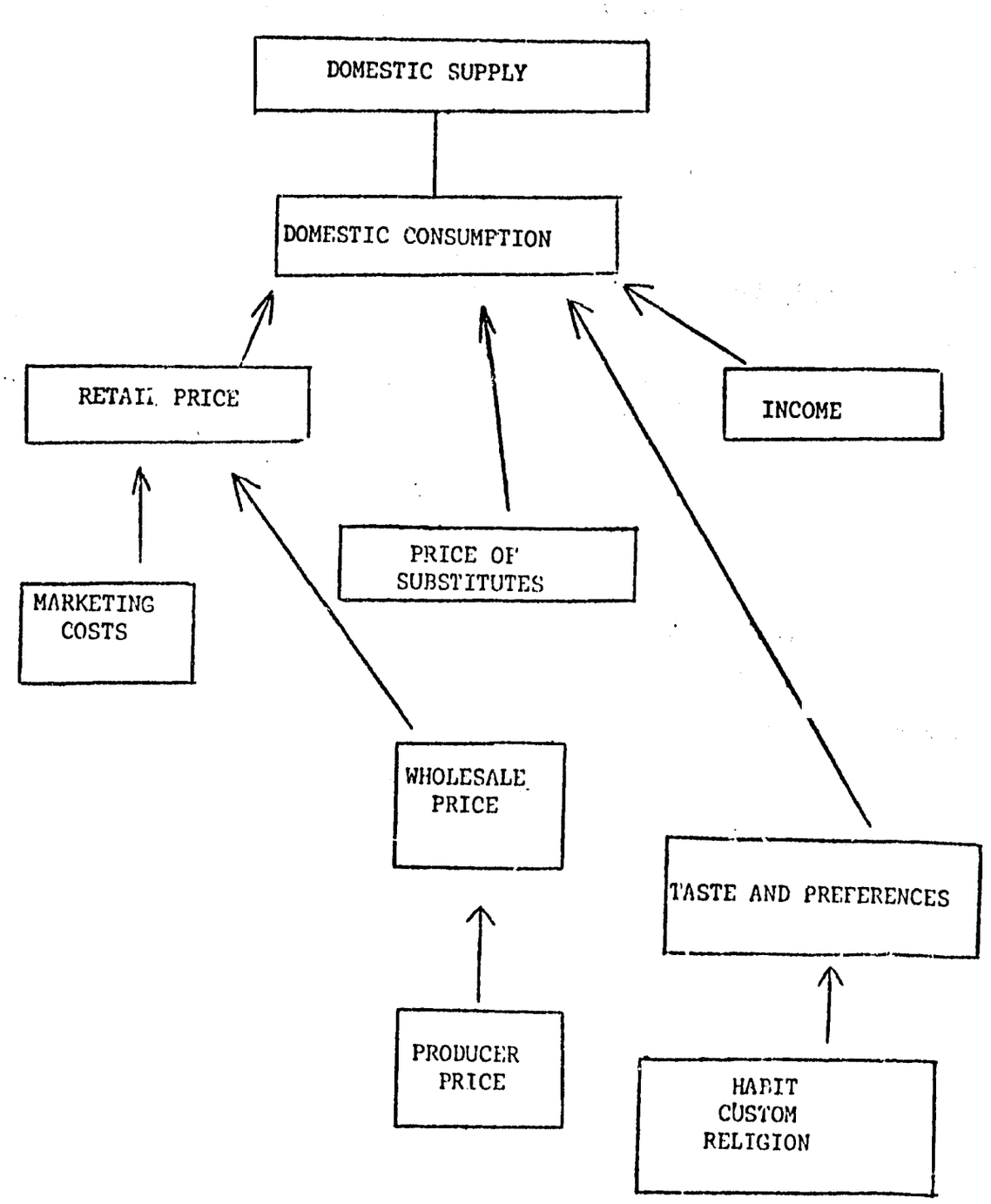
(iv) improvements or innovations adopted

(v) industry growth.

The present marketing system appears to have scored rather low on many of these criteria. Consumers have wanted larger quantities of meat but this has not been conveyed back to the production level. Some consumers would prefer better cuts of meat but these are not generally available especially in the rural areas. The industry has been very static in both new techniques and production despite rapid changes in other meats (e.g. pork and poultry).

THE DEMAND FOR BEEF IN GUYANA

The aim of this section of the paper is to analyse the factors which influence the demnd for beef in Guyana. The following diagram attempts to show the main functional relationships between the consumption of beef and other economic variables.


DOMESTIC SUPPLY
DOMESTIC CONSUMPTION
RETAIL PRICE
INCOME
PRICE OF SUBSTITUTES
MARKETING COSTS
WHOLESALE PRICE
TASTE AND PREFERENCES
PRODUCER PRICE
HABIT CUSTOM RELIGION

As indicated in the diagram the retail price of beef influences the consumption of beef. Variables that relate to the general economy such as prices and quantities of competing meats, and tastes and preferences are independent of the "beef economy". Changes in these external or exogenous variables, however, affect changes in the consumption of beef. A study of current or projected behaviour of prices and consumption of beef necessitates that estimates be made of the exogenous variables.

Economic theory suggests that the demand for a commodity will be some function of the price of the commodity; consumers' incomes; the prices of competing or complementary goods and the tastes and preferences of the consumers.

THE DEPENDENT VARIABLE: The only dependent variable that would be employed in the analysis is the per caput consumption of beef.

THE EXPLANATORY VARIABLE:

(a) The Price of Beef: The price of beef should be clearly incorporated in the model. For a number of reasons price analysis is a fruitful area of research in Agricultural markets. The more important being that agricultural products are more or less hamogenous; have limited product development and limited promotion, and a stable distribution system. There has been some amount of debate as to whether we should use real prices or money prices. Since it is generally felt that consumers do

suffer from money illusion, then real prices should be used in preference to money prices.

(b) Consumer's Income: There are several legitimate measures of income that can be used as an explanatory variable. However, since it is felt that some proportion of income will be taken away in the form of taxes and hence cannot be spent, then it is

(e) Tastes and Preferences: Tastes and preferences play an important role in determining demand. In a country, like Guyana, where religious taboos are attached to the consumption of certain meats, the importance of this variable cannot be overstated. Nonetheless, it is difficult to quantify. One method of circumventing this difficulty is to assume that tastes and preferences change linearly over time and so include an artifical variable that changes by the same amount each year, hence the inclusion of a linear trend variable. The inclusion of this variable may pick up changes in consumption that may occur for a variety of reasons.

THE DEMAND ANALYSIS - METHODS, PROCEDURES, INTERPRETATION

From the data available which is presented in the Appendix, it was quite possible to develop a formal demand model and thus be able to estimate our own price, cross, and income elasticity parameters. The supporting technique that would have been employed is regression analysis. However, the lack of computer facilities for running multiple regressions militated against this. As a result, it was necessary to use another methodology. However, this is merely a stop gap measure, and as soon as it is possible the demand equations would be estimated.

In view of the above, the beef demand projections developed in this paper are a composite of theory, analytical

technique, and judgement. An attempt is made to make explicit the role of each in the derivation of the demand estimates.

Of the various factor that may influence the demand for beef as shown in the flow diagram, this analysis is limited to a consideration of changes in population, per capita disposable income and relative prices. It should be borne in mind that the projections presented here are only as reliable as the data used in the analysis. "No matter how sophisticated the model and the technique, our estimates and the conclusions drawn can be as only good as the data, - the importance of collecting suitable and reliable data and processing it in an appropriate and meaningful way for the problem under study cannot be over emphasised."[3]

DEMAND: POPULATION AND INCOME EFFECTS

The basic growth factors that can affect demand are population and income. As each of these grow, it can have a positive impact on demand. Population has a one to one effect in that if the population increases by one person, then the total demand would increase by the domestic disappearance of

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3. Agrawal and Heady: Operations Research Methods for Agricultural Decisions - Iowa State University Press, 1972.

that additional person. However, income tends to have a different impact for each item in the consumer basket. In the case of beef, we would expect the income effect to be positive. It is only for inferior goods that the income effect is negative. This section concentrates basically on population and income as they affect demand. In another section, the effects of relative prices and other socio/economic factors discussed.

POPULATION GROWTH

YEAR	POPULATION
1960	546,000
1961	560,924
1962	575,030
1963	591,792
1964	606,313
1965	622,407
1966	641,691
1967	658,145
1968	675,001
1969	687,208
1970	699,156

Source: Annual Statistical Abstract, 1971 Exclusive of Amerindians.

From the figures given, the population increased from 546,000 in 1960 to 699,156 in 1970, an intercensal period of ten years. If it is assumed that the census population of 546,000 in 1960 increased by some constant rate of growth which when compounded on an annual basis would yield the census population of 699,156 in 1970, then a natural exponential function can be derived.

$$Y = ae^{tr}$$

where

a is a constant

e = 2,71825, the base of the natural log

t = 10, the number of intercensal years

r = the annual conpounded growth rate

so that we have

$$546{,}000\ e^{10r} = 699{,}156$$

$$e^{10r} = \frac{699{,}156}{546{,}000} = 1.28$$

$$10r = \frac{\log_{10} 1.28}{\log_{10}(e=2.71828)} = \frac{.1072}{.4343}$$

$$10r = .2468$$

$$r = 2.46$$

The calculated average growth rate is 2.46%. If it is assumed that this constant annual growth rate were to continue during the period 1970-1980, then the projected population of Guyana, exclusive of Amerindians, would be 891,489 in 1980. Although this figure may be considered rather crude since it does not take into what are likely to be the changes in the patterns of migration during the period, this should not be considered a serious limitation. This paper merely attempts to determine the approximate magnitude of what is likely to be the potential demand for beef in Guyana in 1980.

PROJECTED POPULATION

1971	716,355	1977	828,807
1972	733,977	1978	849,195
1973	752,032	1979	870,085
1974	770,532	1980	891,489
1975	789,487		
1976	808,908		

- Income Elasticities of Demand and Income Growth Rates -

The income elasticity used in this study is obtained from FAO's commodity Projections.[4] The income elasticity given for beef is unity. Using such an income elasticity presupposes that the income elasticity among the various ethnic groups and the various income groups is the same. However, in Guyana income distribution is shewed and it would be expected that different income groups would bore different income elasticities of demand. This in itself would affect the projections.

With respect to incomegrowth rate, time series data on per capita read disposable income were obtained (See Statistical Appendix). It was assumed that per capita income would continue to grow by the same trend as it did during the period 1960-1973. Using time series data and regression analysis, it was possible to extrapolate real per capita disposable income to 1980. This figure was calculated to be $446, which represents a real income

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4. Food and Agriculture Organisation, U.N., Agricultural Commodity Projections. 1970 and 1980, Vol. II, pp229.

increase of 10.4%.

Projected Demand in 1980

The demand projections would be based on four sets of infesmation, these are:- per capita income; income elasticity of demand; and the projected population in 1980. The general equation for the projection is:

$$Q_i^P = \left[Q_i^b + (Q_i^b \cdot I^P \cdot E_i^I \cdot)\right]\overline{P}$$

Where

Q_i^P = projected demand level at the end of the projection period, 1980.

Q_i^b = per capita consumption in the base period. 1970 is chosen as the base period.

I^P = projected change in per capita income

E_i^I = income elasticity of demand

$\overline{P}$ = projected population in 1980

The equation presented above have been used in a number of studies concerned with explaining and projecting demand.[5]

THE PROJECTION:

Substituting the appropriate values in the above equation, national demand requirements for beef were projected to 1980. The projected demand was calculated as follows:-

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5. See for example:
   1. Martin, Larry J: The Impact of Improved on Regional Production and Prices of Major Food Commodities in Utter Pradesh, India unpublished Phd. Thesis, Univ. of Illinois, 1972.
   2. Robert R. Nathan Associates: Guyana's Food Crop System: An analysis for Development Planning, June, 1974
   Disappearance level, or 23.73% over the 1973 appearance level.

Q_i^b = 14.9 lbs/capita (consumption in the base period, 1970)

I^P = 10.3% (percentage charge in real per capita disposable income)

E^I = 1 (income elasticity)

$\bar{P}$ = 891,489 person

Substituting these values in the equation,

$$Q_2^P = [14.9 + (14.9 \times .103 \times 1)] \; 891,489$$

$$= 14,650,730 \text{ lbs.}$$

This figure represents an increase of 39.7 per cent over the 1970 domestic disappearance level or 23.73 per cent over the 1973 disappearance level.

Some Further Socio/Economic Considerations

The analysis thus far has not considered the effects of price and cross elasticities as they affect demand. Impirical studies have well established that the price elasticity coefficients for most food commodity groups are well below unity (-1.0). In Guyana, FAO has estimated the income elasticity for beef to be unity. It seems plausible to suggest that an increase in supply and thus fall in price would have had a substantial impact on increasing the demand for beef. With respect to the cross elasticity coefficient, there are quite a number of substitutes for beef in Guyana. These include fish pork, and poultry.

Another important factor that affects the consumption of beef in Guyana is that a large proportion of the population is comprised of Hindus. There are certain religious taboos that are attached to the consumption of beef. However, it is generally

suggested that the number of Hindus who consume beef is on the increase. This will in the future have a positive effect on the demand for beef. At the present, there is no emperical work in support of the above suggestion. However, at the present a random sample survey is being conducted and it is hoped that the results of the sample should be able to throw some light on this issue.

POLICY IMPLICATIONS AND CONCLUSIONS

This analysis has been concerned only with the domestic demand for beef. It must be noted that the CARICOM region is a large importer of beef both to meet its own requirements and to provide for its large tourist sector. This is a sizeable market which can be capitalised on. Even if we forget the CARICOM market, and concentrate on the domestic market, we find that in order to satisfy national requirements by 1980, we would need to slaughter 48,035 animals. Immediately, this would have implications for the type of technology that ought to be adopted in the industry, the size of the cow herd that would be necessary to generate the number of animals to be slaughtered, and the type of slaughter facilities that ought to be provided. It seems that these projections are necessary if we are to seriously engage in medium term and long term planning.

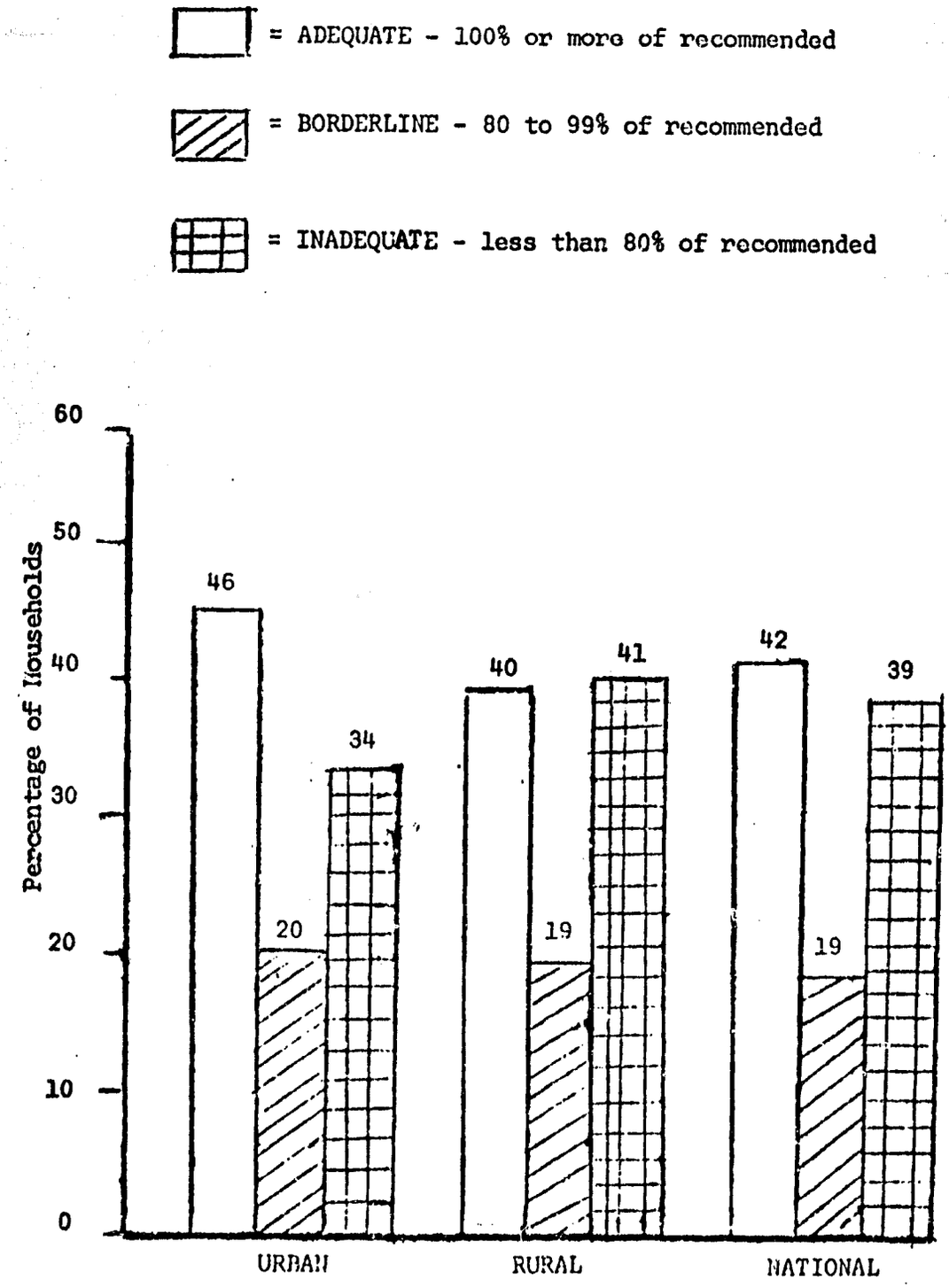
It is unfortunate that at the present time, this study has not been able to estimate a price elasticity of demand for beef. This coefficient is important especially when prices policy have become popular economic measure among governments. Should the government control the price of beef, what are the likely effects on consumption. Recent experiences in Guyana have shown that when

Government controlled the price of chicekn, the demand for chicken immediately increased as people switched their consumption from beef and pork to chicken which became relatively less expensive. As a result, there have been intermittent shortages of chicken on the local market, although the production period for meat birds is just about eight weeks. In the case of beef, the production period is about three years, hence greater caution would have to be taken in instituting a pricing policy especially in terms of supply adjustment to the resultant changes in demand. This study was primarily conerned with demand, there is need for further research on the supply side.

Finally, there is need for further research into the marketing arrangements for beef in Guyana. Most of the research work done to date has either been supply/demand analysis, or technical feasibility studies or appraisal of physical facilities. Supply/demand analysis, while useful, have not explained market conditions very accurately. Consequently further work is required in this area. There is also need to consider the vertical integration of the industry and the spin-off industries that can be developed as a result of an expanded livestock sector.

Figure 1

PERCENTAGE OF HOUSEHOLDS WITH ADEQUATE AND INADEQUATE PROTEIN INTAKES IN URBAN AND RURAL AREAS



Source: Table 688 - Guyana Survey 1971.

Year	$m. National Income	$m. Personal Taxes	$m. Disposable Income	$ Per Caput Disposable Income	Real Per Caput Disposable Income
1960	227.6	4.2	223.4	409	386
1961	248.6	4.2	244.4	435	407
1962	250.7	4.6	246.1	427	387
1963	230.8	5.2	225.6	381	338
1964	255.9	5.8	250.1	412	364
1965	252.3	4.4	277.9	446	384
1966	297.6	5.3	292.3	455	384
1967	323.4	7.7	315.7	479	392
1968	343.4	14.6	328.8	487	387
1969	367.0	15.4	341.6	497	389
1970	391.1	18.4	372.7	533	404
1971	425.9	18.9	407.0	568	422
1972	473.1	20.2	452.9	617	439
1973	512.6	22.3	490.3	651	425

* Deflated by all Items Index.

Source: Bank of Guyana Annual Reports
Annual Statistical Abstract, 1971.

PRODUCTION AND DOMESTIC DISAPPEARANCE

MUTTON IN GUYANA (1960-1973)

	Total Production lbs.	Net Imports lbs.	Total Disappearance lbs.	Per Caput Disappearance -lbs.
1960	25,979	82,595	1,085,474	.1988
1961	27,632	84,396	112,028	. 199
1962	42,550	83,785	126,335	. 219
1963	56,541	81,190	137,731	. 232
1964	81,009	88,683	169,692	. 279
1965	84,700	90,197	174,897	. 281
1966	107,000	73,863	180,863	. 281
1967	118,000	117,125	235,125	. 357
1968	114,200	82,377	196,577	. 291
1969	148,900	61,442	210,342	. 306
1970	138,800	52,134	190,934	. 273
1971	111,200	68,952	180,152	. 251
1972	115,000	15,458	130,458	. 177
1973	75,000	-	75,000	.0997

Source: Files from the Ministry of Agriculture.
Annual Accounts relating to External Trade

Mayers, J.M: Meat Production and Consumption Statistics

Figures of the Commonwealth Caribbean.

PRODUCTION AND DOMESTIC DISAPPEARANCE

OF PORK IN GUYANA (1960-1973)

	Total Production lbs	Net Imports lbs	Total Disappearance lbs	Per Caput Disappearance lbs.
1960	665,896	1,364,214	2,030,110	3.718
1961	659,916	1,427,346	2,087,262	3.721
1962	850,217	1,282,741	2,151,116	3.740
1963	989,641	1,300,899	2,290,540	3.870
1964	1,000,000	1,412,183	2,412,183	3.764
1965	1,000,000	1,282,367	2,282,367	3.667
1966	1,400,000	1,528,168	1,928,367	4.563
1967	1,700,000	1,349,728	3,049,728	4.633
1968	2,100,000	13,034	2,113,034	3.130
1969	2,600,000	51,170	2,651,170	3.857
1970	2,600,000	3,247	2,596,753	3.714
1971	3,300,000	1,273	3,298,727	4.604
1972	3,400,000	2,192	3,398,727	4.63
1973	3,100,000	- =	3,097,808	4.119

Source: Extracted from files of the Ministry of Agriculture - Annual Accounts Relating to External Trade.

Mayers, J.M.: Meat Production and Consumption statistics of the Commonwealth Caribbean.

PRODUCTION AND DOMESTIC DISAPPEARANCE OF POULTRY (DRESSED) IN GUYANA

(1960-1973)

	Total Production lbs.	Net Imports lbs	Total Disappearance lbs.	Per Caput Disappearance lbs.
1960	1,093,419	102,976	1,196,395	2.191
1961	1,416,159	82,409	1,498,568	2.671
1962	1,304,758	47,051	1,351,809	2.35
1963	1,014,381	80.667	1,095,048	1.85
1964	1,900.000	117,314	2,017,314	3.327
1965	2,100,000	41,318	2,141,318	3.44
1966	4,200,000	30,001	4,230,001	6.59
1967	5,500,000	48,071	5,548,071	8.429
1968	5,900,000	33,891	5,933,891	8.79
1969	6,000,000	31,893	6,031,893	8.777
1970	7,500,000	34,327	7,534,327	10,776
1971	8,700,000	34,956	8,734,596	12,193
1972	10,800,000	2,285	10,797,715	14,711
1973	12,500,000		12,500,000	16,621

Source: Extracted from Files of the Ministry of Agriculture
Annual Accounts relating to External Trade
Mayers, J.M.: Meat Production and Consumption Statistics of the Commonwealth Caribbean.

RETAIL PRICES/LB. 1960 - 73 MUNICIPAL MARKETS

Year	Price of Pork	*Real Price
1960	82.3	78.4
1961	80.7	75.5
1962	74.5	6[illegible].2
1963	75.0	66.1
1964	74.3	65.8
1965	74.9	72.2
1966	75.0	62.1
1967	75.2	60.5
1968	75.0	58.3
1969	75.9	58.7
1970	71.1	52.6
1971	77.5	56.1
1972	81.8	55.8
1973	102.4	61.2

Source: Files from the Ministry of Agriculture

*Deflated by Food Price Index

RETAIL PRICES/LB. 1960 - 73 MUNICIPAL MARKET

Year	Price of Beef	*Real Prices
1960	43.4	41.3
1961	45.5	42.6
1962	50.5	46.2
1963	57.1	50.3
1964	56.6	50.1
1965	55.0	46.7
1966	60.9	50.4
1967	60.0	48.3
1968	62.6	48.6
1969	65.2	50.4
1970	73.7	54.5
1971	75.4	54.9
1972	79.3	54.1
1973	117.9	70.5

Source: Files from the Ministry of Agriculture

*Deflated by Food Price Index

RETAIL PRICES/LB. 1960 - 73 MUNICIPAL MARKETS

Year	Price of Mutton	*Real Price
1960	98.	93.4
1961	102.	95.5
1962	104.4	94.8
1963	109.8	97.4
1964	110.0	97.4
1965	107.0	90.9
1966	110.0	91.2
1967	110.0	88.6
1968	109.3	84.9
1969	116.0	83.7
1970	122.8	90.9
1971	136.7	98.9
1972	142.6	97.9
1973	170.0	101.7

Source: Files from the Ministry of Agriculture

*Deflated by Food Price Index

RETAIL PRICES/LB. 1960 - 73 MUNICIPAL MARKETS

Year	Price of Poultry - Dressed	*Real Prices
1960	94.	89.6
1961	96.	89.8
1962	98.	89.8
1963	97.7	86.2
1964	100.2	88.7
1965	98.0	83.3
1966	86.4	71.6
1967	91.2	73.4
1968	96.9	75.1
1969	100.3	77.5
1970	102.0	75.5
1971	92.9	67.2
1972	100.5	68.5
1973	117.3	70.1

Source: Files from the Ministry of Agriculture

*Deflated by Food Price Index.

APPENDIX D

CONCEPTUAL MODEL

In the development of a policy oriented model, we must first determine what information is important to the policy makers to improve their decision making environment. The first section discusses policy instruments which decision makers have available to influence the development of the cattle sector. The next section discusses the types of performance information which would aid the decision makers. The third section discusses the coefficients that can be influenced by governmental programs and policies. These first three sections describe the linkage between government policy and the policy oriented model developed in this study.

The final section presents a general description of the cattle sector model. This description includes discussions of major components, interactions, and specific relationships included in the sector model.

Policy Instruments

Policy instruments available to influence development can be divided into four types: (1) research and education, (2) investment, (3) direct legislative control, and (4) taxes and subsidies. The first two types of instruments may, or may not require enabling legislation, but they are differentiated from the last two types by their requirement of an outlay of investment funds. Funds for research and investment expenditures by the government are derived from internal taxation, international loans,

and international grants. Private investment is stimulated by proper use of the four types of policy instruments to create an attractive (profitable) climate for investors. In order to stimulate the development of the cattle sector, the LDC must utilize these instruments to create an environment that is both technically and economically attractive for the production of cattle.

Research and Education

An economy wide model would be required to allocate all available research funds among competing areas within the economy. In order to answer research allocation questions within the cattle sector, it is assumed that the decision has already been made and funds allocated to the development of the sector. The model can then analyze the effects of the different allocations of funds between investment and research projects and between specific research projects within the sector.

Research projects helpful to the cattle sector could be in forage production, nutrition, breeding, extension, veterinary science, economics, farm management, or many other disciplines. Planning of research is an important part of a successful research program which thus far has been omitted in many areas. Development of a better breed of cattle for an area is of little or no benefit if the forage is not available, disease kills them off, or the extension service is not able to educate the ranchers in new management practices required to obtain maximum benefit from the animals. As these other constraints to development are relaxed, breed improvement will be required to enable future increases in cattle production to be feasible within a specific region.

Time lags of many years between the inception of research projects and development due to the research performed further complicates research planning. For research projects to have maximum effect, the constraints to development must be identified far enough in advance to enable project completion to correspond with the need for relaxation of the constraint. A comprehensive research plan would include projects in most of the areas listed above with timing of projects being dependent upon the urgency of relaxing the constraint and the length of time required for project completion. In the plan, short-term projects of immediate concern and longer-term projects to relax forecasted constraints will be recommended to begin simultaneously to allow for project completion corresponding to the need for the results.

Education and training functions can be performed either at a general level or a sector level to improve the ability of the citizens to produce livestock and other goods. An increase in the general level of education within the country will provide a more productive labor force. At the sector level, specialized training programs in meat handling and processing and extension education programs for farm managers and workers provide the sector with more productive workers in these areas. Governmental support of education should lead to a more efficient livestock sector which in turn would contribute to the overall development of the economy of the country.

Investment

Funds allocated to the development of the cattle sector can be easily divided between competing research and investment projects on the basis of which one yields the greatest returns to the capital invested. The

primary problem is the allocation of funds to large investment projects which benefit both the sector and the economy as a whole. The sector model will supply information on the benefits derived within the cattle sector from the investment. If the value of the investment can be obtained from the rest of the economy, the summation of the value to the cattle sector and the rest of the economy should provide the necessary information to calculate a rate of return of the large investment projects. Once the sector model has identified a regional constraint to the development of the cattle sector, the above valuation must be made to allow for comparisons with other economy-wide investment projects.

Each model solution identifies physical constraints to development and places a value on relaxing each constraint. Long-term solutions of the model will provide a basis for investment planning within the sector. Coordination of research and investment plans on a long-term basis should lead to more efficient use of the LDC's limited funds.

Public expenditures and policies can also be used to create a desirable environment for private investment within the livestock sector. A good example of this sould be the construction of a road into an interior region which would encourage private ranching along the road and make truck transportation feasible. As the area long the road develops, more private investment would be encouraged to provide services to the people living in the area and general development continues.

Direct Legislative Control

The power to enact and enforce laws provides the government with a very strong set of tools to influence the development of the cattle sector of the LDC. Proper utilization of this power can create an environment

conducive to an expanding cattle industry. This power can also be used in conjunction with research and investment policies to reinforce their affect on the development of the cattle sector.

Price controls are a tool available to the government which have historically been misused in many LDC's. Many LDC's use price controls to keep the cost of food low, which discourages the development of the agricultural sector. Artificially, low food prices result in low economic returns to the sector. A sector with lower than average economic returns can attract neither the necessary capital nor manpower for accelerated economic development.

Specific mandates can also be imposed on a specific industry which limits their freedom to make their own decisions. Quarantines can be imposed to restrict the spread of a contagious disease from one geographic location to another. The imposition of a quarantine restricts the freedom of the individual cattle producer but is necessary to the survival of the national industry. When the imposition of a quarantine is necessary, the government should pass legislation to minimize the losses suffered by the affected producers (short-term operating loans, for example).

During periods of extremely high cattle prices, the government may be forced to restrict the slaughter of female and immature stock. This mandate restricts the freedom of the individual producer but is necessary to ensure a long-term meat supply for the country. In order to avoid placing undue hardship on individual producers, the government should encourage active trade in breeding and immature cattle markets.

It is evident from the above examples of government's power to legislate, that indiscriminate use of the power can lead to disaster

within the cattle sector. On the brighter side, legislation can be used as a very effective tool to encourage development of the cattle sector with proper planning and coordination of actions. The danger always exists that the government will attempt to substitute laws for economic forces and produce a controlled economy with no flexibility to market forces. Resource allocations under a controlled economy are usually not optimum therefore the development of the economy is suppressed.

Taxes and Subsidies

Taxes and subsidies are important tools to encourage actions by the private sector which are desirable to the government. Unlike many laws, taxes and subsidies do not dictate action but provide an economic incentive for action desired by the governing body. When the LDC faces a balance of payments' problem, high import taxes tend to discourage the use of imported inputs and encourage the use of domestically produced inputs. The governing body must realize that the imposition of the import tax will create an increase in the price of products or a decrease in the quality due to the forced shift in input usage. Price increases can be avoided by providing a subsidy equal to the increased cost, which will leave the industry in the same relative position as before the tax.

Income tax holidays can be declared for producers in a region to encourage settlement in that specific region. Government subsidies can also be used to provide income increases to citizens in a specific trade or area.

Taxes and subsidies are wide ranging tools which affect many segments of the economy. In order to effectively use these tools to

encourage development, the government must consider all of the consequences of the action taken. In many cases, an action which produces the desired results in one sector, creates undesirable situations elsewhere in the economy. Before enacting the legislation, the government must either be willing to accept the undesirable consequences or provide relief to the damaged parties. Care must be taken when giving relief to the damaged parties not to eliminate the benefits of the initial progra-

Performance Information

Information on the probable performance of the cattle sector under alternative governmental policies and programs will improve the ability of the decision makers to stimulate the development of the sector. This information should also point out inequalities brought about by the selection of a specific course of action. The identification of constraints to development in each time period will provide the policy-makers with criterion for long-term policy planning.

In order to make better policy decisions, the decision-makers need information on: (1) producers' income by region and technology, (2) rate of return on specific capital investments, (3) regional herd composition and offtake, (4) regional labor usage, (5) constraints to the development of the cattle industry by region, and (6) value attributed to relaxing these constraints. A policy model should provide the above type information to the decision-makers and be capable of illustraing the long-run effects of the policies on the cattle sector.

Producer Income

Information about income earned by production systems within each region would be useful to policy makers in planning long-term production to meet the country's needs. Increased cattle production should be easier to obtain in the short-run in an area where profitable production is present and production techniques are well defined. In other regions, where cattle production is either unprofitable or absent, substantial amounts of research and investment will be required to create a viable cattle industry. Knowledge about producer income over time will also permit planners to get at the cost of subsidizing unprofitable units as a means of obtaining a short-run supply of meat.

Capital Rate of Return

The rate of return on both private and public investments will provide the policy makers with a yardstick to measure the success of investment projects. Private investment projects which yield high rates of return provide more capital to be invested in the cattle industry of the country. High yielding public investments can reduce the cost of beef production which results in either lower prices for beef or more profit for the producers. Either of the above results is good for the development of the country.

Even though rate of return may serve as a yardstick to evaluate competing investments, some investments will be required that produce very low rates of return in order to relax a critical constraint to development. These types of investments have a very high rate of return to the country in that they usually open up a large number of potential projects for future development. The actual rate of return to a pioneer

project of this nature would include part of the return to future projects which are unknown until the initial project is completed. This inability to accurately calculate the future returns to a project is a major disadvantage of project selection, based only on the projected rate of return. In this study, both the rate of return and most limitin constraint criterion are used to evaluate the value of a project.

Regional Herd Composition and Offtake

Information on regional herd composition and offtake enables the decision makers to evaluate the efficiency of cattle production in each region in the short-run. The identification of less efficient cattle production regions is the first step to the formulation of meaningful research projects necessary to the development of the cattle sector. Comparison studies could be made to find the causes of efficiency difference between the regions once the relative efficiencies are known. The results of these studies could serve as a guide to the development of a short-term research plan.

Long-term information on regional herd composition will provide the decision makers with a plan for intra-regional cattle movements necessary to supply the domestic market for beef. Possibilities for future export of beef can also be obtained from the long-run analysis. This information could guide the decision makers for future international trade contracts.

Labor Usage

Information on regional labor usage in the cattle sector under different development schemes will provide a basis for governmental

planning of a service industry to satisfy the needs of the area. This information will also provide the decision makers with a basis for adoption of migration incentive programs to encourage labor movement into labor deficient regions. If a large unemployment problem exists, the decision makers may wish to place strong emphasis on employment creation by selecting a slightly less productive scheme which requires more labor inputs.

Regional Constraints to Development

Identification of constraints to the development of regional cattle production permits the decision makers to focus attention on the most important firm level problems. Problem areas may be broadly defined, but more specific research in the area can identify the specific problem. Prior to identification of constraints to firm level development, the decision makers know only that the production of beef is low in a specific region. They have no idea as to whether disease, lack of nutrition, inferior breed, or management prblems is the primary cause of the low production. A large scale research effort would be required to find the problem area with most of its focus away from the immediate problem. By utilizing the information about the constraints to development, research efforts can be focused more directly on the problem at hand.

Long-run analysis will identify constraints to development over time thus allowing for long-term planning of government programs and policies. Planning is most important when looking at longer term research and investment programs which require years to become effective at the marke level. Due to construction time required, the processing and delivery

subsectors require relatively long lead time to avoid a backlog of animals in an isolated region where rapid development is occurring in cattle production.

Value of Relaxing Constraints

If many constraints to development are identified, the decision makers need to know their relative importance. This information is presented to them in the form of a value attributed to relaxing the constraints. Once a high priority constraint is relaxed, new binding constraints are identified and valued for the decision makers consideration. Establishing priorities is required because most countries have a limited amount of resources to use and they are interested in expanding their time and money where it will produce the most benefit to their country.

Reflecting Government Programs and Policies in the Model

Inputs to the model must be capable of explaining changes in the cattle sector brought about by specific government programs and policies. In order to allow for the best possible explanation of farm production, the model is constructed with a disaggregated farm production component to allow for changes in very specific coefficients. More aggregated input data are used for the processing-distribution components of the model to keep the model size reasonable. When the model is used in other LDC's, the emphasis may be shifted by aggregation of parts of the farm production component and disaggregation of some other components of the model.

The remainder of this section will be devoted to the explanation of the inputs available to reflect government programs and policies to the model used in this study which emphasizes the farm production component This is not to imply that the rest of the cattle sector is not important to sectoral development, but farm production is necessary before any binding constraints are defined in the other components. LDC's with more developed farm production components would be best served with a model with more disaggregation in the processing and distribution components.

Development of Cattle Production

A relatively large portion of the resource budget in LDC's is allocated to technological development at the farm level. In order to properly reflect the results of this research on the cattle sector, the input data at the farm level is very specific to allow for very detailed changes in performance coefficients. Programs in disease and death control are reflected in the model by changes in the death loss and increases in the performance of cattle in the technology. An effort to control a contagious disease in an area would be reflected as a revision to the disease coefficients of all technologies within the area. In contrast, a new technology which improves cattle production by better grasses would only affect the technologies where the grass is introduced. To make cattle movement between areas and management systems possible, the national herd is maintained in the model by age and type animal. Live cattle movement is allowed both within each yearly solution and between years in the annual update routines.

Follow up investment projects are sometimes required to activate research results to encourage development in the cattle sector. Farm level investment projects can be influenced by the government making investment funds available to ranchers for specific investments. Direct government investment projects usually influence the production coefficients of most ranches in an area, resulting in a revision of most technologies in the area.

Taxes and subsidies can be used to entice farmers to change their input mix or change production technologies. These changes in the farm environment are frequently relayed to the model as changes in incomes derived from the different technologies in the country. A very effective tool to encourage cattle production in a specific area is to utilize tax holidays and input subsidies to reduce production costs of ranches in the area. Transportation subsidies are widely used to encourage interior development in many LDC's.

Laws which place restrictions on the farmers' actions are another tool available to force farmers to act in a selected way. These restrictions enter the model as restrictions on the freedom of farmers to make their own decisions based on economic factors. The laws can restrict sales, purchased inputs, land use, or about any phase of cattle production.

Beef Marketing Policy

The demand for domestically produced beef is affected by the import and export policies of the government. In a free market, government restrictions on the import of beef will result in a higher farm level price for cattle than would exist if meat supplies were increased via

the import market. Active government participation in the export of meat also cuts the domestic supply and results in higher farm prices. Both of the above policies work in favor of the cattle sector by restricting supply which in turn increases the income of ranchers in the country.

More efficient marketing systems result in an increase in the farmers' share of the consumer dollar. Likewise, a reduction in processing and transportation costs increases farmer income at least in the short run. Demand elasticities at different levels of the market could be such that long-run consequences of increased efficiency in the cattle sector would be lower prices at retail so that the consumer gains outweigh the producer gains. Whether the farmer or consumer gains, the effect would be to improve the standard of living in the country.

The above marketing policies are reflected in the model as changes in supply of meat and costs of intermediate production, respectively. The final result of more efficient beef production is only known after long-run solutions of the model are presented.

Major Model Components

The model is composed of four major components:

1. Domestic beef production.
2. Domestic beef consumption.
3. Import and export of beef, and
4. Supply of inputs.

The first major component along with imported beef provides the supply of beef available for domestic consumption and export. In the same

way, the second component along with export of beef provides the demand for beef which is faced by the cattle production sector. The fourth component of the model represents both domestically produced and imported inputs used in the cattle sector of the economy. Imported and domestically produced inputs are kept separate to allow for the possibility of imposing import restrictions to reduce balance of payments problems that frequently develop in LDC's.

Figure 2.1 illustrates these major components with the major flows represented by the arrows between the components. The dotted lines in Figure 2.1 represents the money flows between the major components of the model. Interactions between the inputs industry and the population are represented as a labor supply activity represented in Figure 2.1 by a labor output from the domestic beef consumption component and a money flow from the input industry.

Domestic Beef Production Component

The domestic beef supply will be obtained primarily from the domestic beef production component with the exception of imported beef (usually of specialized character). With demand at the farm level being derived from the retail demand, this component will include farm production transportation, slaughter of the animals, and disposition of the meat to the consumer.

Each region within an LDC will have a number of possible cattle production management systems, all with their own definitional coefficients. These management systems may vary by only one coefficient, but for a realistic model, there must be a relatively large number of possible management systems within a region. Changes in existing management

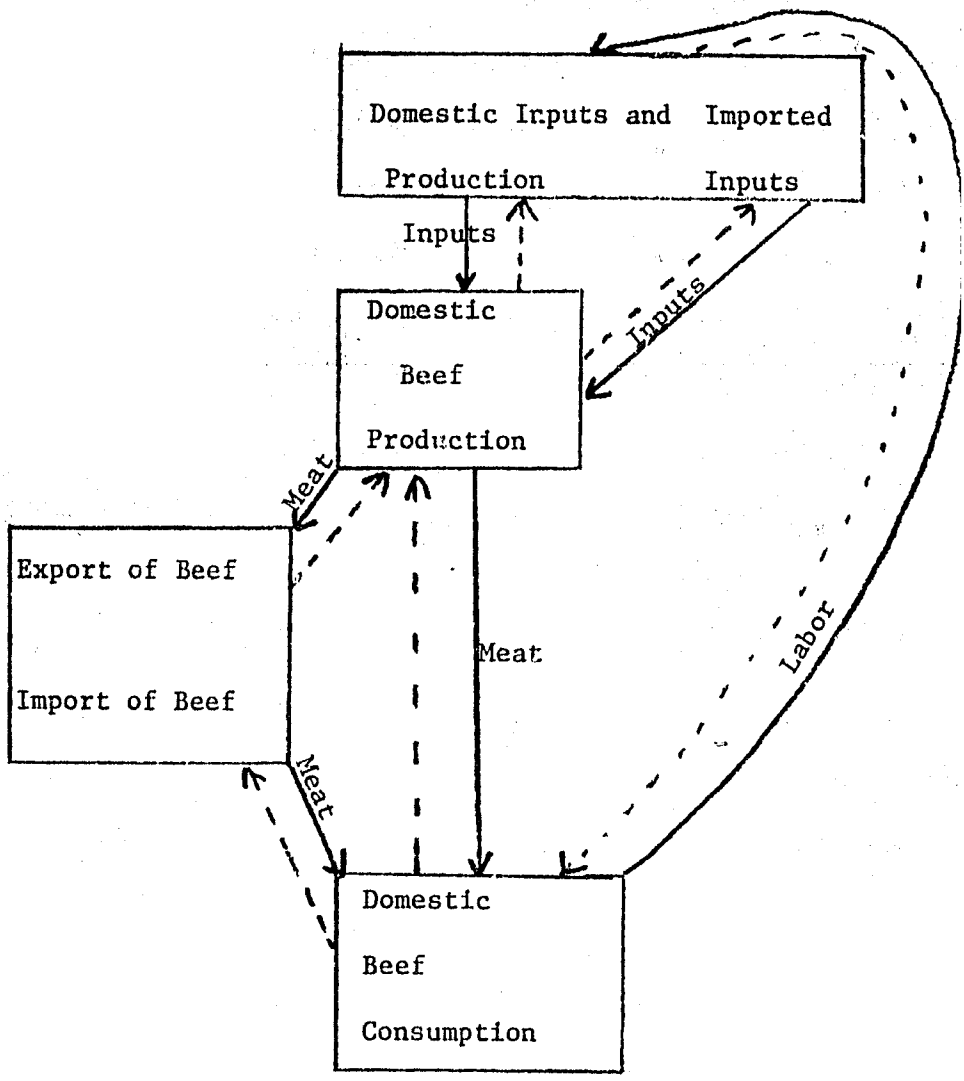


Figure 2.1: Major Component Flows in the Cattle Sector Model

systems and introduction of new management systems through investment or research are reflected as either changes in the affected coefficients in the existing management systems or the generation of completely new (additional) management system for that region effected by the development. Over a long-run (20 years) solution, it is evident that the model could grow almost without bound under a very aggressive development plan. In order to reduce the likelihood of this problem occurring, obsolete management systems should be removed from the model once their utilization falls to zero. In essence this places a restriction on the model which does not allow currently developed ranches to go unkept and revert back to the traditional open range type of livestock production.

Slaughter animals are either transferred to another region for slaughter or slaughtered in a slaughter plant in the region where they are produced. Farm gate prices are calculated as retail price less transportation cost to the pre-determined consumption center. The number and locations of the consumption centers will be input data for the country-specific model. All transportation costs are separate from the production and sales functions to allow for evaluation of transportation as a constraint to regional cattle production.

The domestic beef production component receives income from both domestic beef sales and export sales of beef. Purchased inputs account for the major transfer of funds to other components of the model.

Domestic Meat Consumption Component

Domestic meat consumption is assumed to be a function of the population, income and price of meat. In actuality, the model computes the demand function for meat from a price-quantity point and an

elasticity or slope which are input data. The national price of meat is derived from the interaction between the supply and demand relationships at the country wide basis.

Demand for other livestock products is exogenously determined, but major products, such as milk, can influence the production of beef by increasing or decreasing the profitability of the production units. Beef production could be at a comparative advantage in a highly populated area where milk can be sold to supplement the farmer's income. Increased utilization of by-products in an area could result in increased profitability and therefore incentives for development of the cattle industry.

Import and Export of Beef

The model is constructed in such a way as to allow for constraints to be placed on both imports and exports of beef. If the country is deficit in meat production, meat will be imported at the exogenously set world price to make up this deficit. If the world price is much higher than the endogenously determined domestic price, the consumers will reduce their consumption accordingly unless government subsidies are provided to reduce the market price.

The world market and existing or projected export contracts define the price and quantity range of exported meat. In most cases, this assumption does little to reduce the effectiveness of the model due to the relatively small importance of a specific LDC in the world meat market.

Supply of Inputs Components

Inputs supplied to the cattle sector are either domestically produced in the other sectors of the economy, or imported from other countries. Input production in other sectors of the economy is a secondary source of development which is stimulated from expansions within the cattle sector. In order to properly evaluate the effects of cattle development schemes, the creation of domestic economic activity outside the cattle sector must be measured and included in calculation of the value of the project to the LDC.

Imported inputs generate very little economic activity within the country; therefore, no secondary development effects are included for imported inputs. A very important disadvantage is generated due to the foreign exchange required to purchase these inputs. In order to justify the use of large amounts of imported inputs, the rate of return must be very high and the LDC must be capable of generating significant quantities of foreign exchange.

Labor is an input with some special characteristics which require it to be handled differently from the other inputs. When unemployed or underemployed labor is hired in the cattle sector, per capita income is increased in the country which in turn increases the demand for meat. Many LDC's have large areas of unsettled land which could be settled if a viable livestock sector could be established in the interior regions. Land settlement could contribute to the development of the country by establishing a demand for other services in currently scarcely populated areas.

Increases in production of other agricultural products (rice, for example) which produce low cost by-products utilized by the cattle sector encourages development of the cattle sector. The development is encouraged by either the increase in available feed or reduction of input cost created by the increased availability of the low cost input.

Model Linkages

Major components of the model are linked together both within a time period and between time periods. The within time period linkages are required to give a single period representation of the total system which permits interactions between the major components. Linkages between time periods are required to reflect the updated status of the production, processing and transportation system within the country and to provide a basis for continued production through the demand side of the domestic meat market.

The interaction of supply and demand for meat is the major linkage of components within a time period. In a single period solution of the model, the interaction of supply and demand at the retail level determines the price level for meat in the model. An estimated demand curve will be included in the model based on the best estimate available in the LDC of interest. The alternative livestock production units will produce slaughter animals which can be sold to fulfill the domestic demand for meat. By allowing alternative off-take rates from each management system, the quantity supplied can be equated to a point on the demand curve to derive the national price for meat. Farm gate price is calculated by subtracting the transportation cost to the preselected demand area from the nationally determined price for meat. By utilizing

this approach the model can be used, to a limited extent, to determine the optimum price level and off-take rates for each management system within a region. The limitation mentioned above is due to the modeler's inability to realistically define the alternative off-take rates to be considered in the model.

Supply and demand interactions also serve as within time period linkages inside the major components. Demand information flows through the model in one direction linking the production plans of all sub-components of the model. Meat produced (supply) is a physical flow through the model, in the other direction, which links actual utilization of each sub-component. This two-directional linkage provides the model with the internal consistency to realistically represent the livestock sector of a country.

The inclusion of multiple year demand functions in the model should enable the model to internally generate an incentive for continued livestock production by valuing the livestock on hand at the end of each year's solution. Attempts at recursive solutions of single period models have been of limited success because of the necessity to externally price the goods in process at the end of each period. Internally generated goods in process (cattle herd) pricing should provide a more realistic and internally consistent model capable of better long-run analysis.

On the supply side, the herd is carried from year to year by transferring the final solution herd from the previous year to the initial base herd for the current year, which enters the current year's model as base data. Changes in performance variables of an existing

management system and the introduction of new management systems int the regions are inserted between planning horizons in the livestock production component.

Inputs purchased by the livestock sector will serve as the linkage of the input supply component to the remainder of the model. By linking the input supply component to the livestock production component, the supply-demand linkage of the other components provides the desired linkage to the model. For the special case of labor as an input to the cattle sector, the direct linkage to the estimated demand function through changes in the per capita income provides a more direct linkage between the input supply and consumption components. In an indirect way, the increased economic activity in the domestic supply production industry is also tied to the demand component through an increase in per capita income of the country.

The import and export component is linked to the model very loosely in that it serves only as a source of additional meat and a market for excess production. Limitations on beef imports are imposed by the government of many LDC's in an attempt to keep their balance of payments in line. These limitations tend to restrict the use of imported beef to stablize meat supplies in an attempt to create a stable domestic market. The need for foreign exchange has also caused the governments of some LDC's to attempt to export meat which is not in excess of domestic demand. This practice could result in large fluctuations in meat supplies and a very unstable domestic price level.

Specific Variables and Relationships

Each of the above components is made up of several sub-components representing the phases of cattle production and beef distribution.

Figure 2.2 presents the sub-components of the cattle sector model which serves as a guide to the discussion of the specific variables and relationships in the model. Sector-wide relationships not divisible into the sub-components in Figure 2.2 are discussed in the latter part of this section.

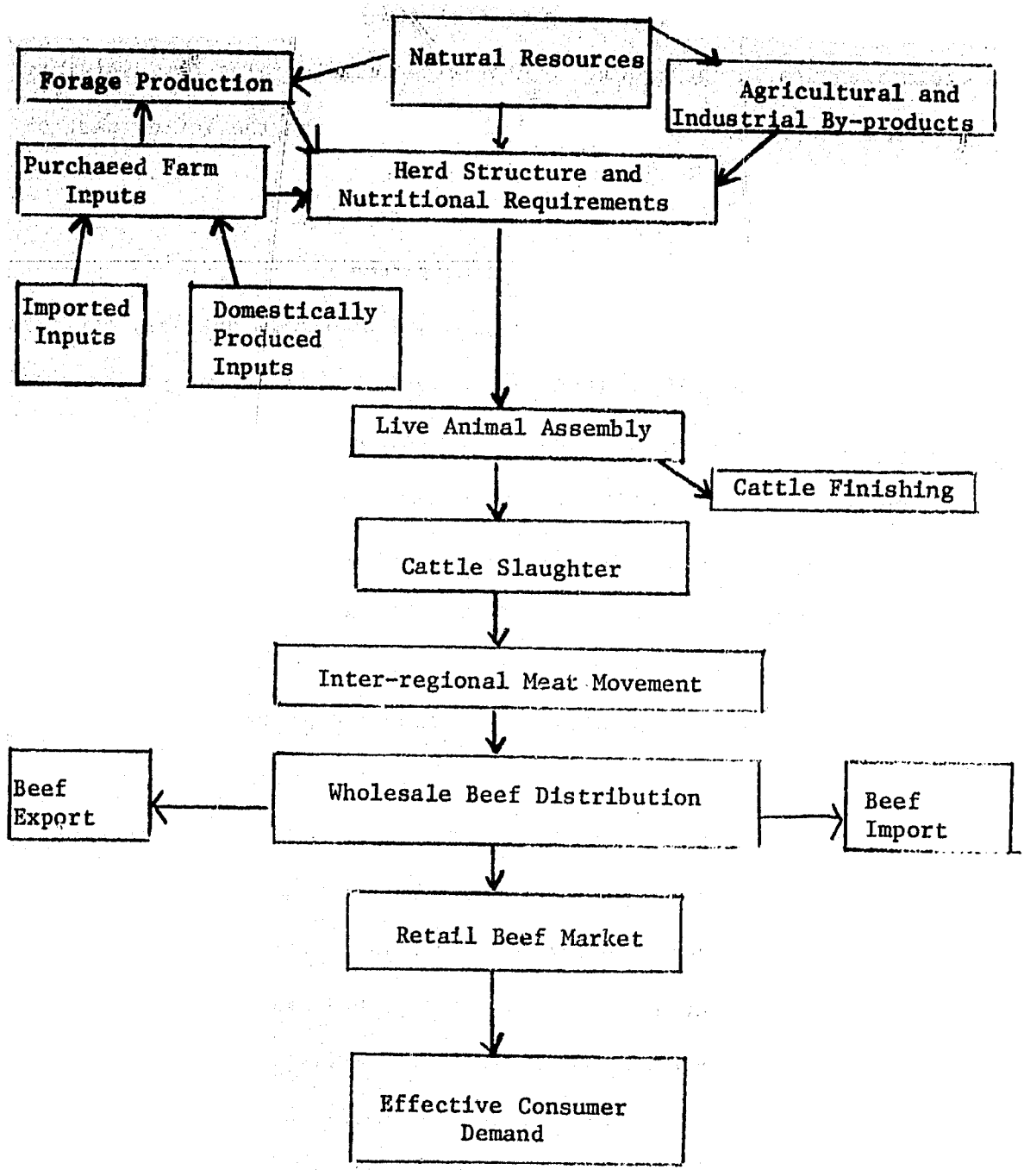
Natural Resources

The natural resources in an area are available not only for cattle production but also for production of other agricultural products and industrial or residential uses. To accommodate these multiple use resources, the model must contain estimates of the value attributed to the alternative use of the resources. Reservation prices are considered when defining the supply curves for inputs purchased in the model to restrict resource use by the livestock sector to resources which do not have greater returns in other uses. Land and native forage are examples of natural resources utilized by the livestock sector.

Land is maintained in the model by types and area to restrict cattle production to a level feasible under the existing conditions. These restrictions are required not only to hold regional production to a realistic level but also to restrict improved pasture production to soil types where production is possible. Native grass performance on different soils is enough different to require a detailed explanation of land by types.

Quality of native grass does not receive the special treatment that land is given. Native grass quality is differentiated only with respect to the land type. It is assumed that a specific type land produces native grass of a specific quality and in a predetermined quantity.

Figure 2.1. Sub-components Flows in the Cattle Sector Model



In order to include improved pasture production in the model, the natural resource restriction must be carefully checked to insure feasibility within each region. The limitations on the use of improved pasture imposed by the management ability of the ranchers must also be included. Capital requirements and import restrictions will also be included as a limit on improved pasture production within the LDC. Availability and cost of transportation into each region is also a constraint to regional use of purchased inputs.

By-Product Utilization

Agricultural and industrial by-products can provide a cheap domestic supply of inputs to the livestock sector. Many tropical foodcrops produce waste and residue which if properly utilized could provide protein for cattle production or finishing. The area of by-product utilization could be a fruitful research area for the government to investigate.

Better utilization of cattle by-products would result in more income to the cattle sector and the country as a whole. In many cases, better methods of extractng bone meal could do much toward the elimination of mineral deficiencies in the cattle of the country. These better uses of by-products are reflected as long-run improvements in the cattle sector of the country.

Purchased Farm Inputs

Purchased farm inputs come from either the domestic supply industry or the import market. Domestically produced inputs create economic activity within the country; therefore, make a contribution to the

In the wet-dry tropics, cattle movement during the dry season into areas with an adequate water supply is reflected by the carrying capacity defined. The lack of an adequate year-round water supply in an area could limit the carrying capacity of the area because large areas of grasslands may not be available during the dry season.

Forage Production

In order to increase cattle production in some regions, improved pastures will be required to increase carrying capacity to accommodate the larger cattle numbers. Improved pasture produced on native grazing lands results in a decrease in available native grazing and possible strain on the existing water supplies; whereas, if the improved pasture is produced on either unused land or land used to produce other agricultural crops, the forage available to the region is increased more and the water supply is usually unaffected.

The requirement of purchased inputs in the production of improved pasture is the major limitation to its extensive use in many LDC's. If balance of payments' problems exists, limitations are even more severe because the nature of the purchased inputs, (fencing, fertilizer, machinery, etc.) is such that most of them must be imported. Large capital outlays for pasture establishment also will be beyond the short-term means of most small ranches in the LDC.

The educational level of most ranchers also restricts the effective use of improved pasture in many regions. Relatively sophisticated management systems are required to maintain the improved pastures in the set-dry tropics. Rotational grazing is required and caution must be taken to avoid killing off the grass by overstocking during the dry season.

development of the country. Imported inputs do very little to stimulate economic activity outside the cattle sector and contribute to balance of payments' problems of the country. In order to encourage use of domestically produced inputs, the government can either impose a tax on imports or provide a subsidy to users of domestically produced goods. This policy is against the economic theory of comparative advantage but has been widely used to protect the infant industries in developing countries. Import restrictions are reflected in the model as either limits on quantities imported or higher prices for imported products.

The purchased inputs industry is composed of domestic production, wholesale, transportation, and retail activities. In the cattle sector model, transportation is treated separately, but the other activities are assumed not to be restrictions on the model. Long-term solutions will report the required inputs so that governmental officials will know future capacity requirement in the input industries. Projected use of imported inputs should also give the government valuable information with respect to future balance of payments' position as far as the cattle sector goes.

Herd Structure and Nutrition

A regional cattle herd is composed of several different types of livestock production with each type represented by a management system in the cattle sector model. Cattle numbers are maintained for animals in the following categories:

(1) Breeding bulls

(2) Brood cows

(3) Bull calves

(4) Heifer calves

(5) Heifers (2 yrs.)

(6) Heifers (3 yrs.)

(7) Steers (2 yrs.)

(8) Steers (3 yrs.)

(9) Steers (4 yrs.)

(10) Steers (5 yrs.)

(11) Steers (6 yrs.)

(12) Steers (7 yrs.)

Each planning period the structure of the herd is used to derive the nutritional requirements for the specific technologies in each region of the country. Cattle sales and transfers between management systems are determined in the model and fed back into the appropriate management system to derive the new herd structure by management system and region for the next period.

Physical constraints to live cattle movement between regions and management system are included in the model. Cattle movement between regions is limited by the capacity of the transportation system between the regions. The time required to develop new management systems or increase the capacity of improved management systems restricts cattle movement between management systems both within a region and between regions.

Breed improvement, disease control, and similar development programs are reflected as changes in the coefficients in the management system which describes herd performance. When the changes in performance occur over time, periodic changes in the coefficients are made to reflect

the annual change in performance of the cattle in the specific management system.

Each management system within a region requires nutrition for vital activity, pregnancy, milk production, true maintenance and growth. The nutritional requirements of a management system are dependent upon the structure and size of the herd in the management system at the time. Herd performance is also dependent upon the level of nutrition provided to the specific herd. Changes in the herd structure and performance are reflected in periodically updated coefficients in the herd structure section of the model. Nutritional requirements for the entire herd are used to define the carrying capacity for the forage production and utilization section of the model. The level at which these requirements are met is used to calculate the performance variables for the next sequence of runs.

The extent to which management systems enter the solution depends upon the production potential and utilization of the land area available in each area. Nutrients produced and purchased for each herd in association with the total requirements set the performance of the herd for future years. Management systems which have higher performance coefficients produce more cattle from the same initial herd size so that the country's livestock production is increased by moving cattle to the higher performance management systems.

Live Animal Assembly

The live animal assembly function is required to collect cattle for slaughter or movement ot other management systems within the region or in other regions. Slaughter facilities may be located in the region or

in a nearby [illegible] ing interregional slaughter animal transfer. Transportation [illegible] ter animals is paid for by the rancher or dealer who owns the cattle just prior to slaughter.

Transportation is also required to move entire herds to improved management systems in an attempt to increase cattle production in the country. Immature male stock may also be transported to another region or management system to specialized finished facilities. In addition to the transportation capacity limitation, live cattle movement is sometimes restricted, by law, to avoid the spread of diseases within the country. This restriction on live cattle movement may result in slower development of the cattle sector because of the inability to fully utilize the most efficient management system.

Cattle Slaughter

Different sanitation requirements between the domestic and export markets sometimes requires construction of separate slaughter facilities in many LDC's. In LDC's with a relatively small cattle sector, the requirement of specialized facilities for export beef eliminates much of the benefits derived from the exportation of beef. The model will permit slaughter for both markets in the facilities meeting export standards, but all meat exported must be slaughtered in an approved facility. This restriction could result in an increase in interregional transfer of live animals.

Slaughter facility operations are included in the cattle sector so profits and losses from the operation of the facilities are reflected in the income accounts of the sector. When a salughter fee is charged,

it is costed against the butchers or farmers, but final accounting accumulates all income and expenses in the cattle sector resulting in a single income reported.

Interregional Meat Movement

If national demand for meat is to be satisfied, either live animal or meat must be transported from meat surplus to meat deficit regions in the country. Either method of transportation has both advantages and disadvantages when compared to the other method. Live cattle are more bulky to transport, and live cattle are also subject to a death loss due to accident or disease during shipping. Meat is less bulky and is not subject to death and disease loss, but it is more perishable, so that it must be moved in either refrigerated transports or very rapidly to avoid spoilage. An advantage attributed to live animal movement is that larger, more efficient processing plants can be constructed to handle large numbers of cattle in a few locations. A larger number of small plants minimizes death loss due to accidents in shipping and shipping diseases because of the short distance between ranches and processing plants.

Transfer cost is borne by the owner of the meat at the time of shipment. Transportation cost and capacity of the system restrict meat movement between regions. The cost of transportation limits movement only to the extent that it decreases the farm proceeds from the sale of cattle. Decreased returns at the farm level results in unprofitable operation of marginal farms in the region. The final result is a decrease in cattle production in regions which face high transportation costs. Capacity of the transportation system serves as an absolute

restraint to meat movement that can only be relaxed by capital investments to either create a new system or enlarge the existing system.

Wholesale Beef Distribution

The wholesale beef distribution sub-component of the model serves to collect the meat and distribute it to the local retailers in each region. Each country and region within the country will have its own specific beef distribution system. Wholesale meat distributors in some regions will purchase live animals from the ranchers and hold possession of the animals until they reach the retailer in the major consumption center. Other regions will have wholesalers who only deal in meat after it leaves the slaughterhouse. Whatever system is used will have a capacity which, in the short-run, limits the movement of slaughter animals to the retailers. Long-run adjustments in the wholesale distribution system can be made to increase the capacity and efficiencies of the system.

Import and Export of Beef

The use of imported meat to satisfy domestic demand is usually restricted by government policies of quantity and price controls. In countries where balance of payments' problems exist, quantity restrictions are usually imposed on imports to save foreign currency. Import taxes are also imposed to protect the domestic production from low priced imported goods. Both of these policies work against the comparative advantage principle, but are thought to be necessary for the short-run survival of the country.

Beef exports have the reverse affect in that they generate foreign exchange that the country can use to purchase foreign goods or improve their balance of payments' position. In the model, beef export demand must be estimated from information provided by governmental officials of the specific country.

Retail Beef Market

The existing retail marketing establishments within the country provide the short term channels and capacity constraints for the model. Current trends in changes in market structure will be used to define the future retail beef market for long-run model solutions. Effects of governmental policies and programs in the retail sector will be reflected in long-run changes in the structure and efficiency of the retail markets.

Effective Consumer Demand

Domestic demand for meat is referred to as effective consumer demand because demands of interest to the model are those which have purchasing power to make them effective. For consumers to voice their desires for goods in the market, they must purchase the goods. As consumers voice their desires with money, the cattle sector's income account should increase if there is truly an effective demand for beef. Increased income in the cattle sector will provide the investment funds necessary to further increase the production capacity of the sector. If demand for meat is strong, the continual development of the sector is assured because of a continual influx of funds in the form of profits.

An increase in per capita meat consumption of the country is an improvement in their standard of living and is therefore an important contribution of the cattle sector to the economy of the country. If the market is allowed to operate freely, a large increase in cattle

production could possibly reduce the price of meat to the consumers, resulting in a large increase in per capita meat consumption and a relatively small increase in the income to the cattle sector. Increases in domestic meat consumption must be considered as an increase in the well being of the country.

The presence of high effective demand for meat results in more ra development of the cattle sector if the profits are reinvested within the sector. More efficient production without extremely high effective demand results in slower development of the sector, but contributes to increased per capita meat consumption in the country.

Contributions to National Income

The value-added approach to national income accounts is used to calculate the contribution of development in the cattle sector to national income. The national income accounting section of the model is separate and not related to the section which calculates the net farm income by region. An attempt is made to reflect both income generated within the cattle sector and the economic activity generated outside the sector by the increase in demand for products and services required from other sectors of the economy.

Increased economic activity in the supply industry due to an increased use of purchased inputs for cattle production increases the cattle sector's contribution to national income. The size of the increased contribution is dependent on the source of the inputs that are required. If the inputs are imported, the contribution to national income must be adjusted by subtracting the cost of importation from the

value calculated. The use of locally produced inputs generates the full value of their cost as contributed to national income.

Domestic Beef Prices

The model utilizes the interaction of supply of and demand for beef at the retail level to endogenously calculate the domestic beef price. Production and transportation costs are used to derive prices at other stages of production, using retail price as the base. The use of endogenously determined price levels should enable the model to effectively represent long-run cattle sector development.

In regions where meat production exceeds local demand, local consumption is satisfied at the national price less transport cost to the largest consumption center. Meat deficit regions receive their meat from the cheapest source and prices are adjusted from the national price calculated in the highest demand area. Transportation routes could restrict a region to higher cost sources of meat than would be possible if more direct routes were available between excess supply regions and the local demand region.

In most LDC's where meat is produced for export, only certain areas are equipped to produce meat for export. If these export regions are not able to produce enough excess meat for local consumption, meat will be shipped from other areas to satisfy the local demand. Export meat and domestically consumed meat are treated as two separate products with the amount of export meat demanded entering the model exogenously.

Capital Investment

Alternative capital investments can be evaluated by the model only by alternative runs of the model. In order to evaluate alternative capital investment schemes internally, a multi-year model would be required. A multi-year sector model of a livestock economy would be too large for solution in a single run if the detail desired in this model was maintained.

New management systems or increased capacity of existing managemen systems will be created by capital investments and improvements made within an area. In order to evaluate specific capital investments, the changes in the system are imposed on the model and rates of returns to these investments are derived by comparisons of the different results obtained from the two solutions.

APPENDIX E

Notes on Model of Guyana's Livestock Industry
211(d) Consortium Modeling Workshop
Purdue University
June 30 - July 1, 1975

I. Purdue Model

A. Purpose -- To provide assistance to policy makers in allocation of development resources and in design and evaluation of policy for the L.S. industry by simulating the multiple impacts of alternative programs and policies on the industry.

B. Components of Model

1. Input form
2. Matrix generator
3. LP solver
4. Report writer

C. Input Form

1. Purpose -- guide user in providing data necessary to describe L.S. industry

2. Types of Input Data
   a. Initial herd inventory
   b. Input-output coefficients to describe
      1. Production alternatives
      2. Development activities
   c. Product demand and input supply characteristics
   d. Description of transportation system
   e. Values for livestock and developed pasture inventories at end of planning horizon
   f. Initial endowment of resources

3. Integration of Various Discipline Occurs in Filling Out Input Form

D. Matrix Generator -- Package of Computer Programs Which:

1. Converts input data into coefficients required to define activities in LP
2. Organizes coefficients into matrix suitable for LP solver
3. Projects herd composition through planning horizon

E. LP Solver

1. Produces an optimal solution to the problem formulated by the generator based on specification provided in input form
2. Structure of the LP model of the Guyana livestock industry is presented under (II) below

F. Report Writer

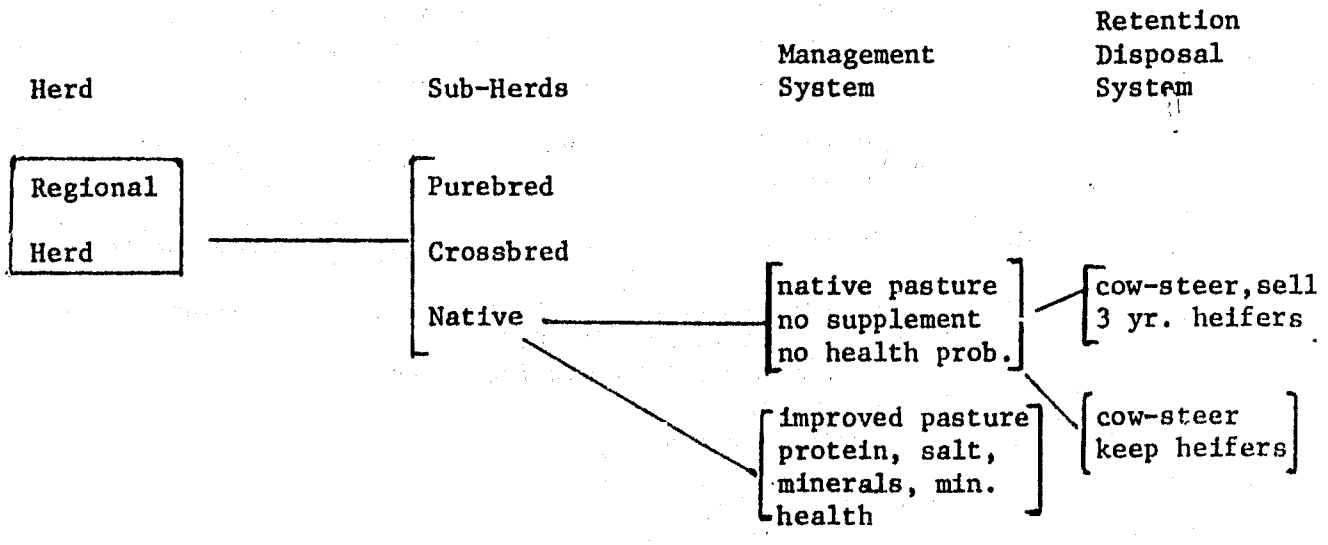
1. Takes output from LP solution and organizes it into a set of tables which are more readable and contain that output of interest to the intended users
2. Types of information reported

   a. Equilibrium and quantity for beef (domestic Mkt.) and total revenue produced
   b. Use of inputs and services, price paid and total outlay for each (by region if regional market)
   c. Net revenue to cattle producers
   d. Level of production (no. cows) by system by region
   e. Quantity of land cleared, pasture developed, pastu maintained
   f. Value of additional unit of fixed constraints (transport, managers, machinery, slaughter capacity, purchased imports with fixed price)
   g. Inventory of cattle by category, sub-herd, region

. Structure of the LP Model of Guyana's L.S. Industry

A. Conceptualization of industry

1. country divided 4 regions
2. herd in each region with disaggregation as shown below



a. Management systems and retention disposal systems compete for cows in sub herds,
b. Animals move between sub herds and region as 1 year and 3 years old only,
c. Production activities standardized to unit of one cow,
d. Once a cow enters a management system it stays there for a run (planning horizon),
e. Production measured in pounds of carcass beef.

3. Planning Horizon

a. Assumes producer plan for more than one year (variable) and revise plan at specified intervals (variable),
b. Planning horizon longer than revision interval.

4. Markets

a. Consumption primarily in coastal area-- price-quantity demanded schedule reflects nature of this demand,
b. Consumption in other producing regions is not price responsive,
c. Export demand may compete with domestic,
d. Two types of input markets
   1. If LS sector competes with others for use of inputs, supply is represented as a price-quantity schedule
   2. If price is not responsive to quantity demanded or quantity available is not responsive to price a fixed-price purchase activity and/or a quantity constraint is used

5. Slaughter

a. Availability of slaughter facilities is specified by region as an input and employed as a constraint,
b. Region in which each category (production activity) of cattle is to be slaughtered is specified,
c. Model stops with carcass at abattoir door in Georgetown.

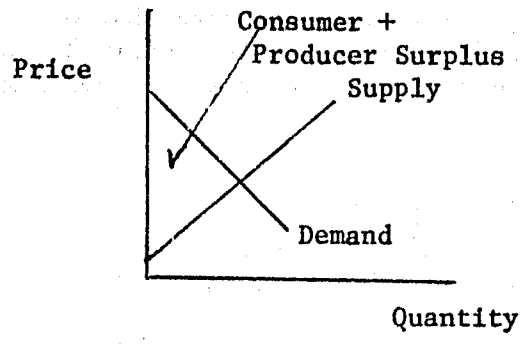
6. Transportation

a. Three types of transport--boat, truck, air,
b. All shipments flow through Georgetown,
c. Capacity fixed by mode and route,
d. Three categories of goods transported--carcass meat, live animals and inputs.

7. Pasture Development

   a. Activities convert native pasture or new land into improved pasture,
   b. If not maintained reverts to native,
   c. Production is lost for one year in process of pasture development.

8. Competitive Market Economy Assumed



   a. National meat demand represented in LP as set of activities,
   b. Supply of beef is implicit in production activities, input supply and purchase activities and resource constraints,
   c. Maximization of consumer + producer surplus in LP forces a competitive equilibrium solution (price and quantity).

B. The Linear Programming Tableau

Activities Obj. Function & Constraints	Production Activities by Region	Development Activities by Region	Meat Demand (National)	Factor Supply Land-Labor (Reg.)	Sell-out Inventory (sub-herds)	Trans-port	Purchase Inputs & Service--Fixed Prices	RHS

Objective function

National Constraints

- Purchased inputs (salt, minerals, mixed feed, fertilizers, fencing materials, etc.)
- Meat supply
- Meat demand control
- Income accumulation
- Gov. subsidies
- Balance of payments

Regional Constraints

- Cows
- Weaned calves
- 3 yr. old males and females
- Land & improved pasture supply
- Land supply control
- Labor supply permanent temperature skilled mgt.
- Labor supply control
- Machinery
- Veterinary service
- AI service
- Slaughter capacity
- Transport capacity
- Transport balance meat, live animals, inputs
- Regional demand

APPENDIX F

SOME GENERAL REQUIREMENTS
FOR ABATTOIRS IN DEVELOPING COUNTRIES

Pete Wenstrand

May, 1975

INTRODUCTION

Although probably appearing simple at first sight, the economic and sanitary handling of slaughter stock, from the time they enter abattoir until they leave as dressed carcasses or various by-products, is a skilled and complex series of operations. And of course these problems are increased in a tropical environment and among populations with relative low sanitary standards. The following notes embody points which are often overlooked in the construction, equipping, and operation of abattoirs in the developing countries.

CONSTRUCTION

A modern abattoir, particularly if it is to engage in the export of meat, is a highly specialized enterprise. Its design is a complex affair calling for the experience of plant operators, butchers, and health officials as well as the professional skills of engineers and architects. Most abattoirs conform to certain basic design principles, irrespective of minor variations in layout and equipment.

The construction of a modern abattoir will require a combination of expertise and advise together with a knowledge of local conditions. Religious beliefs, cultural customs, marketing practices, labor interests and habits, and consumer habits, such as the consumption of what is normally accepted as inedible offal, must be considered in the final planning of the abattoir if it is to function successfully.

A firm specializing in abattoir design, construction, and operations, should be engaged for the important preparatory work involved. They would be required to prepare preliminary drawings together with the construction and engineering specifications needed. It may be desirable to contract a consulting firm to evaluate the bids for constructing and equipping the facility. The designs should meet not only with the approval of domestic public health standards, but also those of potential export customers. It is extremely important to coordinate the

building and equipping of the plant and may therefore be desirable that a contract not only include the construction work, but also the supply and installation of all plant and machinery. Construction of the abattoir should be such that future expansion of production or chilling facilities or the addition of by-product processing or canning facilities could be made with minimum expense and reorganization.

LOCATION

In selecting a site, the following criteria should be considered:

1) Water and power supply
2) Livestock proximity and volume
3) Labor supply
4) Disposal access
5) Transportation
6) Communications
7) Topography and soil type
8) Markets for the products
9) Benefit to the region
10) Profit opportunities

It is desirable and only reasonable that the abattoir should be sited in a strategic position for livestock procurement. It must be convenient to the traditional livestock routes of the particular country, but yet probably should be located away from built-up urban areas. A constant water and electrical supply is a must.

WATER REQUIREMENTS

The abattoir must have a sufficient supply of wholesome water at an adequate pressure and a sufficient supply of hot wholesome water (at least 180°F) should be available in the slaughterhall during working hours. Water requirements will vary according to the extent that edible offals are cleaned and by-products processed.

Only such water should be used in the abattoir that meets the requirements for drinking water. One report states that drinking water should show no coliform bacteria. Many natural waters meet this standard as would any chlorinated supply. If water is to be supplied from a river, some sort of filtration would be necessary. Of course the treatment needed to bring any water up to standard depends upon the type and source of water.

THE BUILDING

As previously mentioned, the abattoir should be designed, constructed and equipped to meet international sanitary standards. The layout and sequence of processes will determine the shapes and locations of the processing areas which will in turn establish the features of the buildings and their relative placement. Note: In small slaughterhouses, there is a tendency for all of the butchers to begin slaughtering at the same time. This demands much floor space and duplication of equipment and usually results in congestion and unsanitary conditions. Except for the smallest slaughter slabs, the use

of overhead rails will provide a much more efficient sequence of operations.

The slaughterhouse should be a single story building, although some designs require a basement.

The brick walls finished on the inside must give an impervious washable surface. Glazed brick, glazed tiled, concrete with Portland cement, or other non-toxic, non-absorbent material may be used. Where possible, the walls should be tiled to a height of nine feet.

Floors should be of concrete and finished with a non-slip and impact resistant surface. Good results have been obtained by embedding in the concrete, particles of abrassive material such as carborundum (silican carbide).

There should be a minimum slope of 1-60 to the drains and coves with radii of 1/2 to 2 inches at the juncture of floors and walls promote sanitation in the building

For insect and rodent control, all openings in the building must be screened. Ample ventilation is required throughout the building.

It may be desirable to include in the plans a mezzanine floor to permit the introduction of a sheep or goat slaughter line at a future date. The animals would enter the mezzanine floor by way of a ramp and the carcasses would be lowered at the opposite end of the line.

EQUIPMENT

It is likely that individual firms tendering for the plant will compile their own equipment list in accordance with their own particular manufacturing program or abattoir designs.

All equipment that comes in contact with edible products should be made of stainless steel. Working platforms, and certain other equipment should be galvanized. Copper, cadmium, lead, enameled material dna porcelain are unacceptable for use in the equipment.

Inside corners of equipment should have a radius of at least 1/4" and the production area should be free of protruding screws, rivets, welds, or angle iron.

Because of the greater risk of contamination in hot climates, wood should be used to a very limited extent in the production area.

Work surfaces should be approximately 34 inches above the floor.

Cutting and boning tables should be made of approved plastics or unlaminated hardwood.

MAINTENANCE

A sound system of preventive maintenance is necessary not only to maintain operating efficiency, but sanitary conditions as well. It is extremely important that manufacturers of plant and equipment give details to the proper use and routine maintenance required for each item they supply. Likewise they should furnish a list of recommended spare parts

which should be acquired together with the initial equipment. Skilled mechanic(s) must be employed to keep the plant in sound running order.

SANITATION AND HYGIENE

An essential feature of large abattoirs is an amenities block which will include showers, clothes lockers, toilets, wash basins, and a small health clinic.

Some abattoirs require each person engaged in processing work to shower and to be issued clean overalls, before reporting to work. Before commencing work, workers should scrub their hands preferably in a weak solution of sodium hypochlorite. It is also desirable to have all personnel before entering the abattoir to walk through a shallow foot bath containing 1% solution of Deciquan or similar disinfectant.

To minimize fly nuisance and insect infestation, the slaughter pens for cattle should be located well away from the abattoir. The cattle pens should be provided with a roof for shade and concrete floors. The pens should contain drinking troughs and be surrounded by sanitary curbs to avoid the spreading of effluent.

At the end of the day's work, the entire abattoir floor, walls, and equipment should be thoroughly washed down with hot water. This should be followed by one of several procedures:

1) Spraying with Malathion or Tego S1.

2) Spray with 180° - 200°F water under 200-250 psi through 1/2 inch high pressure hoses.

3) Wash down with milk of lime, which is made by mixing unslacked lime with 4 times its volume of water.

Particular attention must be given to the drains. It is highly important that disinfection of a slaughterhouse not be substituted for, but rather combined with general cleaning.

Where possible, all empty trays or containers used in processing should be left in an inverted position after washing. All knives, cleavers, and other tools should be sterilized at the end of the day and again before starting work the next day.

All waste traps must be cleaned daily and at least once a week the catch basins for effluent must be emptied and thoroughly cleaned.

Grounds and lairage surrounding the abattoir should periodically be sprayed with insecticides and a constant watch must be kept for possible breeding places for flies and other insects.

BIBLIOGRAPHY

Adelatec, Pre-feasibility Study for Slaughterhouses and Meat Processing Plant in Guyana. 1968.

Arizona-Colorado Land & Cattle Co., Inc., A study to determine the feasibility of establishing an abattoir in the Sudan, U. S. A., 1974.

Experience, Incorporated, The Technical/Economic Feasibility of Establishing Additional Meat Processing Facilities in Botswana. Minneapolis, Minn., 1973.

Mann, I., Meat Handling in Underdeveloped Countries, FAO Agricultural Development Paper, No. 70, Rome, Italy, 1960

APPENDIX G

LIVESTOCK SECTOR
IVORY COAST

by

W.H.M. Morris

June 2, 1975

Table of Contents

	page
A. Economic Setting and Livestock Sector	
I. Introduction	1
a. Population	3
b. Agriculture and Livestock Section	4
II. Livestock Economy	
Livestock Numbers / output / Exports or Imports	8
III. Livestock Production Systems & Ecological Zones	
a) Ruminants	12
b) Pigs	14
c) Poultry	15
IV. Marketing Patterns & Prices	16
V. Government Organization and Activities	
a) Ministry(s) of Production	25
1. Livestock Service	25
2. Parastatal Organizations	27
3. Research Institutes	28
b) Education and Training	
1. Formal	31
2. Non-formal	32
B. National Plan and Strategy for Livestock and Meat Production	
I. Plan Documents	34
II. Evaluation of Strategy	37
III. Public Policy Constraints	43
IV. External Assistance	44

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IVORY COAST

A. Economic Setting and Livestock Sector

1. Introduction

The Ivorian livestock sector has one of the greatest potentials for expansion of any in Francophone West Africa. Traditionally a large consumer of meat, with reported livestock slaughter rising until 1974, Ivory Coast depended heavily on imports from Mauretania, Mali, and Upper Volta. Since April 1975 Maruetanian and Malian exports have declined to nearly zero and have been, in part, replaced by imports from France.

Although the rate of economic growth (GDP) has been of the order of 8-10%, much of the advantage of this over the last decade has been lost to the consumer due to inflation. The per capita disposable income less savings has remained almost constant; this probably disguises the fact that the south has gained economically more than the north. The per capita disposable income in the North, like that in the interior countries has declined in real terms. However, the price of meat had also declined in real terms until the second quarter 1975. The real price of the dietary staples has changed relatively little.

Ivory Coast differs from the other francophone West African countries in having:

-more trained personnel in the livestock sector, both African and expatriate

-a willingness to use expatriates.

-superior planning ability.

-an effective and in depth agricultural research system, with the largest livestock production research station, now geared into a research program to increase production.

-an active plant breeding program which has contributed to grass breeding.

-a four year agricultural college, which will soon have the capability of graduating "agronomes" without sending them abroad for the third cycle (5th year).

-an established university including faculties of social sciences and economics.

-an infrastructure for agricultural development with many successful programs, albeit mainly in industrial crop production in the forest zone.

-a substantial potential for the production of animal feeds (maize, roots and soybeans).

However, in the past the livestock sector, probably due to the substantial supply available for import, has received very little budgetary support for its development. Only in recent months (April - May 1975) has the supply-demand situation been such that prices in the African market have risen rapidly and consumption has declined. This is expected to lead to a crash program for the development of the livestock sector. Given the capabilities at the disposition of the GOIC, positive results can be expected.

For these reasons, the Ivorian livestock sector is interesting and its performance in the next 5 and 10 years is expected to blaze a trail which could be followed by other countries in the region with forest, guinean or sudanian zones.

a) Population

It appears that until now, there has never been a census of the Ivoria population as a whole. Estimates of the population in 1970 were:

5,100,000	in the 1970-75 plan
4,980,000	Sedes 1969 (based upon the same population as the Plan in 1965)
4,310,000	FAO Annual Statistics

These can be projected to give the 1975 population* respectively as:

6,000,000	Plan (+3.3%/year)
5,800,000	SEDES (+3.0%/year)
4,876,000	FAO (+2.5%/year)

The annual rate of increase of 3.3% used in the plan is made up of 2.3% natural increase plus 1% migration. The IBRD Special Report on Employment suggest that the natural increase will rise to 2.9% in the decades of the 1970's and 80's due to decline in mortality rates.

There is a question on the rate of migration into the Ivory Coast in the next decades, due to Voltaic s being sent to Gabon to work on the construction of the railroad and to higher wages recently offered to farm workers in the modern Agricultural sector in Guinea.

Table 1

Population Projection (000 head)

	1970	1980	1985
Abidjan	516	1130	1510
Forest zone towns	558	1120	1490
Savanna zone towns	318	580	650
All urban	1390	2830	3650
Forest zone rural	1763	2270	2560
Savanna zone rural	1507	1420	1350
All rural	3270	3690	3910
Total	4660	6520	7560

* These estimates are for the "de facto" population, i.e. those present, rather than "de jure" Ivorians.

b) Agriculture (including livestock sector and forestry).

The development of Ivorian agriculture in the decade of the 1960's was uniformly satisfactory; that is food crops, meat and fish production advanced more rapidly than the growth in population and the industrial and export sectors responded well to development investment.

Table 2 Change in the Value of Production

	Value in fcfa			Annual increase
	1960	1965	1970	%
Agriculture, foods	36,295	43,263	48,054	2.85
Agriculture, industrial and export	22,357	33,262	49,063	8.3
Forestry	7,253	16,709	23,500	12.5
Livestock and hunting	3,586	3,937	5,565	4.5
Fishing	2,218	2,974	3,700	5.25
Total	71,709	100,145	129,882	6.12

However, the national data do not disclose the disparity in the development between zones. The forestry, palm oil, coffee, and cocoa production all take place in the forest zone. The development in the guinean and sudanian (savanna) zones was less satisfactory and was accompanied by a decline in population. Cotton production in these zones increased markedly and investment was made in irrigated rice production.

In the plan for 1970-80 the following problems were identified:

-dominance of coffee production in spite of efforts to diversify agriculture.

-regional disparities in development between the south and central areas and the north and west.

-domestic demand for certain foods, especially rice and meat advancing more rapidly than production, with the gap between domestic production and consumption of meat increasing continuously.

-despite the increase in growth in the sector as a whole, labor supply has not so far become limiting because of the migration of foreign workers. In the forest region the high levels of income permit the use of hired immigrant workers. However, the supply is not unlimited and wages will continue to increase and conditions of work will have to be continually improved.

-In the savannah region at present there is general seasonal underemployment in agriculture but it is declining rapidly with the development of rice and cotton production. Seasonal bottlenecks in labor supply are appearing in some regions and the lower level of income in the savannah does not permit hiring immigrant workers. Mechanization is the only way to resolve this constraint; especially for seed bed preparation and cultivation to remove weeds.

-Most interventions in agriculture have been entrusted to "para public" organizations specializing in one or more crops. In the savannah, where a rotation of several different annual crops is followed, the peasant has to deal with a series of extension agents from the different organizations, leading to wasted effort and an inability to promote a reform of the whole system of production.

-Serious deficiencies appear in the domestic crop marketing system. Margins are often excessive and the producer is discouraged by periodic inability to market his product.

-In forestry the rapid rate of development threatens the future of this national resource, with reserves in several species becoming low.

The major lines for development in the 1970-80 plan were:

-reduction as far as possible in the regional disparities in income levels.

-increase the money income of the mass of the peasantry by improving productivity.

-improve the quality and quantity of the diet.

-lead the peasant to participate in his own development.

-provide a better outlook for young people in farming (economically and socially) to reduce the rural exodus.

-improve the living conditions of the rural world by installation of social and cultural infrastructure.

Quantitative goals included:

-increase in the growth of the value of the agricultural and livestock sectors by 3.7% a year from 1970-75 and 3.9% from 1975-80. In fact, although agriculture did not perform at this rate in the 1960's (growth rate was 2.85%/year), the livestock sector exceeded this rate (4.3%).

-The fish supply was planned to be increased at a rate of 13.5% a year from 1970-75 and 10.1% a year from 1975-1980.

An increase in the livestock sector output was proposed by increase in the production of maize and the production of soybeans. The maize, which has traditionally been grown in the forest zone and to a lesser extent in the guinean zone, is to be produced in the sudano-guinean (savanna) where there are two rainy seasons. It will preceed cotton in the rotation.

The planned production and its disposition are shown in table 3. In fact, this program has hardly been started. The GOIC is having difficulty in deciding whether to grow the maize industrially* or to encourage peasants to produce it. The drying and storage problem is considerable and the GOIC proposes to install large scale units in 1975-1980 for this purpose.

The necessary adjunct of producing soybeans is also planned but it does not seem likely to bear fruit until near 1980, if then.

The proposed use of maize flour as a dilutant of bread flour has not been tried on the consumer. It is probable that using a white or yellow grain sorghum would be more acceptable. If maize is not used as a dilu-

*IBRD studies of Ivorian farm machanization show that costs exceed returns at present, but that motorization will become feasible in the 1980's.

tant of bread flour production of the target for use as feed grain will be more easily met.

Table 3. Corn demand and planned supply, m. tons.

	1965	1970	1975	1980
Food grain				
urban	9,300	15,000	23,000	31,000
index	100	161	243	330
rural	161,000	177,000	195,000	214,000
index	100	110	121	133
Total	170,300	192,000	218,000	245,000
Industrial use				
feed grain*	3,000	5,000	12,500	30,000
flour			22,500**	32,000**
Total	3,000	5,000	35,000	62,000
Export	2,700	3,000	3,000	3,000
Total consumption	176,000	200,000	256,000	310,000
Losses and seed	24,000	21,000	23,000	26,000
Planned production	200,000	221,000	279,000	336,000

** To be used as a dilutant, 15-20%, in bread flour.

* For the development of the livestock sector maize production is of direct importance and other crops (including sugar cane and rice) of indirect importance as byproducts.

The GOIC has been put in touch with CIAT (by REDSO/WA) to discuss the use of cassava in feeding of livestock. This could provide a less costly and more easily produced carbohydrate feed, but with a more intense problem of protein supplementation. Ground cassava chips are currently being included in pig and poultry rations.

GOIC also proposes to use molasses for feeding cattle in feed lots and for pig production; they are being informed of the work of Preston (formerly in Cuba, now in Mexico) on this technology, which has considerable possibiliti

The past performance of the livestock sector, and the import of livestock and meat are shown in tables 4 and 5. Projections are made for domestic production for 1980 and 1985.

Domestic Livestock Production

Table 4.
Domestic Production

Cattle	1966		1972		1974	
	Taurin	Bovin	Taurin	Bovin	Taurin	Zebu
Herd size	267,000	38,000	365,000	60,000	371,550	65,000
Assumed offtake %	13	12.1	10	10	10	10
Offtake, Head	34,700	46,000	36,500	6,000	37,155	6,500
Av carcass wt, kg	77	115	100	150	100	150
Carcass wt, tons	2,680	530	3,650	900	3,715	975
Offals (at 25%) tons	670	132	915	225	924	243
Total tons	3,350	662	4,565	1,125	4,644	1,219
Total beef tons	4,012		5,690		5,863	

(f/kg carcass) at 130 f/kg to producer 420 millions f

Sheep/Goats	1972		1973	1974
Herd size	1,400,000	1,800,000	1,679,000*	1,700,000
Assumed offtake	30%	25%	25%	25%
Offtake, head	420,000	450,000	419,987	425,000
Av carcass wt, kg	10	10		10
Carcass wt, tons	4,200	4,500	4,200	4,250
Offals (at 25%) tons	630(offal 15%)	1,125	1,051	1,062
Total tons	4,830	5,625	5,251	5,312

at 135f/kg lw 567 millions f

*866,000 sheep and 813,000 goats.

Pigs	1966		1972		1974	
	Traditional	Modern	Traditional	Modern	Traditional	Mode
Estimated herd	80,000	20,000	90,000	20,000		
Estimated offtake%	60	80	60	75		
Assumed offtake,head	48,000	16,000	54,000	15,000	111,685	19,691
Av carcass wt, kg	25	50	25	60	25	60
carcass wt, tons	1,200	800	1,350	900	2,792	1,181
Offals at 10% tons	120	80	135	90	195	83
Total	1,320	880	1,485	990	2,988	1,264
Grand Total	2,200		2,475		4,252	

Mod 90f lw 130fcarc
Trad 70f lw 100f carc
220 millions f

Poultry	1966		1972		1974	
	Traditional	Modern	Traditional	Modern	Traditional	Modern
Estimated head	6,000,000	8-9 million	1,058,000			
Offtake	100-120%					
Av carcass wt	1 kg					
Carcass wt. tons	7,000	10,000	1,500*			
Total	7,000	11,500			est. 13,570	

Total all meat and offals	18,062t	25,300t	29,002t

*900-1000t from 700,000 head of meat birds at 13-15kg a head and 200,000 head of cull hens at 2.8-3.0kg (5-600t).

Table 5. **Livestock Production**
Import and Consumption (tons)
1966 - 1974, with projections
of domestic production to 1980 and 1985

	1966	1970	1971	1972	1973	1974	1980	1985
Beef Dom. Prod.	4,050	5,291	5,487	5,690	5,776	5,863	6,839	7,776
Import	19,062	37,200	36,766	36,077	32,250	29,553	+2.6%	
Total	23,112	42,491	42,253	41,767	38,026	35,416		
kg per cap	5.07	8.28	8.00	7.86	6.96	6.29		
Sheep/goats								1.4%
Dom. Prod.	4,830	5,031	5,328	5,625	5,251	5,317	5,780	6,196
Import	3,399	5,801	6,740	5,529	6,321	5,390		
Total	8,229	10,832	12,068	11,154	11,572	10,607		
kg per cap	1.81	2.11	2.28	2.10	2.12	1.88		
Pork Dom. Prod.	2,200	2,200	2,226	2,475	3,525	4,252	11,420	26,016 +17.9%
kg per cap	0.48	0.43	0.42	0.47	0.64	0.76		(+15.3%)
Meat Import.	1,911	2,011	1,839	1,493	1,294	1,473		
Poultry Dom. Prod.	7,000	9,992	10,626	11,500	12,535	13,570	21,654	31,964 (+8.1%)
kg per cap	1.54	1.93	2.01	2.17	2.29	2.41		(+5.7%)
Fish Dom. Prod.	78500**	85000	102940	112240	92400	86307		
Import	0	10000	15060	23760	55000	73693		
Total	78500	95000	118000	136000	147400	160000		
kg per cap	17.76	18.52	22.33	25.62	26.96	28.41		(+11.3%)

*SEDES 1966 basis is offtake of 13% taurin with carcass weight 77 kg. and 12.1% zebu with carcass weight of 115 kg. The plan uses a basis of 10% offtake for both species and 100 kg. carcass for taurin and 150 for zebu. The SEDES estimate results in almost the same tonnage as does the 'Plan".

**for 1965

The domestic beef production in the above table is based upon estimates of the cattle herd, usually from the rindepest/cbpp innoculation campaign, multiplied by the assumed offtake rate (10% in the estimates for 1970 and subsequent years) multiplied by an assumed weight for the carcass and the offals (100 + 25 kg. for taurin and 150 + 38.5 kg. for zebu cattle). The year to year differences are then based upon an assumed rate of increase of the herd (in this case 3%). The rate of increase of the taurin herd has only been about 2% a year, and the size of the zebu herd has fluctuated greatly depending on the conditions as perceived by the Peul herders, resulting in their leaving the country or in more herds arriving

Estimates based upon reported slaughter of cattle amount to about half of the estimated number that are slaughtered (officially and unofficially).

The imported beef is based upon an estimate of the importation of cattle, assuming 100% slaughter with a carcass weight of 150 kg. and 38.5 kg. of offals. This is probably fairly accurate.

Other estimates are made in similar ways but tend to be less reliable (for domestic production) because of the hazy estimates of the size of the traditional herds. Estimates for modern pig production are based upon knowledge of the producers and their volume. Modern poultry production is based on sales of day old poults plus estimates of the number of layers culled.

The projections are based upon the rate of change in the 1970's. For beef and small ruminants thereis no doubt of the capacity of the market to absorb the increased supply.

In the case of pork, it is likely that the modern sector is responsible for much of the 17.9% a year increase in production. This product is sold only in category 1 butchers shops. A modern packing plant, financed by private investors, is planned for Abidjan next year, with a minimum throughput equal to the output of the modern sector in 1972. Subsequently a packing plant is proposed in the north. It is proposed to market the increased pork supply through the national chains (like "Avion"). It is not clear that the present rate of expansion of the pork supply can be matched in the feed supply or in the marketing, unless the feed grain programs move much faster than they are doing now, with a consequent decline in price.

Poultry production has expanded rapidly in the last decade. As with pigs there is a different market for the traditional and the modern production; the traditional poultry are sold in the African market alive and the modern birds are sold dressed in the supermarkets and butchers shops. However, the modern poultry had only 13% of the market in 1972, compared to 40% in the pork market.

The 1975-80 Plan

In the past, the livestock sector had not received any substantial investment in the Development Investment Plans. In 1967 livestock received 439 million fcfa, 1.2% of the budget, and in 1973 621 million f, 0.7% of the budget. The increase, as usual in the Francophone countries, mainly just covered personnel costs, while there was a decline in the real value of the budget for operation. In the 1970-75 plan 5.9 milliards were planned for livestock development investment; however the total invested will probably be less than half of this sum.

The 1975-80 plan is currently being developed (May 1975). The political pressures exerted by the farmers are being considered; the election will take place in November 1975. On the other side the disturbance in the meat market, which really started in April 1975 is likely to stimulate action.

Action in production of non-ruminant livestock is, in part, dependent upon the ability of "Agriculture" to provide the increased feed supply. This should be brought nearer to reality in the next plan than in the current one.

Supply-Demand for 1980-1985.

The projected increases in total domestic production are sufficient, assuming the trend in supply of fish is maintained, to sustain 1973 levels of per capita consumption with 1970-72 levels of imports of ruminants. However, because the major increases in production are in poultry and pigs, the consumers would have to substitute these for sheep, goats, and beef. While poultry may be acceptable in these quantities, it is not likely that pork, which was 4.3% of the red meat supply in 1972, and 6.5% in 1973, and 8.1% in 1974, could be 30.6% of the supply in 1985. The figure of 16.5% in 1980 seems possible.

3. Livestock production systems and Ecological Zones

In the Ivory Coast three major ecological zones are represented:

the Sudanian Zone

the Guinean Zone

the Forest Zone

The potential for extensive ruminant production on natural pastures is better in sudanian and guinean zones. However tsetse fly infestations and ticks make it necessary to take precautions in cattle production.

In the forest zone, clearance of the forest is a major obstruction to ruminant production. In limited areas such as palm groves where the ruminants can keep the grass under control, there are demonstrated possibilities for production.

The Ivory Coast has no stable group of nomadic herders, descending regularly into the sudanian zone in the dry season. From time to time large numbers of nomads enter the Ivory Coast from both Mali and Upper Volta as a sort of drought avoiding strategy. In spite of the widespread complaints by farmers to the administration and even to President Houphouet-Boigny, repeated surveys in the North of the Ivory Coast indicate that there are almost no nomadic herders present. The relatively small numbers of Zebu cattle (60,000 head) make small migratory movements; the herders typically have permanent dry season houses and are Ivorian residents.

The Peul herd not only these Zebu cattle but also taurin cattle for the autochtone population. Some autochtone groups do not herd their cattle at all; others do herd their own cattle.

The Peul are "professional" herders and watch their cattle at all times, whereas the autochtone cattle herds may be left to graze unwatched during the day and to return to the village at night.

The Peul have traditional grazing agreements with the farmers and live at peace with them; the farmers gain by having their fields manured and their

cattle tended; the Peul gain from the milk produced by cattle entrusted to them, certain other perquisites (such as a portion of the calves), and they gain from the feed value of the crop residues.

Production in this system is limited in its capacity by the amount of dry season pasture and fodder available; the wet season pasture and fodder typically is not limiting. The thesis is proposed that the increase in population is requiring more land for food production and so decreases the land available for grazing. In fact, the population in the sudanian (savanna) zone is slowly declining, due to migration of the population to the urban areas and to the forest zone.*

Traditionally the extensive production of cattle has depended upon the combination of dry and wet season pastures. Attempts are being made to encourage keeping cattle on farms and distributing nucleus herds of taurin cattle to farmers. These are attempts to develop a modern sector of cattle production with cultivated forage. These methods are exemplified on the Sipilou ranch and the Bandema Valley Authority cattle finishing scheme.

Included in this modern sector is animal traction, with feeding for draft and finishing the cull animals for butchery.

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*		1970	1980	1985
Forest zone	urban	558,000	1,120,000	1,490,000
	rural	1,763,000	2,270,000	2,560,000
Savanna zone	urban	318,000	580,000	650,000
	rural	1,507,000	1,420,000	1,350,000

Source: Desplechin, J. Strategie du developpement de l'elevage, Min. of Economy and Finance 1973.

Attempts are being made to develop "industrial feedlots" (for example, at Ferkessedougou), which is part of the intensive modern sector development. However, at present there are noneof these units in existance.

In the forest zone it is feasible to produce cattle on the grass growing under the palm trees in groves. The contribution of such production to the national supply is currently negligable.

The last system of cattle production to be discussed is the "recuperation" of cattle before slaughter. This involves attempting to restore weight on cattle delivered to the major cities. This is a logical course of action but one which, so far, has not been done at a profit.

Small ruminant production. Some of the small ruminant production is done by the Peul, with their own herds. However, most of the small ruminants (sheep and goats) are "self raised" (autoelevage), that is, the animals are left untended for almost all the year (except perhaps during the crop season). Substantial changes would be necessary to obtain substantial increases in production. Research on improved methods is underway.

Modern pig production. Modern pig production is well established in the north (Bouake, Ferké, Korhogo) and near Abidjan. The output has doubled in the last 5 years. There are three large producers (finishing a thousand head a year) and many smaller producers. There is one center for producing feeder pigs for sale to farmers for finishing (Korhogo). The Korhogo center also supplies the pig feed. The larger producers may import their own supplement and mix their own pig rations. The Korhogo center is running at a loss. The profitability of modern pig production under suitable production is likely to be demonstrable from the 12 or more units selling over 200 head a year. However, a regular supply of feed at a profitable price in relation to price of pork may be difficult to assure. Molasses, if regularly available, might fill part of the need.

A limited amount of short term credit has been available for modern pig producers from the BNDA.

Pig and poultry production. The traditional production is done in villages. The stock are fed byproducts from the household and sometimes purchased by-products (such as brewers grains) are used. The stock are largely untended and get much of their ration from scavenging. The parasite problem can be serious , especially in pigs which may carry parasites of humans (trichinosis and tapeworms).

Traditional pig and poultry production are both important and very significant in terms of their contribution to the domestic meat supply.

Modern poultry production. There are both private entrepreneurs and Government organisations involved in modern poultry production. The largest unit is at Abobo, where both meat birds and eggs are produced.

The major GOIC poultry center is at Bingerville. There is a hatchery there and day old chicks and feed are supplied.

There can be no doubt that a properly managed modern poultry enterprise is profitable but a number of African entrepreneurs were forced out of business in 1973/74 by the squeeze between the cost of feed and the price of the product.

It must be remembered that the supply of eggs on the african market is sufficient and that the modern meat birds are sold dressed and only through category I butchers shops and supermarkets. The market is thus limited. However, the price is still higher than african market prices of meat.

From time to time attempts have been made to improve the meat and egg production of the local chickens by introducing improved cocks. This is quite feasible but needs management and a maintenance of a supply of suitable cocks so that the breed does not become pure "improved". The improved breeds do not stand the conditions of production of the traditional sector. So it is occasionally necessary to back cross to traditional breeds to maintain a "rustic" quality.

4. Markets and prices

The market data is incomplete and does not account for even the sale of all of the imported animals. The point of slaughter of about 50% of the cattle and about 95% of the sheep and goats is not known.

In general, cattle enter at points along the northern border (see description of projection veterinary posts on the frontier and fig 1) and move southwards to market. Cattle entering in the Odienné region transit to Liberia (about 10,00 head a year) or move to the cities in the West, Man, San Pedro and Sassandra. Some of these cattle move by truck and some on the hoof. All of the sheep and goats move by truck. The main stream passes through Niellé or Ouangalodougou to Bouaké and Abidjan. The Malian cattle mainly arrive on hoof and about half of the Voltaic imports arrive on the hoof and half on rail.

All of the cattle arriving at Abidjan are supposed to arrive on wheels - rail (90%) or truck (10%).

Major problems are caused by delays at railway loading points, waiting for wagons. The loading points are usually in densely populated areas with a lot of farming and the delay leads to conflicts between drovers and farmers. An attempt is to be made to improve the declining efficiency of the railroad. The cost of transport has doubled in recent years.

The trade in imported cattle is mainly between Malians who are the merchants dealing with the wholesale butchers, many of whom are Malians. However, in spite of frequent allegations that the profits are excessive, all of the studies which have been made (SEDES, UNDP Mali project 523, etc.) indicate that the livestock are handled in a competitive market with relatively modest margins of profit.

There is, however, a problem common to the whole francophone region meat prices are set officially but the prices of cattle are set in the market place.

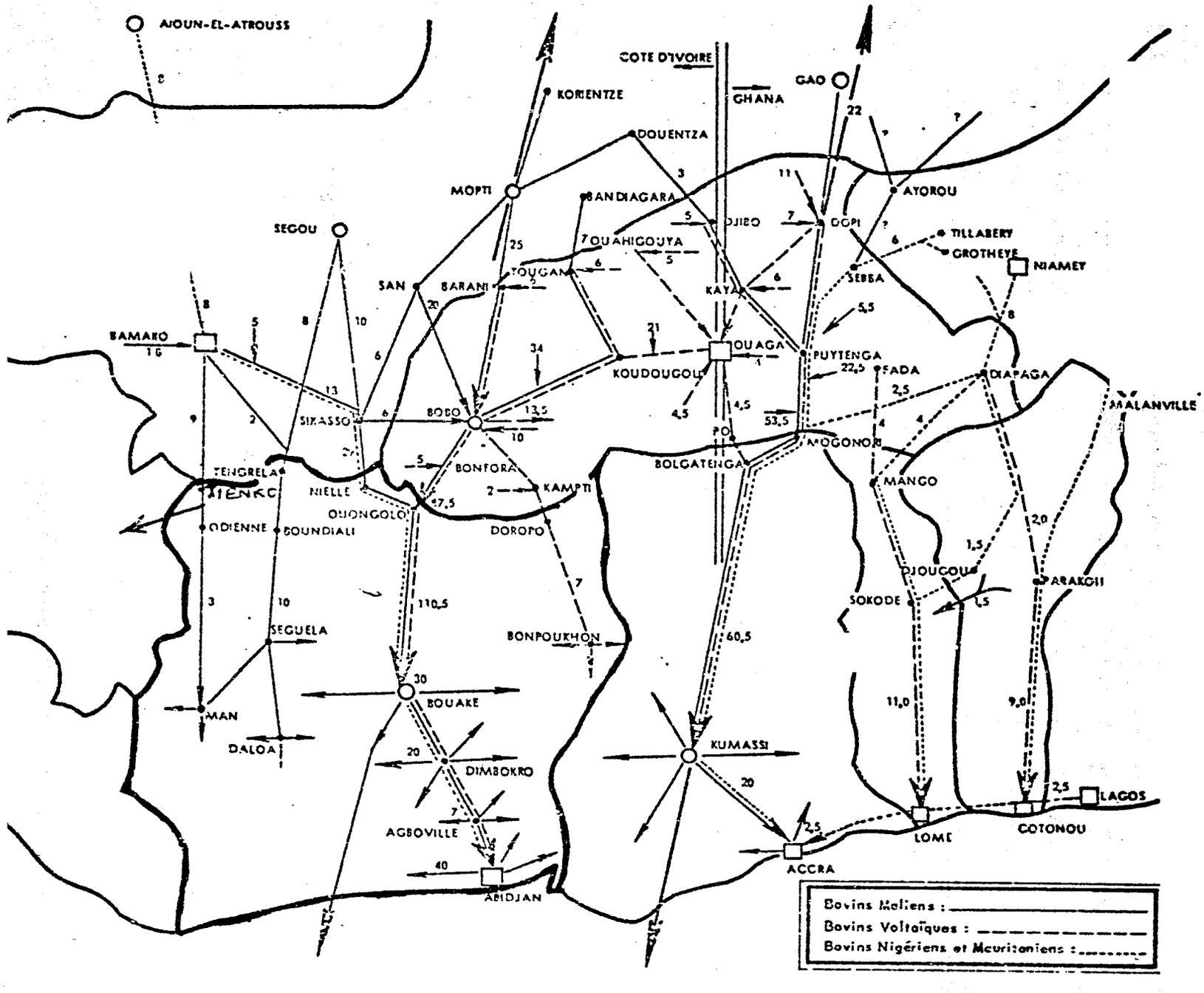

Fig. 1. Regional Cattle trade (data are for 1966)

In 1974 the slaughter declined in most of the countries including the Ivory Coast, although the price of meat rose only modestly--less than the increase in the minimum wage of 20 + 25% within a 6 month period in FY 1973/74 (table 6). However, the price of rice more than doubled (from 60f to 125f/kg.) and the prices of other staples (cassava, yams, and plantains) also increased. The market appeared to be adequately supplied; that is, there was still plenty of meat available on the Treichville and Adjamé markets during the noon hour.

Recent results of studies by Montgomery* support our hypothesis that the meat and other ingredients of the sauce take second place (in the priorities of the consumer) to the purchase of the carbohydrate staple. Montgomery's results also show that consumers respond rationally to price changes in meat and to the alternative of substituting fish for meat. The price of fish has remained relatively stable (at about 150f/kg. on the African market) largely because the GOIC has permitted an enormous increase in the purchases of fish from foreign trawlers in Abidjan harbor.

Since April 1975 the meat situation in Abidjan has changed. The supply is inadequate and, in spite of a modest increase in price at the end of March, the actual price has reached a record level . The situation has probably been accentuated by an official decline in the price of rice from 125f to 100f/kg.

The change in prices of meat over the last 20years can be seen in table 6 and the current (May, 1975) offical prices in table 7 . However, at this time of penury the price of the beef sold in piles by one butcher (who also slaughtered cattle) was determined. On each pile of bones the butcher's assistant place 150 gm. of meat (weighed on the scales) and each pile was sold for 100f (or 667f/kg. meat with bones free). The official price for such a transaction was 50f for a 350 gm. pile with 40% meat and bones, and 60% offal or about 180f/kg. edible product.

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* The consumption of meat in Abidjan varies with the prices of meat, of fish (a substitue for meat), and of a composite of cassava, yams, and plantains.

Table 6. Development in the price of beef, Abidjan (4/kg)

		1956 to 59	1959 to 64	1964 to 67	1967 to 70	1971	1972	1973	1974	1975
MODERN 1ST CLASS BUTCHERS	FILET	460	460	580	580	900	900	900	950	1100
	BROILING	375	430	510	510	800	800	800	800	950
	ROAST	300	345	390	390	650	650	650	650	800
	BRAISING	200	230	260	260	335	335	335	340	360
	BOILING	130	130	150	150	240	240	240	300	300
	LIVE CARCASS	60 170 TTC*	70 175 TTC	80 180 TTC	90 210 TTC	100 225) 306 tax 81)	120 225) 306 81)	130 250) 331 81)	150 250) 343 93)	275) 388 113)
TRADITIONAL 2ND CLASS BUTCHERS	FILET	250	290	335	335	335	335	335	500	
	BROILIN	200	230	255	255	255	255	255	350	
	ROAST	200	230	250	250	250	250	250	350	
	BRAISING	150	175	190	190	190	190	190	300	
	BOILING	120	120	130	130	130	130	130	300	
	LIVE CARCASS	60 140	70 150	80 165	90 175	100 200	110 210	120 225	130 300	

* TTC - taxes included

Table 7. Adminstrative Prices for Meat
(Abidjan, 22 March, 1975)

	Category of Marke		
	1st class		2nd class
	1st quality	Extra	
		f	
Beef			
Filet, kg.	950	1100	500
Grills, Kg.	800	950 with	
Roasts, kg.	650	800 bones	300
Braising, kg.	340	360 without	350
Stewing, kg.	300	300 bones	
		by the pile*	50
Offals			
liver/kg.	320	320	250
heart	320	320	each 225
tongue	320	320	each 200
kidney	320	320	each 150
brains/each	200	200	150
tripe/kg.	110	110	110
Mutton			
Leg/kg.	675	820	370
Chops/kg.	600/660	650/800 with	350
Shoulder (boneless)/kg.	600	650 bones	
		by the pile**	50
Pork	No fixed prices		

*Minimum standard for beef "tas" is to be 350 gm. with 60% offal and 40% meat and bones (or better).

**Minimum standard for mutton "tas" is to be 300 gm. with 60% offal and 40% meat and bones.

The price of beef with bones was 350f and without bones 400f, 50f/kg. higher than the official level. There was no filet available but it was priced at 800f/kg. (500f officially). All of the filet was taken by the supermarkets and Class 1 butchers.

The price of cattle was reported to be 40-45,000f for a steer that would provide about 125 kg. carcass or 320-360f/kg. carcass plus 16f/kg. slaughter tax. Under these circumstances the butchers will not sell meat at the official price. There was less of a shortage of mutton in the market. The price was about 50f above the official level. However, since only about 31% of the sheep sold in the area were sold through the abattoir and meat market normally, the significance of the supply in butchers stalls is not known.

An attempt was made to find out why the number of cattle imported had declined in the last two months. These cattle would normally come from Mauretania (13% in 1974), Mali (53%) and Upper Volta (33%). Of the Voltaic exports a considerable number are of Malian origin smuggled into Upper Volta.

Three important changes have occurred. Mauretania has officially stopped cattle exports, although we have no information of the effectiveness of this measure. In May the Malians closed their borders to stop export of cattle. Upper Volta has effectively stopped Malian cattle from entering.

The last will be causing a reduction in the "domestic"* supply and so creates price competition for exports. This could have reduced exports from Upper Volta.

The Mauretanian action, if effective, will cut off the stream of Mauretanian cattle to the Ivory Coast and also the several thousand head each year which were normally slaughtered in Mali.

The Malians in April (OMBEVI) recognized the reduction that was taking place in the export to Ivory Coast but believed it to be a transitory effect. Subsequently, Malian cattle export was banned. The drought

*Many of the smuggled Malian cattle were slaughtered in Western Upper Volta.

in Mali mainly affected the region which supplied cattle down the Niger river to Niger and Nigeria. The regions supplying the Ivory Coast were relatively lightly affected.

It is possible that the closing of the Voltaic border caused some cattle, which would have gone through Upper Volta to Ivory Coast and Ghana, to follow the Niger river route to Nigeria. Traffic along this route in 1974 was only about 10% of normal (believed to be due to the drought). Movement in 1975 is believed to have recovered somewhat but still to be below the normal level.

The Ghanian market, which has a fixed price for buying cattle at the Voltaic frontier, is not a major factor in the Ivorian shortage of supply. Indeed, the rise in prices may have reduced the supply offered to the Ghanians and the lack of access from Mali, except through Ivory Coast, followed by the banning of Malian exports has greatly reduced the Ghanian supply.

The shortage of beef on the Ivorian market cannot be expected to remedy itself, although import of meat will take the edge off the acute shortage. It is believed that the shortage will cause acceptance on the African Market of frozen imported beef.

The effect is expected to be lasting on the livestock and fishing sector development plans of GOIC, coming as it does at the time when the 1975-1980 plan is being formulated. It is to be hoped that, in spite of the usual complaints of "anarchy among the wholesale butchers" need to "limit the number of butchers licensed to slaughter," "need to Ivorianize the butchers"*, the GOIC and its technical advisors will recognize the fact that the meat market is working effectively and that intervention by setting maximum prices for cattle will only further reduce the quantity and quality of the supply.

It is interesting to hypothesize how close the price of boneless meat is to the threshold at which say Nigeria first, followed by Liberia and perhaps Ivory Coast

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*Fraternité Matin 22/23 March 1975, the semi-offical Ivorian newspaper, p. 3.

will import boneless chilled or frozen carcasses from other continents.* The GOIC has increased meat imports of about 1500-2000 tons a year by perhaps 3000 tons of frozen beef from the French surplus at $1000/ton fob France.

The increase in price of cattle is met with satisfaction by many, who consider that the price of meat on the coast was excessively low and that a higher price will make such modern sector trends as industrial feedlots profitable. However, if Nigeria and Ivory Coast decide they can import beef from Brazil or Australia and the chilled or frozen (boneless) carcasses can be handled, the pressure will be taken off the supply, at least in this geographical area.

Furthermore, the increase in the price of cattle and their scarcity makes it more difficult and more expensive to supply a feed lot. The increase in the price per Kg. liveweight gain is increased but the cost of the feed and of operating a feedlot has risen as fast or faster. So the economics of industrial feedlots may not be improved.

Market for Pork

The major part of the pork produced, (60% of the tonnage in 1971), that of the traditional sector, does not pass through the regulated livestock markets, abattoirs, or butchers. This is presumably produced and consumed by non-Moslems, although Moslems may produce pigs.

The majority of the output of the modern sector, with carcasses 2-3 times the weight of the traditional pigs, appears to be purchased by a small number of wholesale butchers (most of whom are not African), slaughtered in large urban abattoirs, and sold to supermarkets, or in the category 1 (European) butchers shops of the wholesalers. With the exception of pigsfeet, which are sold outside the butchery area, pork is not handled at all in the African meat markets, mainly because the butchers, often Malian in origin, are Moslem.

* Australia currently has a large surplus of grass fed beef for which no market has been found. Current price (June 1975) would be about $1.20/kg boneless if Abidjan or Lagos, almost the same as the French surplus at $1.00/kg fob

Poultry Market

Eighty seven percent by weight of the poultry produced in 1972 was in the traditional sector. These birds are marketed alive in a poultry section of the village and urban markets. A portion of them are purchased by merchants who transport them to the larger urban markets.

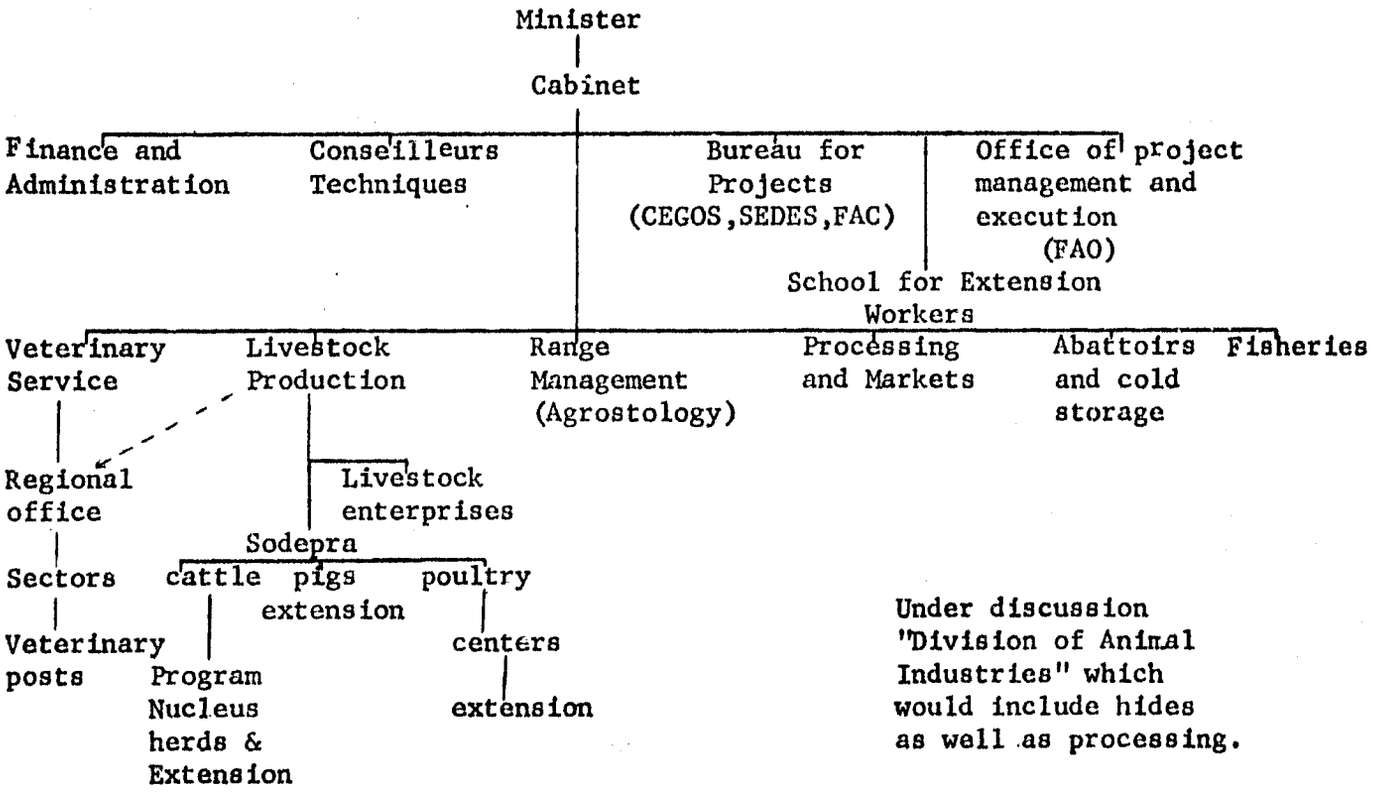
The modern birds are not the choice of the African mass market because of the lack of flavor and the tenderness (which causes them to disintegrate in the stew pot). They are sold dressed in the supermarket, the Category I butchers shops, and at the farm. The extent to which the market will accept a much greater volume of modern poultry is unknown.

Eggs from the modern sector are sold throughout the markets and by vendors on the street. They are completely accepted by the Africans.

5. Government Organization

a) Ministry of Animal Production.

The GOIC has a Ministry of Animal Production, concerned with all aspects of livestock production except research (Ministry of Scientific Research) and grain feed production (Ministry of Agriculture). The organization of the Ministry of Animal Production is shown below:



1. The Veterinary Service. (Last report, 1972)

The 1972 report indicated a need, not presently covered by people in training, for 3 veterinarians, 3 livestock assistants and 13 monitors, with an extra 3 assistants in training for ITE. However, this cadre has to take care of increased demand for staffing the enlarged veterinary posts in the north (2 vets, 2 ITE, and 8 assistants) and other development programs.

Region	No. of sectors	No. of posts	Staff 1972 Vet. Inspector	Vet. Asst.	Livestock Asst.	Monitor	Total
Headquarters			3	-	6	7	16
North	5	14	4	-	13	36	53
Center	3	8	-	-	9	19	28
East	3	4	1	-	10	10	21
South	2	6	1	-	8	10	19
West	1	2	-	1	2	8	11
Center West	2	2	-	1	5	8	14
Laboratories*			-	2			
Total	16	36	9	4	49	98	160
Training					3***	5	8
Detached					4	1	5
New posts operations			6**		8****	13	

*Bingerville and Korhogo diagnostic laboratories.

**3 new veterinarians arrived at the end of 1973.

***3 assistants training will become ITE (Ingieur des travau élevage).

****5 moniteurs in training to be livestock assistants.

Operating budgets have been:

1970	38,630,000	
1971	22,600,000	
1972	26,600,000	including 14.6 million for vaccines.
1974	26,600,000	

Health Status

In 1972, there was the usual level of cbpp but also an outbreak of rindepest in imported Malian cattle. There was a mortality of about 560 head of imported and 140 head of domestic cattle. There were 396,000 immunizations given. About 50,000 head were treated with trypanocide drugs.

In 1973, according to the ELC summary, there was another outbreak of rindepest in May with 562 deaths.

Livestock Production Division

The livestock production division has principal responsiblity for the poultry program. It also has an extension program on pig production and has distributed about 175 nucleus cattle herds (almost 2,700 head) to farmers. Lack of definition in the position of Sodepra, nominally under the Production Division, handicaps action in pig and ruminant production.

Staffing 1973 Report.

	Vet.	ITE	Assistant	Monitors	
Sodepra	1	1	1 + 3*		(excludes expats)
Bingerville Center	1	1	2	3	
Korhogo Centers			2	6	
Bouake Center			1	3	
Headquarters	2	2			
	4	4	6	12	

*Detatched from vet. service.

The composition of the Agrostology, Procession and Markets, and Abattoir divisions is not known. In Abidjan they have a separate staff, but in the rest of the country they share duties within the regional framework.

Sodepra is an autonomous parastatal organization with responsiblities for

-Abokouamikro and Sipilou Ranches

-Livestock production program in the north for farmers, for Peul

-Korhogo pig center and program

-Livestock production in crop programs (Soderiz, etc.)

The [illegible]est ranch, Marahoue, financed by FED, has been set up with a contracted management working under an executive committee which sets up the annual production plan. This arrangement is to overcome deficiencies in management by Sodepra.

Research Institutions

The research programs are under the direction of the Ministry of Scientific Research. A special program for establishing research priorities has been developed* and its effect is now being felt. Interagency subject-matter-area program and budget committees are responsible for identifying priorities and allocating funds. The committees include the staffs of the Ministry of Scientific Research and the research institutes, the Plan, Economy and Finance, Animal Production and its divisions, Agriculture, and the University. The program has been modified to bring it more in line with the needs of the development program.

The research program for the livestock sector involves:

ORSTOM (Km14) Forage plant breeding

CRZ (Bouake) Livestock Research Center

CIRES (Abidjan) University Institute of Social and Economic Research
National Agricultural College.

Applied Research is also done by Korhogo substation of CRZ

Sodepalm - cattle production and selection using palm groves

Ministry of Animal Production - Sheep/goat management.

The CRZ also is responsible for the management of the forage seed multiplication farm.

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* du Plessix, C.J. et al. Planning of Agricultural Research in the Ivory Coast; Ministry of Scientific Research, 1973.

Priority programs in the livestock sector for 1974 and 1975 include:

-Systems of exploitation of the Savanna

-Agrostology of natural pastures

-Improvement of forage grasses (Panicum)

-Cattle nutrition

-Genetic improvement of ruminants (especially cattle)

Projects at CRZ

1. Forage production and management including grazing trial

-Panicum maximum, including ORSTOM's new variety.

-Stylosanthes.

-Brachyaria mutica in low lying land.

-Improvement of natural pastures by brush killing and seeding various species.

-Irrigated forage production.

This project include study of the digestability of forages at different time of the year.

2. Cross breeding of introduced breeds on the local taurin and Zebu cattle

Originally this involved Jersey x N'Dama; the half-blood has been found to be trypano-tolerant but increasing the Jersey blood then causes a loss of the tolerance. Forty 3/8 Jersey cattle have been put into herds in the bush

The Neilor and Guzeira Zebu cattle, donated by the GO Brazil, are being used to create pure bred herds and for crossing with local Zebu and N'Dama. At three years of age the Brazilian Zebu males weigh 600-650 kg. compared with 300 kg. for the local Zebu.

It is proposed to create a Zebu center, perhaps with a loan from the Council of the Entente, either near the forage seed multiplication farm at Badika or in the Forest of the Palé. The center will serve

-to select from the local Zebu cattle.

-to study crosses between Zebu and taurin cattle.

-to study crosses with the Brazilian Guzeira and Neilor cattle (already in the North of Ivory Coast.

-to test the Azawak and Gobra and perhaps the Sahiwal and Sokato Goudali Zebus pure and in crosses.

There is already a market for improved Zebu bulls for sale or lease to the sedentary Peul in the region. The Zebu center would provide stock for multiplication and subsequent use in livestock production for milk, meat and animal traction.

3. Sheep and Goat Project. A project has already started on the evaluation of the Sahelian and the intermediate Djalonké breeds of sheep. The next steps will be selection and crossing.

Next year (1975/76) a start will be made on a similar study of goats.

Management systems for sheep and goat production will be studied.

This work will be carried into the field, in coordination with the FAO village sheep program: in base line villages, in villages with expatriate volunteers to carry on an extension program, and on an industrial scale on irrigated pastures under management of Sociabé (an autonomous Ivorian organization).

4. Improvement of N'Dama Cattle. CRZ is responsible, with Sodepra, for using the herds on the Sipilou and Abokouamékro ranches for selecting of improved cattle for use in the cattle development programs in the Ivory Coast.

5. Improvement of Baoulé and Lagoon cattle. The Baoulé cattle herds in the Sodepra palm groves are being used as a basis for selection of improved Baoulé cattle for grazing programs in the other palm groves and for peasant production.

In another area a nucleus of 200 lagoon cattle (smaller and more trypano-tolerant than the Baoulé) is being used to start selection in this breed.

b) Education and Training

1) Training of the cadre for the livestock sector.

Veterinarians are trained at the regional Veterinary School at Dakar, as well as in the French and Belgian (french speaking) veterinary schools.

Agronomes (Ing. Ag. and Elevage) are trained in the ENSA at Abidjan, with an enrollment of about 40-50 students a year (one third "foreign"). Currently the first cycle is being taught in the University at Abidjan, the second cycle is taught in the ENSA, and the third cycle is done abroad. It is planned to do the third cycle in the Ivory Coast soon.

ITE (Ingineur des Travaux élevages) is believed to be taken at the school at Bamako; it requires 4 years after the BAC.

Livestock Assistant is taken at the Bingerville school

Monitors in livestock production are trained locally.

There are almost no Ivorian "animal scientists," who would have taken a course at the ENSA followed by the third cycle abroad. This makes it difficult to man the livestock production development program projects. For this reason, the Ivorians plan to use expatriates as project managers; the Ivorian counterparts should be trained in place.

Only recently have formally trained ITE's been used in the livestock sector in Ivory Coast. A few of the older ITE's were awarded the qualification on the basis of experience and not formal education. This rank is also in short supply.

There is almost a complete void in Ivorian livestock research workers. One Ivorian veterinarian has just started to work at the CRZ, Bouaké.

Because of the high level of training available in the special branches of livestock production in the U.S., it would be helpful to the Ivorians if the third cycle could be taken as a masters program (with or without thesis) in the U.S. or at Abidjan. Such specialties as range management, animal breeding, animal nutrition, pig production, poultry production, rangeland cattle and sheep production, and forage production, could be usefully studied in the US or with US assistance as training for project managers and research workers, both short term and for degrees.

2) Extension in Livestock Production

Apart from the nearly complete lack of a qualified Ivorian Cadre to develop an extension program in livestock production, the organization to carry such a program is not in existence.

The extension work is mainly carried on by the veterinary service, which is organized by regions and sectors and is stationed in posts. This program is carried out by the staff that delivers the veterinary service and a small number of "specialists" in pigs and poultry.

In theory, the livestock extension should mainly be done by Sodepra. However, Sodepra does not have the means to do the job. Farmers receive extension service from their "operation" -- rice or cotton. The operations are becoming polyvalent; that is they now include food crops and, in theory, livestock.

In the proposed livestock development program in the North, each region will have an expatriate director within Sodepra and the extension agents, trained by the project staff, will presumably work through the "operations" with the farmers. A separate program, using Peul extension workers, will be used with the Peul herders.

The decision to develop teams to deliver a rural development program has not been taken. It must be remembered that the "operations" have been relatively successful in stimulating the production of the export crops such as cotton, palm oil, coffee, cocoa, etc., and have already made a start in rice. Also shortage of domestic rice supply has been more of a political problem (with rise in prices) than has shortage of food grain, whereas the interior states

and Senegal have suffered important shortages of food grains in both rural and urban areas, which has resulted in broadening the responsibilities of the operations to include food grain. In the Ivory Coast, maize and soybean production programs have been entrusted to Soderiz, the rice operation

Furthermore, only in the last 2 years has a real effort been proposed for development of the North. It is not clear at the moment the extent to which this will be incorporated into the financed production programs. It is clear that it is a politically charged program, with frequent trips into the countryside by President Houphouet-Boigny and his entourage, and with magnanimous promises of financial assistance (often beyond the means of the GOIC and requiring external financing). The elections take place in November and examination of the budgets of Calendar 1976 and 1977 will show how many of the proposals are to be financed.

B. National Plan and Strategy*

1. The Plan

The 1975-80 plan provides a broad set of interventions in all the areas of Ivorian Livestock Production and also changes in the Ministry of Animal Production to improve project design, development and supervision.

In the last "plan" it was recognized that reliance on ruminant livestock production alone would not be sufficient to maintain, let alone increase the percapita meat consumption in the Ivory Coast. So a program was started, at the Presidential level, to stimulate production and storage of maize and soybeans for poultry and pig production. This program is carried forward into the 1975-80 plan.

The program of the Ministry of Animal Production includes:

1. a major program of livestock extension and improved veterinary service delivery to farmers in the North under Sodepra but integrated into the "operations". This involves FAC (applied research unit), the French Caisse Centrale (CCCE) providing a loan, and German and Belgian funding and technical assistance. This will include ruminants, pigs and poultry.
2. five new veterinary posts, markets and abattoirs, plus housing, water and electricity supply, to monitor the trade cattle entering the Ivory Coast in the expectation of reducing the morbidity and mortality of diseases introduced by trade cattle, sheep and goats. AID loan funding

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The 1975-80 Plan Document is not yet available. A copy of the 1970-75 plan is available.

is being sought for this from the Council of the Entente. Grazing areas are proposed to reduce the conflicts with farmers and to minimize weight loss on the way to the market.

3. a program of extension and improved veterinary service to the nomadic and sedentary Peul, providing water supply, cattle trails, fire breaks, improved grazing and forestation. This is expected to reduce conflict between the nomadic herders and the farmers.

4. Set up a production ranch (Marahoue) financed by the FED and an industrial feedlot by the sugar factory at Fekessedougou (hoped to be financed by Germany). The Marahoue, although under Sodepra, has a management policy committee establishing the annual program and a contracted management given the authority to carry it out. The management of the feedlot has not been established; it is not yet clear whether it will be under Sodepra or Sodesucre.

5. Provide credit to set up a number of intermediate mixed farming enterprises. This was originally conceived as 25,000 ha. cattle ranches, which proved to be unattractive financially and slow to mature. The size has been reduced to about 1,500 ha. and the concept includes mixed farming and several livestock enterprises. Latino-conult is to produce a program plus detailed plans for the first 5 farms by the end of calendar 1975. Credit has been sought from the AID loan through the Council of Entente. Extension will be provided by UNDP.

6. Agrostological and Entomological study of the Savanna region. UNDP sponsoring Entomological survey and? FAC Agrostology.

7. Industrial supply of feed for pigs and poultry on private and on state nonfarms. USAID loan support is sought for an initial 5,000 ton drying and storage facility in the Bouake area. An international feed company is being sought to participate in setting up of the feed industry.

8. A major thrust in pig production involving:

   -- expanding the Sodepra feeder pig center at Korhogo

   -- building a series of 5 x 200 sow farrowing units under independent (non Sodepra) management at Fakessedougou.

   -- finish pigs at the Ferke feeder pig center

   -- promote pig finishing among private farmers in operations like SODERIZ and SODECOTON

   -- a private pig packing plant with 15-20,000 head a year capacity Bouaké. (See page 10).

9. A program to increase modern poultry production in the private sector, especially near Abidjan, using feed delivered from Bouaké. Within the Ministry of Animal Production, the structure exists for

   -- Project Development Office (Bureaux des Projets) with personnel from CEGOS and SEDES (FAC financed)

   -- Project management office (Cellule d'execution et Controle des Projets) with a staff of three expatriates (FAO) and Ivorian counterparts

   These are to be developed in the 1975-80 plan.

Existing development projects which are to be continued include:

1. Livestock production and peasant cattle feeding on stylosanthes in the Bandama Valley Authority Program (FED)

2. Demonstration projects (UNDP)

   -- Baoulé cattle in palm plantations with Sodepalm

   -- Lagoon cattle in palm plantations with Sodepalm

   -- Village sheep production

The Research Strategy has been discussed under research institutes (page 8)

2. Evaluation of the Strategy

The strategy is well conceived to meet the needs of the livestock sector of the Ivory Coast in maintaining or increasing per capita meat consumption. However, it seems that most of the emphasis in ruminant production is on cattle, the major component of the large city meat supplies. In the next 5 years the increase in the domestic cattle supply will be quite small. A thrust in small ruminant production could make a substantial increase in supply within this period.

There are six major areas of weakness and two areas where problems may arise.

1. The concept that maize and soybeans must be produced in large scale mechanized units and stored in very large central drying and storage units will be very costly to get going. Small farmers in the forest zone have already demonstrated their ability and willingness to increase maize production if they can either store it themselves or sell it to some organization that can store it. The major limitations are drying and storage and storage and a market price high enough to encourage production as a cash crop.

If the 2 tons/ha (31.4 bu/acre) yield on 100 ha at Sipilou is any indication, the government societies should be kept out of maize production. The farms would need drying and storage facilities on them because of the near impossibility of planning to move maize to a large central storage at harvest time, which is during the rainy season.

Soybeans would most simply be grown as an intercrop between rice crops, as is successfull one in the Cameroons.

The whole economic basis of the proposed pig and poultry programs can be threatened if the feed cost becomes excessive. Alternatively the government will have to set arbitrarily low prices and subsidize the cost of production.

2. Sodepra will have to be able to delegate authority and use modern farm management principles if it is to overcome the need for a substantial annual subsidy to balance its business. It is also necessary to avoid "direct operations" managed by Sodepra in the expanded program in the plan.

3. The GOIC will have to be certain that is is acting on the basis of information and not emotions in the program for the nomadic and sedentary Peul (item 3, p 35). The results of the studies being made by BNEDT and CIRES in the north indicate that

- there are no nomadic Peul left in Ivory Coast
- there is little friction between the sedentary Peul and the farmers because they wish to preserve their traditional relationship.

Current proposals to develop a grazing area in the Forest of LaPalé and the Valley of the Bagué , conceived in the heat of a political confrontation by the Ivorian farmers in the north, will have to be re-developed with new goals (i.e., abandoning the concept of reducing conflict) and to be evaluated in the light of the extra production of milk and meat, without the benefit of the social value of reducing conflict. The proposed investment of 42,000 cfa/head* of cattle in the grazing area is already extraordinarily high and if the cost is charged only against the additional grazing capacity obtained, the cost becomes ridiculous. The 42,000 f has already reached the

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* 500 million for 12,000 head. There are already 11-12,000 head of cattle in the area at certain times of year and so the additional carrying capacity of the system on a year round basis must be estimated. The new "Plan" calls for an investment of 5000 f/head for development (table 8, p. 39).

level of investment per head of a ranch.

The concept that tsetse flies can be controlled piecemeal, rather than, if economically feasible, by a substantial campaign, may need revision.

Table 8. Investment proposal for livestock development in the Savanna (1975-80 Plan

	Village Livestock	Transhumant Cattle	Frontal Zone
		f cfa/head cattle	
Stock Water Supply	1,000	2,000	4,000
Natural pasture management	500	500	1,000
Cultivated forage	1,000	---	---
Trails, water supply domestic	500	500	1,000
Tsetse fly eradication	1,000	1,000	2,000
Verterinary infrastructure	500	500	---
Veterinary treatment equipment	500	500	1,000
	5,000	5,000	9,000
Number of head	500,000		25,000
Total Investment	2,500,000,000		225,000,000
Annual maintenance cost/head	711		700
	335,000,0000		17,500,000
Extension cost/head	400	100	100
Prophyllaxis/head	250*		250

Commitment by president 900 million f

* Cattle at 250 f and sheep/goats 155 f
Cost of prophyllaxis estimated at 14,166,000/year.

4. In order to reduce the real source of conflict between the Peul - that is the drovers of trade cattle herds - and the farmers, it is essential that the RAN (railroad) reorganize its cattle car service to avoid keeping large herds, in densely populated farming areas, awaiting railroad cars. This would also reduce the frequency of outbreaks of disease introduced by the trade cattle.

5. The concept of the intermediate sized enterprises seems quite wrong from the farm management point of view. Farms should be started on a size scale that permits the manager to learn the technology, making a number of mistakes, without going broke. They should not be started at the large size proposed. For every ten farms that are started at the most 2 or

3 can be expected to grow; perhaps 1 or 2 is a more realistic estimate. In the U.S. on most farms the management is handed on, with the successor undergoing an apprenticeship before he succeeds the manager. If not the result is often disastrous.

The intermediate sized enterprises should be "tailor made" to fit the demonstrated skills of managers of existing farms that show promise for growth. In a free market, such as the livestock sector in the Ivory Coast, only the exceptional manager can make and keep enough money to grow.

The same problem occurs in starting farmers in pig production and finishing; it is better to start a large number of small enterprises and help the viable ones grow than to try to launch a few large units. Of these large units a third can be expected never to get to full capacity, a third will reach full capacity but be unable to repay their debt and about a third may be successful.

6. The "magical attraction" of size also leads the GOIC to set up the ranch of the Marahoué (15,000 head) and the feedlot at Ferké. The only financially successful ranches in the region were set up in Central Africa (Zaire, Congo RP and Cameroons) by private entrepreneurs. There is no record of the number that failed.

There is no economic reason to think that a 15,000 head ranch can compet in cost of production with the traditional herders. There is every reason to expect that the expenses of the infrastructure and management and labor of a ranch will not result in sufficient increase in efficiency to produce at a price competitive with the traditional herders, subsisting on milk and with low cost family labor.

The deficits on the Sipilou and Abokouamekro ranches are greatly reduced by the possibility of selling pure bred females at very high prices to other parastatal societies. The Marahoué ranch will have to market its cattle in competition with the Zebu of the traditional herders in Ivory Coast and in the Sahelian countries.

In the same way, there is no feedlot in West Africa that is known to be profitable if it has to pay a realistic price for the feed and if it is to pay the cost of the facility and management. The proposal at Ferké is to run 3 groups of 33,000 head through each year. It will only be possible to feed cattle intensively in the dry seasons and so the investment will have to be amortized against two lots fed a year rather than three. It is assumed that 66,000 head of cattle can be purchased a year in Ivory Coast, Mali and Upper Volta, without seriously disturbing the prices. This is certainly untrue at the present.

If the cattle are fed cane tips and charged the cost of bringing in the tips and hauling out the manure to replace the nut rients removed from the fields, and if they pay the commericial prices for molasses, rice bran and cottonseed - rather than a "prix de faveur" the profitability of the feedlot will be difficult to demonstrate (as it has been elsewhere).

There seems to be no idea of trying a 1,000 head pilot feedlot at Ferké, without full-time management, to see what the costs and returns are!

7. A pig production program based upon a high level of molasses in the ration has been demonstrated as feasible for growing and finishing by T.R. Preston and his colleagues in Cuba. Preston, now working for the Mexican National Commission for the Sugar Industry and consulting for FAO, could presumably advise on this.

Production of pigs selling for $1/kg liveweight or more, with a supply of molasses at 2¢/kg is likely to be profitable. Pigs can be produced in the U.S. for 45¢/lb. with maize at about 9¢, a ratio of 9:1 between the price of pigs and of maize.

The proposal to supplement the pigs ration with slaughter house wastes may need revision, since the Mexicans found fish meal (which is available in Ivory Coast) a superior supplement with molasses. The concept of building a yeast plant, converting molasses to yeast, at each "industrial" pig production unit should probably be replaced by one large industrial yeast production and drying unit. Yeast only comprises a very small portion of the ration (2% of the dry matter).

A problem that may arise is that the operation may be so profitable that the GOIC and Sodepra will not try to establish peasant pig feeding units, but will monopolize the production themselves.

The supply of molasses, while not inexhaustible, is sufficient for the production proposed. However, if the cattle feeding operation for 100,000 head a year is set up, this will consume more molasses than the output of the Ferke' sugar plant.

The pig program assumes a sufficient demand for the product with an already increasing supply (see Table 5). One part of the population, including the butchers in the African markets, will not touch pork; although in Ghana it was reported that Moslems were more likely to eat smoked cuts.

A complete marketing organization has to be built to carry the product outside the traditional market (supermarkets and one or two butchers who also made sausages, smoked hams, etc.). This problem is recognized and it is proposed to handle the product in the PAC and AVION chains of small supermarkets not at present in the fresh meat business.

Another problem is that the meat prices are highest in Abidjan where the existing market for modern pork production lies and where the packing plant will be. Can pork be marketed in competition with other meats and fish in the other urban markets?

A similar problem is met with modern meat birds (broilers and cull hens). The traditional African market is for a smaller, more flavored, live bird. Can sufficient outlets be found for the modern, dressed birds - a highly perishable product - at a price that will encourage production?

The pig production program again assumes that there are economies to large scale units (1,000 sows). Unless the unit at Ferké can perform better than the unit at Korhogo (12.1 pigs weaned per sow per year, with about half of these sold as feeder pigs) it will not be financially viable. The unit at Ferké is to be prepared to finish pigs, which it will certainly have to do because of the lack of a market for feeder pigs. The economics of pig feeding depends mainly upon the price of feed, the efficiency of conversion of feed to liveweight and the price of the finished pigs.

While some individuals are making a profit finishing pigs, usually by buying low priced feed (spoiled grain, etc.), it cannot be assumed that a government unit in large scale finishing will be able to do the same. Use of molasses at 4 f/kg is proposed but it is not known the extent to which it can be used.

The shortage of protein above that produced as a by-product at the abattoirs is to be overcome by the production of yeast from molasses and its incorporation (after centrifusing) in the ration. Fish meal might be more suitable as a supplement to molasses.

3. Public Policy Constraints

The concept of development operations for single crops - rice, cotton, palin - has caused confusion for a farmer being visited by a number of extension workers each trying to promote his own program. To some extent this still happens. However, attempts are being made to unite programs presented to a group of farmers.

Similarly the veterinary service has one group of agents and chain of command, Sodepra has another, and the Division of Livestock Production (Sodepra's supposed superior) has yet another (mainly in poultry).

4. External Assistance

1. Ministry of Animal Production to form an Office of Project Development (FAC/GOIC) and Project execution and Control unit (FAO).

2. Sedentary Livestock Production in the North. A substantial demonstration and extension project for farmers and sedentary herders (largely excluding Peul).

FAC "Cellule d' Appui"	
CCCE (French)	Technical assistance
Germany	and
Belgium	rural development project.

3. Transhumant (and Sedentary) Peul herders in the North,

   Seeking AID loan

4. Distribution of tsetse flies in the Savanna region Study (UNDP).

5. Group of small demonstration production projects (UNDP)

   - Baoule cattle in palm plantations
   - Lagoon cattle in palm plantations
   - Village sheep production

6. Grazing areas for trek cattle in the North

   BISI?

7. Pig packing plant, Abidjan, capacity at least 15,000 head a year.

   Ivorian private enterprise.

8. Feed mill and grain storage complex (1 miliard)

   Feed mill, mixed corporation: state (30%) ivorian (30%) and foreign enterprise (35%).

   Grain drier and storage 5,000 t ?AID loan.

9. Marahoué ranch, 15,000 head production unit (FED).

10. Bandema Valley authority livestock production including peasant feeding on stylosauthes (FED).

11. Korhogo increase the center for production of feeder pigs BISI/SODEPRA.

12. Ferke feeder pig production center, seeking AID loan.

13. Pistes and markets in the North (Odienne, Boundiali, and Korhogo or Ferke) BISI

14. Medium sized livestock enterprises:

    extension paid by UNDP

    planning Latino-consult

    financing first 5 units by ?

APPENDIX H

A SUMMARY OF DR. MORRIS'S ACTIVITIES IN AFRICA AND THEIR INTEGRATION INTO 211(d)

During his year at Redso/WA Bill Morris participated in the design of Mali Livestock Project, the Eastern ORD Project in Upper Volta (involving mixed farming, animal traction, and a proposed intervention with the Peul), R and R. Livestock activities in Upper Volta (intervention for sedentarized Peul in West Volta, station for multiplication of trypanotolerant bulls, animal traction program and restoration of Makoye Ranch), as well as preparing project review papers on livestock development in other parts of the region.

He also played a leading role in preparing the Redso strategy paper on the livestock and crop sectors for the spring review of Sahelian at projects in AID, Washington.

Bill Morris also had the opportunity to participate in the Dakar Workshop on cattle finishing and the Paris Colloquium on trypanosomiasis in humans and cattle. He also visited livestock research stations in Francophone, West Africa.

In all, this year of experience provided an excellent learning opportunity as well as a satisfactory experience for the family. The year's work is serving as a foundation for a review on livestock production and marketing problems in West Africa. It has also resulted in many demands for Bill Morris's services for project identification, and preparation of project review papers and project papers for USAID.

Bill Morris completed his year's work for REDSO/WA in Abidjan at the end of August 1974. He attended the seminar on Tropical Cattle Production at Edingburgh en route home. This meeting was particularly interesting because it provided an opportunity to meet the anglophone African specialists in livestock production, while the work for REDSO was mainly with the francophone specialists.

In September 1974, Bill Morris participated in the International Congress of Agricultural Engineers in the Netherlands, which included an active discussion on animal traction in agricultural development. Following this meeting he was guest lecturer at the University of Helsinki; one of his series of lectures was on problems of agricultural and livestock development in West Africa.

During the year 1974/75 Bill Morris prepared the livestock sector papers for Upper Volta and Niger (as a consultant to AFR/CWR); the paper are being revised and expanded as part of the monograph on West African Livestock. A livestock sector paper was also written on the Ivory Coast; part of this was based on study and visits in the Ivory Coast (to research stations and ranches) on the 211(d) project.

Material was also collected on Togo and Dahomey, both during the DAP exercise and the preparation of the Project Paper for the Entente Second Livestock Loan/Grant while consulting for AFR/CWR. This is also to be used in the monograph.

The 211(d) also supported some library research at the IEMVT* near Paris. The opportunity was also used to start a small study to

* Institute of Tropical Livestock Production and Veterinary Medicine, Maison Alfort.

see whether the enhanced ERTS imagery produced by LARS at Purdue can be used for rangeland classification using the French system as found in their series of agrostological studies. The results are not yet available. This would make it easy to up-date studies, to see changes in pasture conditions, and to reduce the cost of making the studies by eliminating part or all of the aerial photographic coverage normally used.

Bill Morris also prepared the project review papers for several small ruminant projects in West Africa some of which will be coming up for design in FY 1977.

Collection of library materials on African livestock development continues and a start has been made on a bibliography and content analysis of the collection. We have been asked to collaborate with the DAC library at OECD in preparation of an annotated bibliography for the "Friends of the Sahel." This is in support of the AID officer who is the executive secretary of the organization.

Consideration has also been given to the application of a mathematical model to a Sahelian livestock sector, such as that of Mali. Purdue proposes to bid on this project if bids are solicited.

Assistance was given to Mr. Montgomery (CRED fellow at CIRES at Abidjan) in conceptualization of his study of meat consumption in Abidjan. We pointed out the significant role of the real price of the carbohydrate component of the diet in the consumption of meat in the region. This, together with the price changes for meat and fish permitted Montgomery to predict the consumption of meat in Abidjan. This also proved the hypothesis that we had been discussing at Purdue on the subject.

Other sources of data have been found that describe purchases of meat in different forms. A study of the economic activities in a Haussa village in Niger is being published from the University of Bordeaux and we have arranged to discuss the subject in detail with the author on the next opportunity (which will be in September 1975). Another study in the Cameroons reports the food consumption of cocoa planters; we are seeking further data on the changes in their consumption when faced with a substantial decline in income. The data exist but have not been published.

A third report on a village in the Ivory Coast is also being studied for evidence on the same subject.

This is part of evaluation of the consumption of meat resulting from transaction both in and outside the traditional market place. This includes cooked meat in prepared dishes (corresponding in the U.S. to the sales of meat in ready to eat form in restaurants and other establishments).

APPENDIX I

PURDUE UNIVERSITY inter office memorandum

To Michael Galli

From Kelley White KW

Date May 1, 1975

Subject Cable to Kenya

Enclosed is the text of the Consortium's response to Kenya's request for more information. It is a little long, but we feel this detail is necessary to reflect Consortium interest and assistance needs.

Will you request that they reply by cable?

Thanks for your help.

KW:me

Enclosure

This is in response to AID-Kenya request for more information concerning Consortium plan of operation and clarification of GOK assistance required. A specific operation plan and determination of GOK assistance cannot be finalized until specific objectives and scope of work have been determined jointly by GOK, Consortium and AID-Kenya. However, a tentative outline of in-country activities by each Consortium member is presented below along with an indication of the tangible benefit that would accrue to the GOK from each. This will be followed by a summary of GOK assistance desired.

Animal Production Component--Texas A&M

An outline model will be developed for sheep and goat production. This model will indicate approximate individual and herd production levels under a range of production systems and environmental conditions. Development of this model will require the following in-country activities:

1. Acquisition of production data from existing research and field survey records for those producing regions of interest;
2. Observation of a sample of existing production systems and conditions to establish the range of actual and potential production methods; and
3. Acquisition of census and other statistical reports concerning the size and composition of herds by region.

If it is concluded that cattle as well as sheep and goats are to be included in the study parallel data will be required for cattle to be utilized in modifying the formal, computerized herd model to approximate Kenyan conditions.

This activity will result in an analysis of existing ruminant livestock production systems and a preliminary evaluation of development problems and potential in regions of interest.

Animal Health Component--Texas A&M

The in-country activities to be conducted and the associated benefits are as follows:

1. Conduct a survey of sheep and goat diseases and parasites to determine incidence and severity as handicaps to production. We envision this would be done largely through review of reports and interviews with personnel of the Kenya veterinary services. diagnostic laboratories, EVARO, the Kabete laboratories, the College of Veterinary Medicine at Kabete, Extension Services, field stations and meat inspection service personnel as at the Athie River abattoir.
2. Having conducted the above survey and having selected the most important disease handicaps to production, we would do the following for each disease of justifiable priority.
   a. Prepare a summarizing paper of information from the world's literature and current research workers on the diagnosis, control and prevention of that disease, thereby determining whether improved field control requires the application of what is already known about the disease or whether research for better control methods is still needed.
   b. Prepare a library of current information. Through contacts established under 1. above, obtain access to case material, take

colored pictures of clinical cases and gross lesions and, when appropriate, collect tissues for pathologic study. From these, prepare sets of colored pictures with commentaries as training aids.

3. Make all of the above information available to the Kenyan Government for the training of veterinarians, extension personnel, and the veterinary college faculty.

To the extent that cattle are included in the model, disease and parasite incidence would need to be surveyed. It is anticipated that the amount of work needed in this area will be much smaller.

Animal Nutrition and Forage Production--University of Florida

An inventory of range resources will be developed by major livestock producing regions. The potential for increasing range productivity through introduction of improved forage production and utilization systems will be evaluated. The nutrient composition of native range will be determined, and quantity and quality of forage available evaluated as a factor limiting livestock production.

Accomplishment of the above will require the following in-country activities:

1. Acquisition of data from research reports, surveys and interviews of individuals with experience in forage production and utilization, and livestock nutrition in Kenya.
2. Site visits to the major range areas to observe forage conditions and livestock forage management systems.

The summary reports developed will be made available to the GOK.

Sociology and Extension Component--Tuskegee Institute

Major emphasis will be on identification of constraints imposed on livestock development by extension and sociological factors. In order to identify those constraints Tuskegee will need:

1. To interview GOK Ministry officials, livestock project personnel, livestock producers, extension coordinators and workers and other relevant persons;
2. Access to relevant documentation on extension livestock programs and livestock production; and
3. Contact with on-going livestock extension programs, especiall at farmer training centers.

The GOK will receive reports which provide information relative to:

1. Producer objectives, needs, current husbandry practices, and receptiveness to improved practices;
2. Socio-economic characteristics of producers;
3. Livestock extension program reviews;
4. Sociological impediments to ruminant livestock development; and
5. Strengths and weaknesses of extension training center activities, and programs for in-service training of extension workers and producers.

Economics Component--Purdue University

The principal objective is to identify the economic variables characterizing the ruminant livestock industry and to integrate these with findings of the other Consortium components into a formal model of Kenya's livestock industry (or that portion of it that we jointly with GOK select for analysis). This model will serve as a means for identifying bottlenecks to ruminant livestock development and for evaluating the economic consequences of alternative means of alleviating them.

In-country activities will consist of:

1. Acquisition of existing reports and data pertaining to production, transportation, processing and marketing costs and returns; marketing institutions; availability and movements of inputs and products by regions; demand for ruminant livestock products; and government policy effecting the industry.
2. Visits to major production regions and major markets to interview producers and marketing people.
3. Interviews with government officials concerning government objectives, policy alternatives considered feasible, and resources available for ruminant livestock development.

Preliminary economic analyses will be made available to the GOK. The industry model will be available for future use by the GOK in policy planning and evaluation. The Consortium will be willing to conduct a workshop to familiarize GOK personnel with the model.

GOK Assistance Required

It is anticipated that over a period of eighteen to twenty-four months each of the Consortium members would have personnel in Kenya for one or two months. Total Consortium in-country activity will amount to

approximately six to ten man-months. Not all members would have personnel in-country at the same time, and presence would be planned and coordinated with the GOK to minimize duplication of effort and inconvenience to the host country.

The following types of assistance will be needed:

1. Identification of institutions and individuals who car provide data and information;
2. Background briefings on the ruminant livestock industry;
3. Initial contacts with and introduction to officials to be interviewed;
4. Guides and interpreters when needed for interior travel and interviews with herdsmen and market people--if these cannot be provided, assistance in identifying suitable people to be hired by the Consortium;
5. Provide access to government reports and data;
6. Assistance with entry and exit procedures upon arrival and departure, if necessary, and arranging hotel reservations. Possibly this help can be provided by the AID Mission.

It would facilitate coordination if a person in the Ministry could be designated as the primary contact for Consortium members when in the country and for communication between the U.S. and Kenya. While these types of assistance will absorb some time of GOK personnel, no financial support will be required. The Consortium has financed resources to pay all in-country costs incurred.

Next Step

The above plans and assistance needs are tentative and subject to modification in light of future discussion with respect to GOK interest. The Consortium would appreciate the opportunity to send representatives to Kenya to develop a mutually agreeable plan of work and operating procedure. Since the Consortium is composed of seven disciplines at four universities, we would suggest a minimum representation of four people and a maximum of seven. We feel that approximately one week would be needed to work out objectives, scope and procedures would welcome GOK and AID-Kenya suggestions. The Consortium on size of party, time and duration for a visit to discuss details of a Consortium involvement in Kenya. In order to avoid conflict with teaching commitments, we would prefer a date in July or August.

APPENDIX J

COLLECTED ARTICLES, BOOKS AND PUBLICATIONS RELATING TO USAID 211(d) PROJECT ON TROPICAL LIVESTOCK-- July 1, 1974 - June 30, 1975

Abel, Martin E. and Delane E. Welsch, "Environmental Constraints, Commodity Mix, and Research Resource Allocation," Staff Paper P74-19, August 1974, University of Minnesota.

Abel, Martin E. and Delane E. Welsch, "Microeconomics of Technology and the Agricultural Output Mix," Staff Paper P74-16, August 1974, University of Minnesota.

Abercrombie, Frank D., "Range Development and Management in Africa," Agency for International Development, August 1974.

AID, "History of AID Programs in Agricultural Credit," Vol. XVIII, June 1973, No. SR118, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit Additional Papers," Vol. XVI, June 1973, No. SR116, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit Analytical Papers," Vol. XIX, June 1973, No. SR119, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Africa," Vol. VI, Feb. 1973, No. SR106, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit Country Surveys," Vol. XVII, June 1973, No. SR117, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Colombia," Vol. V., Feb. 1973, No. SR105, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Costa Rica," Vol. II, Feb. 1973, No. SR102, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in East Asia," Vol. XI, No. SR111, Feb. 1973, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Ecuador," Vol. IV, Feb. 1973, No. SR104, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Ethiopia," Vol. VIII, Feb. 1973, No. SR108, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in HYV in Pakistan," Vol. XIV, Feb. 1973, No. SR114, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit - Informal Credit," Vol. XV, June 1973, No. SR115, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Kenya," Vol. VII, Feb. 1973, No. SR107, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Mexico and Central America," Vol. I, Feb. 1973, No. SR101, Dept. of State, Washington, D.

AID, "Small Farmer Credit in the Philippines," Vol. XIII, Feb. 197 No. SR113, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in South America," Vol. III, Feb. 1973, No. SR103, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in South Asia," Vol. X, Feb. 1973, No. SR110, Dept. of State, Washington, D.C.

AID, "Small Farm Credit Summary Papers," Vol. XX, June 1973, No. SR120, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in Thailand," Vol. XII, Feb. 1973, No. SR112, Dept. of State, Washington, D.C.

AID, "Small Farmer Credit in West Asia," Vol. IX, Feb. 1973, No. SR109, Dept. of State, Washington, D.C.

Anderson, Jock R., "Simulation: Methodology and Application in Agricultural Economics," University of New England and Centro Internacional de Mejoramiento de Maizy Trigo, Mexico.

Balassa, Bela, "Estimating the Shadow Price of Foreign Exchange in Project Appraisal," July 1974.

Baumol, William J., "Activity Analysis in One Lesson," The American Economic Review, Vol. XLVIII, December 1958, No. 5.

Bhagwati, Jagdish N., and Eckaus, Richard S., "Development and Planning," Essays in Honour of Paul Rosenstein-Rodan.

Biggs, Huntley H., and R.L. Tinnermeier, "Small Farm Agricultural Development Problems," Colorado State University, Fort Collins, Colorado, Copyright, 1974, First Edition.

Binswanger, Hans P., "Induced Innovation: A Critical Review of the Theory and Conclusions from New Evidence," Staff Paper P72-29, December 1972, University of Minnesota.

Binswanger, Hans P., "The Measurement of Technical Change Biases With Many Factors of Production," December 1974.

Blitzer, Charles R., "On the Social Rate of Discount and Price of Capital in Cost-Benefit Analysis," International Bank for Reconstruction and Development International Association, February 1973.

Calavan, Michael M., "Cultural Environmental, and Socioeconomic Factors in Food Use: The Sansai Case," SEADAG Papers.

Candler, Wilfred V., "Evaluation Report - MSU Livestock Sector Models," USAID, Washington, D.C., March 1974.

Caribbean Community Secretariat, "The Caribbean Community: A Guide," Georgetown, June 1973.

Caribbean Community Secretariat, "The Common External Tariff of the Caribbean Common Market," Georgetown, Guyana.

Caribbean Community Secretariat, "Treaty Establishing the Caribbean Community," Chaguaramas, July 4, 1973.

Center for Agricultural and Rural Development, "Alternative Futures for American Agricultural Structure, Policies, Income, Employment, and Exports: A Recursive Simulation," Iowa State U., Ames, Iowa 50010.

Clark, Peter K., "A Competitive Market Model for "Futures" Price Determination," Discussion Paper No. 21, August 1972, University of Minnesota.

Commonwealth Caribbean Regional Secretariat, "From Carifta to Caribbean Community," May 1972.

Consulative Group on International Agricultural Research, "International Research in Agriculture," New York 1974.

Dantzig, George B., "Linear Programming and Extensions," Princeton University Press, 1963.

Darling, David L., Jr., "The Economic Feasibility of Establishing a Second Export Abattoir in Botswana," August 1974.

Desai, M.B., et al., Changing Farm Production and Organization in Developing Agriculture, Final Report, Vol. I, Dept. of Ag. Econ., Faculty of Acts, Maharaja Say Ajirao, University of Baroda, Baroda.

Dukhia, John L., "Regional Agricultural Planning in Guyana - A Mathematical Programming Approach," University of Guelph, Ontario, Canada 1973.

E. F. P. (S. A. de Estudios de Factibilidad y Proyectos), "South American Approach to Feedlots Based on High-Forage Cattle Rations," Feedstuffs, July 1, 1974, pp. 6 and 37.

FAO Monthly, "Current World Meat Situation and Short-Term Outlook," December 1974.

Gerken, Egbert, "An Alternative Approach to the Theory of Labor Supply in LDC's," Staff Paper P73-18, July 1973. University of Minnesota.

Goreux, Louis M. and Alan S. Manne, "Multi-Level Planning: Case Studies in Mexico."

Gregory, Peter, "Wage Structures in Latin America," Discussion Paper No. 4, June 1971, University of Minnesota.

GUYANA MINISTRY OF AGRICULTURE - "C. Development of Agriculture."

Harricharan, H., P. Mahadevan, B.G.F. Springer, "The Performance of Santa Gertrudis, Sahiwal, Brahman & Crossbred Animals in the Intermediate Savannas of Guyana," University of the West Indies, St. Augustine Trinidad, W.I.

Hayami, Yujiro, Barbara B. Miller, William Wade, and Sachiko Yamashita, "An International Comparison of Agricultural Production and Productivities," University of Minnesota.

Hayami, Yujiro and Vernon W. Ruttan, "Induced Innovation of Agricultural Development," Discussion Paper No. 3, May 1971, University of Minnesota.

Hewes, Laurence, "Rural Development: World Frontiers, Iowa State University Press/Ames, Iowa, 1974.

Holder, Noel L., "Supplemental Feeding of Beef Cattle Grazing Pangolagrass Pastures on the Intermediate Savannas of Guyana," unpublished M.S. Thesis, University of Florida, Gainesville, Florida 1972.

Holder, N.L., M. Koger, J.R. Dickey, and R. de la Torre, "Breed, Age of Dam and Lactation Effects on Beef Production in Guyana," IV Meeting of the Latin America Association of Animal Production, Guadalajara, Mexico, June 25, 1973.

Holder, N.L., M. Koger, J.R. Dickey, and R. de la Torre, "Management Effects on Beef Production in Guyana," IV Meeting of the Latin American Association of Animal Production, Guadalajara, Mexico, June 25, 1973.

Humber, Joseph B., "Application of Decision Analysis to Alternate Policy Selection in Range Management," December 1974.

INTERNATIONAL LABOR OFFICE, "Youth Training and Employment Schemes in Developing Countries," Second impression 1973.

"International Development Strategies for the Sahel," a conference held at the Bellagio Study and Conference, Italy, October 1974.

"International Development Strategies for the Sahel," Working Papers, the Rockefeller Foundation, May 1975.

Joandet, Guillermo, "Application of Markov Process to the Computation of Population Structure," Texas A&M University, College Station, Texas, July 1974.

Joandet, Guillermo, "A Model for Simulation of Beef Production," Texas A&M University, College Station, Texas, July 1974.

Jones-Hugh, M.E., "Brucella, A Computer Model of Bovine Brucellosis," Ontario Veterinary College, University of Guelph, Ontario, Canada, July 1974.

Jones-Hugh, M.E., "Pragmatic Aspects of Animal Disease Monitoring," Ontario Veterinary College, University of Guelph, Ontario, Canada, July, 1974.

Judge, George G., and Takashi Takayama, "Studies in Economic Planning Over Space and Time."

Lal, Deepak, "On Estimating Income Distribution Weights for Project Analysis," Catalog No. 27, International Bank for Reconstruction and Development International Development Association, March 1972.

Leath, Mack Naugher, "An Interregional Analysis of the United States Grain Marketing Industry," unpublished Ph.D. Thesis, Oklahoma State University, May 1970.

Lucas, H.L., Jr., "Project Review," (of a Texas Project).

Lucas, H.L., Jr., "Systems Analysis and Mathematical Modeling," Regional Task Force Report S-45, North Carolina State University, Raleigh, N.C., May 1, 1974.

Lucas, H.L., Jr., "Modeling Forage - Animal Systems," North Carolina State University, Raleigh, N.C., 1974.

Lucas, H.L., "Modeling Forage-Animal Systems," North Carolina State University, 1974.

Martin, Lee R., "Some Market Effects of Agricultural Development on Functional Income Distribution in Developed Countries," Staff Paper P72-9, March 1972.

Meyer, Neil Larry, "Minimum Resource Requirements for Specified Levels of Income on Crop-Livestock Farms in the Sinu River Valley of Colombia," unpublished Ph.D. Thesis, University of Florida, 1969.

Mott, G.O., "Nutrient Recycling in Pastures," Forage Fertilization, 1974.

Mott, G.O., (John E. Moore & Mott), "Structural Inhibitions of Quality in Tropical Grasses," Anti-Quality Components of Forages, Chop Science Society of America, Madison, Wisconsin, 1973, pp. 53-97.

Mott, G.O., C.L. Rhykerd, R.W. Taylor, T.W. Perry, and D.A. Huber, "Techniques for Measuring the Contribution of Pasture in Pasture-Grain Feeding Systems," Forage Economic-Quality, ASA Special Publication Number 13, American Society of Agronomy, November 1968, pp. 95-108.

Mott, G.O. et al., "Stilbestrol and Its Effect on Pastures Fed Zebu Steers," IBEC Research Institute Paper No. 15, 1958.

Nathan, Robert R. Associates, Inc., "Guyana's Food Crop Systems: An Analysis for Development Planning," USAID Contract AID/LA-C-1035 (Guyana), Washington, D.C., June 30, 1974.

NATIONAL ACADEMY OF SCIENCES, "African Agricultural Research Capabilities," Washington, D.C., 1974.

NATIONAL ACADEMY OF SCIENCES, Soils of the Humid Tropics, NAS, Washington, D.C., 1972.

Packer, Arnold H., "Models of Economic Systems," A Theory for Their Development and Use.

Patrick, Neil A., and Earl O. Heady, "Development and Application of a Model for Multi-County Rural Community Development," Center for Agricultural and Rural Development, Iowa State University, CARD Report 52T, December 1974.

Pritsker, Alan B., "The GASP IV Simulation Language," John Wiley & Sons, New York, 1974.

Quinn, L, et al., "The Influence of Stilbestrol Upon Pasture Fed Zebu Steers and Male Suckling Calves," IBEC Research Institute Paper No. 23, 1960.

Quinn, L.R., et al., "Fertilization of Colonial Guinea Grass Pastures and Beef Production with Zebu Steers," IBEC Research Institute, Paper No. 24, 1961.

Quinn, L.R., et al., "Beef Production of Six Tropical Grasses," IBEC Research Institute, Paper No. 28, 1963.

Quinn, L.R., et al., "The Response of Male Zebu Calves to Creep Feeding, Castration, Diethylstibestrol and Supplemental Feeding and Pasture," IRI Research Institute, Inc., Paper No. 30, 1966.

Quinn, L.R., et al., "The Effect of Diethylstilbestrol Upon Performance of Pasture-Fed Zebu Steers," IRI Research Institute Inc., Paper No. 34, 1971.

Quinn, L.R., et al., "Supplemental Feeding of Steers on Pasture With Protein-Energy Supplements," IRI Research Institute, Inc., Paper No. 35, 1971.

Quinn, L.R., et al., "Molasses as an Energy Supplement for Zebu Steers Grazing Nitrogen-Fertilized and Unfertilized Colonial Guieneagrass Pasture," IRI Research Institute, Inc., Paper No. 36, 1970.

Quinn, L.R., et al., "Economic Analysis of Forage and Livestock Experiments Conducted in the State of Sao Paulo," IRI Research Institute, Inc., Paper No. 38, 1972.

Quinn, L.R., et al., "The Retention of Nitrogen in a Soil-Plant-Animal System in Guinea Grass (Panicum Maximum) Pastures in Brazil," Proceedings of the XI International Grassland Congress, University of Queensland Press, pp. 414-416.

Rios, Libardo Rivas, "Some Aspects of the Cattle Industry on the North Coast of Colombia," Centro Internacional de Agricultura Tropical, Technical Bulletin No. 3, December 1974.

Samuelson, Paul A., "Spatial Price Equilibrium and Linear Programming" Massachusetts Institute of Technology.

Simmons, Emmy Bartz and Thomas T. Poleman, "The Food Balance Sheet as a Parameter of Tropical Food Economies: The Case of Mauritius," Cornell Inter. Agriculture Bulletin 29, Cornell University, Ithaca, New York, June 1974.

Slama, Abdelmagid, Willis Anthony, and John De Boer, "Livestock Projections by the Technique of Flow Charts," Staff Paper P72-3, January 1972.

Strickland, Roger P., Jr., and Jimmie D. Davis, "Interfacing the MPS/360 Linear Programming Routine with Fortran Programs," USDA, Economic Research Service, Washington, D.C., November, 1972.

Syvrud, Donald E., "Foundations of Brazilian Economic Growth," AEI-Hoover Research Publications.

Takayama T. and G.G. Judge, "Spatial and Temporal Price and Allocation Models."

Turner, Harry Everard, O.B.E., "The Rupunni Development Company Limited, The Early History," Rupunni Development Company, Georgetown, Guyana, May 1972.

Vaurs, R., L. Goreux and A. Condos, "An Agricultural Model From the Ivory Coast Programming Study," International Bank for Reconstruction and Development," Economic Staff Working Pape No. 125, March 1972.

Villasmil, J.J., J. Atencio, J. Barcenas, A. Casanova, M. Urdaneta, and D.H. Timm, "Response Surface Designs and Linear Programming Applied to Cattle-Forage-Feeding Systems in the Tropics," 65th Annual Meeting of the American Society of Agronomy, Las Vegas, Nevada, Nov. 11-16, 1973.

Wageningen, "Actual and Potential Herbage Production in Arid Regions."

Walderhaug, Albert J., "The Composition of Value Added in the 1963 Input-Output Study," Survey of Current Business, Supplement to February, 1974, pp. 34-44.

Westphal, Larry E., "Planning Investments with Economies of Scale."

White, T.K., Jr., et al., "Description of the Purdue Development Model: A Conceptual Model of Population as a Variable in General and Agricultural Development," Ag. Economics Dept., Purdue University, West Lafayette, Indiana, August 24, 1973.

Zaidi, M.A. and S.K. Mukhopadhyay, "Economic Development, Structural Change and Employment Potential," University of Minnesota.

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* There are an additional 167 books in Dr. W.H. Morris's African 211(d) Library. These will be placed in the 1976, 211(d) Annual Report.

APPENDIX K

Economics of World Food Situation

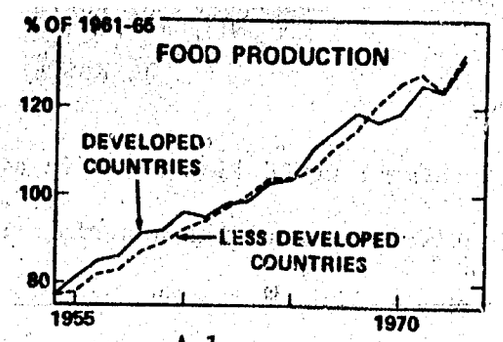
T. Kelley White

The first thing I would like to do is attempt to put the world food problem in perspective. Much of the material that was provided to you before the meeting today, if you had a chance to read any of it, leads one to believe that the world food crisis, or the world food problem, is a recent occurrence. Secondly, one would be lead to believe that the world food situation, in terms of availability of food on a per capita basis, has been worsening in recent history. In fact, neither of these is true. Dr. Malthus, two hundred years ago, was making many of the same predictions that we hear today. It has been estimated that France in the late 1700's, which was one of the most highly developed industrial nations in the world and probably had one of the highest per capita food consumption levels in the world, exhibited a capita food consumption level, as measured in terms of calories, about equal to that of the poorest country in the world in 1971. So we have made some progress over the long run.

If we look at the more recent past, we see that in the last 20 years world food production has increased by roughly 50% from an index of about 80 to an index of 120 (Figure A.1). This rate of increase in food production has been about the same in both the highly developed and the less developed countries of the world. We have had another trend occurring at the same time. An increase in population. You can see in Figure A.2 that the rate of increase has been much more rapid in the less developed countries than in the developed ccuntries. If we look at these two trends for the developed

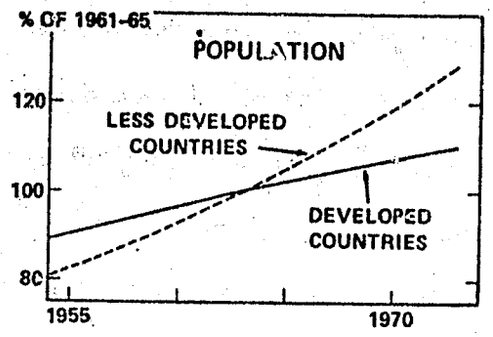
FOOD PRODUCTION AND POPULATION
DEVELOPED AND LESS DEVELOPED COUNTRIES

Food production has grown steadily over the past two decades. Growth in the developed countries has roughly paralleled that in the less developed countries.



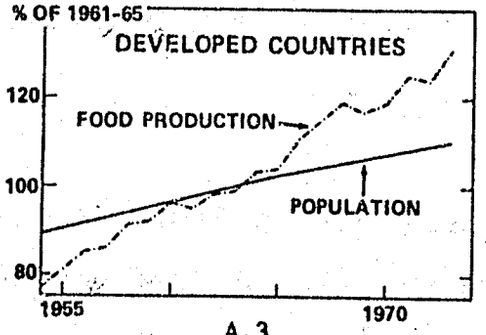
A.1

Population has grown faster in the less developed countries.

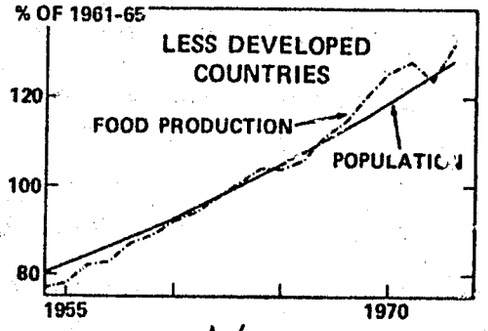


A.2

Peoples of the developed and less developed country groups have not fared equally from the roughly equal growth in food production. In the developed countries production has increased much faster than population, boosting production per capita. In the LDC's population gains have absorbed nearly all of the production increase; production per capita has improved only slightly.



A.3



A.4

POPULATION EXCLUDES COMMUNIST ASIA

countries of the world, (Figure A.3) we see that we have achieved substantial gains in terms of food production. The increase has been roughly 1.5 percent per year during the last two decades. Even the less developed countries of the world, while undergoing population increases which were the highest in the history of mankind, have been just about able to maintain per capita food availability. If we ignore 1972, when we had some weather problems, the less developed countries gained about .5 percent per year during the same period (Figure A.4).

While we have made some progress, there is a real world food problem today. A number of countries including Indian, Bangladesh and several African countries are suffering from famine. The food problem is likely to persist for the forseeable future. Dr. Breen has indicated that there is no likelihood of diminishing rates of increase in population substantially for at least the next quarter of a century. Hopefully, the countries of the world are going to be successful in continuing economic development--that is, increasing the income level per capita, and improving the distribution of income.

To the extent that we are successful in stimulating economic development, we're going to add even more pressure on available food supplies. This is true because most of the less developed countries have per capita income levels in the neighborhood of $200-$300 or less per year. At these levels of income people must spend a large proportion, seventy percent or more, of their annual income on food. Therefore, any increase in income is also going to be

spent largely for food--either to increase the quantity or the quality of food consumed. Quality increases in food consumption place even greater demands on food supply than do quantity increases. In general, when we discuss improved quality, we think in terms of variety. We think in terms of substitution of meat for cereals and, in general, meat is more expensive, terms of recources, to produce than are cereals.

If we are going to have long-run success in solving the world food problems, we must depend on success in reducing the rate of increase in the population. In the shorter run we must depend primarily in increasing the supply of food. If we are going to be successful in stimulating aggregate food production substantially in the world within the next 25-50 years, we must have policy decisions made by government in all countries of the world which will recognize what I am going to call the "five economic realities."

The first of these realities that I would like to mention is that there is a difference between the need for food and the demand for food. We've had considerable discussion this afternoon of the two major components of the need for food. These are first the size and composition of the population of the world and secondly the nutritional requirements necessary to maintain this population. Demand, on the other hand, depends not only on need but, also on the ability to pay. Demands and needs are not the same. Most of us in a country like the U.S. demand much more than we really need. In much of the world, because of low income, people are not able to demand as much as they need. So we get divergence among people within a country and among countries.

In most countries of the world, the problem of stimulating production and the problem of allocation of production, or supplies, among people is done, to at least to some extent, by markets. This is true even in Russia. With respect to the market firms dealing with food, we might not recognize some of them. When we think of a food marketing firm in this country, we think in terms of supermarkets and General Mills. In the less developed world, in a small African village for example, a family enterprise on the sidewalk may serve both the processing and retailing functions. It is common to see young lady pounding millet into a flour, then adding water to make a paste which is used to make a bread-like food and selling either the paste or bread. Even though we might not recognize the firms, they are markets.

Policymakers must recognize the limitations of what markets can do. Markets have been proven to be quite efficient in stimulating supplies (i.e. in stimulating production) if they are allowed to work. They are also efficient in allocating supply among the demands that exist within the economy. They are not very effective in meeting needs, unless those needs can be converted into demands. So either governments must recognize the limitations of markets and not attempt to meet all needs through the marketplace by manipulating prices, or we must find meanings of bringing all the people in all the countries into the marketplace. That is, providing them with higher levels of income so that their needs can be expressed as effective demand in the market. In the immediate future, we are likely to continue charities to meet needs that occur because of drought and many other kinds of castastrophic situations.

The third economic reality has to do with the economics of research. We have heard quite a lot about research of different kinds this afternoon. As we saw earlier, we have increased food production rather dramatically in both the developed and the less developed world. There is quite a difference in the way in which this increase in food production has been obtained. We can illustrate this difference by looking at table 1 where we see what has happened to the average yield of grain per hectare since the 1934-38 period up to and including the '69-'70 period--about 35 years. In the earlier periods the average grain yield in both the developed and less developed countries were essentially equal. Even by 1952-56 there had not been a great deal of change in the developed world-- about a 20 percent increase in yield--and no change at all in the less developed countries. By 1969-70 the yield in the developed world had almost doubled, while the yield in the less developed countries of the world had increased by only 30 percent. Now this means that the developed countries of the world increased production while reducing the amount of labor and, in many cases, the amount of land used in agriculture. The majority of increased output in less developed countries of the world came from applying additional resources to agriculture--bringing more land into production and in some cases increasing the labor input. Why this difference? Primarily the difference is investment in research. The United States invests $93 per farm in agricultural research annually. In contrast, average annual research expenditure in South America and South Asia are equivalent to only $1.50 and $0.43 per farm respectively.

Table 1. Trends in Grain Yield--Developed and Less Developed Countries

Year	Grain Yield (M.T./Ha) Developed Countries	Less Developed Countries
1934-38	1.15	1.15
1952-56	1.37	1.15
1969-70	2.14	1.41

There is a great deal of evidence which shows that the return to investment in agricultural research is extremely high. Benefit-cost ratios in the neighborhood of 5 to 7 for research leading to development of hybrid corn in the U.S. and improved cotton varieties in Brazil are examples. Given such returns, why has expenditure on agricultural research been so limited in the less developed countries? One explanation is the nature of agricultural research--the way it has to be produced; the way it is marketed or disseminated; and the impact that it has. It is very difficult for the benefit from many types of research to be captured by the entity which produces that research. Private firms are not likely to invest in research if the payoff to this research is going to be captured by others. Therefore, much of agricultural research must be performed or at least financed by government. In the U.S. we have done this--in the less developed countries of the world it has not been done.

The fourth point is that policy makers must recognize the role of prices and the role of economic rewards. Prices provide a system of signals to producers, to consumers, to investors, and even to research institutions even when they are public. Three examples of the signals that prices give are:

a. An increase in the price of a product signals the consumer to reduce consumption of that product. At the same time it signals the producer to expand his output

b. As a resource becomes scarce, the price increases. This provides an incentive for the user of that resource to look for substitutes. And one way to look for substitutes is to put pressure on the universities and experiment stations to conduct research to develop

new technology which makes it easier to substitute some other resource for the one which has become relatively more expensive.

c. The quantity of resources which appear to be available for agricultural production are, in part at least, a function of price--how much can we pay for them? I was just reading an article in the newspaper a couple of nights ago about a group of investors who are attempting to buy 400,000 acres of North Carolina marsh land. They want to convert this into farm land. Why at this time? Agricultural prices are high. Profits, at least in some kinds of agricultural production, are high. Thus they can afford to spend money to convert previously unusable resources into usable resources.

For many years, we heard the myth that farmers in the poor countries of the world were not rational. They were subsistent farmers. The only thing that they worried about was producing their own food. Prices didn't effect them. The green revolution has proven this to be wrong. Research has shown that small farmers are rational. They will adopt new technologies. They will purchase and use new and modern inputs--if it is profitable for them to do so. Policymakers must make sure that the market is able to transmit correct signals and not false signals. In addition to simply not obstructing price signals, institutions which make it impossible for the price signal to stimulate the kind of response that is normally desired need to be modified. In Africa where the drought has been so devastating one of the major problems is over population of the range, especially in the vincinity

of water holes. No vast change in technology is needed to correct that. Mainly a system for controling grazing is needed. There is little or no incentive for the individual cattle producer to improve the quality of or control the grazing pressure on range land. Why? It is very simple. In these countries in Africa there is no private ownership of land. All land is public property. Every livestock owner has equal access to the range. So why should any one individual livestock holder invest in range improvement or better management practices? New institutional arrangements must be found or the investment must be made by the public.

The last point I would like to make is that we cannot treat the food problem in isolation. Essentially all of the less developed countries of the world depend primarily on agriculture as a source of employment and as a source of national product. Incomes are low. Why? Because people have very low productivity. Why do they have low productivity? Because they have low skills, and they have small amounts of resources and low quality resources to work with. If we are going to increase the income levels of these countries, we must increase the productivity of the people and much of this increase in productivity must occur in the agricultural sector. Much of this increase in productivity must occur through improving the quality of the human agent (investment in education) and through increased research to develop new and better agricultural technologies. These are the areas in which universities such as Purdue have expertise, areas in which Purdue has been working to assist development efforts of a number of countries, and areas in which I personally feel we need to continue working. I believe that the payoffs are going to be very high both in stimulating development and in helping to resolve the world food problem.

APPENDIX L

THE ECONOMIC DEVELOPMENT PROCESS AND THE TROPICS

T. Kelley White

The topic suggested to me for tonight was economic considerations in the Tropics. However, as is common with invited lecturers, I am not going to limit myself to that topic. Instead my comments will be focused primarily on the economic development process and the conditions necessary for the achievement of "rapid" rates of economic progress. I will pay particular attention to the agricultural sector since that is my principal area of interest, since agriculture is of major importance in most less developed countries (LDC's), and since development theory has recently tended more and more to stress the importance of the agricultural sector in the general development process. Only at the end will I turn to the question of whether tropical countries possess unique characteristics which affect the nature of the development process.

Let us begin by adopting a definition of economic development so that we are all talking about the same thing. The purpose of economic activity is to convert available resources into goods and services desired by society, and to allocate these goods and services among its members. The performance of an economic system can then be judged by the level of goods and services produced from its available resources and the manner in which production is allocated.

Likewise the economic well-being of a society is determined by the quantity of economic goods and services produced per member of the consuming

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population. The best measure we have of this phenomenon is probably per capita income. This index is criticized for ignoring distributional questions in addition to its other shortcomings such as the failure to account for externalities associated with production. But, I know of no better index. Therefore, we will identify the level of per capita income with the level of economic development, and the rate of increase in per capita income with the rate of economic development.

There are, of course, many other aspects of development which are not primarily economic but which are related to economic development. We will not consider these aspects except as they affect economic performance.

Ruling out continuous international charity of significant magnitude, the only avenue by which the per capita availability of consumable goods and services can be increased, in the long-run, is by increasing per capita production. In the short-run international borrowing may be an important source of both consumption and capital goods. However, borrowing can contribute to lasting improvements in economic welfare only if it facilitates future increases in domestic production.

Per capita production for a given population can be increased in two ways. The proportion of the population productively employed can be increased thus altering the ratio of consumers to producers. So long as the marginal productivity of additional producers is not negative, this will expand total and, for a given population, per capita production. Secondly, per capita production can be expanded by making that proportion of the population which is employed more productive. Obviously production can be increased relative to population through various combinations of these two means.

In a very fundamental sense then, economic development is a matter of altering the ratio of productive to nonproductive members of the population and increasing the productivity of those employed. The question from an operational point of view is what are the variables which control the proportion of a population which is productive and the level of productivity of employed members. Given an answer to this question, we can rationally evaluate alternative economic and social policies relative to their likely impact on the economic development process.

Participation in Economic Activity

Whether or not an individual engages in productive activity depends to a large extent to two factors -- 1) availability of employment opportunities and 2) incentive to participate in productive endeavor. Expansion of aggregate employment opportunities in an economy depends on increasing demand (domestic or foreign) for goods and services (expanding markets) and investment to provide the physical capital necessary to complement labor in the production process. Opportunity for productive employment is further affected by a wide variety of social, political and economic barriers which artificially limit access of segments of the population to the labor market. These include 1) socio-economic barriers such as discrimination on the basis of race, sex, religion, etc.; 2) political-economic barriers such as child labor laws, minimum wage laws, employment taxes, mandatory retirement, etc; 3) institutional barriers such as labor unions, professional licensing, etc.

Incentive to participate in the economic production process is provided when an individual's ability to command goods and services is enhanced by participation. In simple terms that means a system in which any individual can increase his income by working more rather than less-and certainly one which does not penalize a person for working.

Many policies adopted by less developed countries, as well as the more developed ones, have the effect of reducing the availability of employment opportunities or the incentive to participate in the labor market or both. As a consequence economic development is retarded rather than stimulated. This, of course, is not usually the objective of the policy. It is rather the unanticipated result of a policy intended to improve the welfare of some part or all of the population. A couple of examples will help to make this point clear.

Minimum wage legislation is often used in an attempt to improve income distribution and protect workers from exploitation. It is politically attractive, but frequently its full impact is either not recognized or ignored. In some cases workers, because of their lack of skills, the limited capital they have to work with, and the limited demand for the good or service produced, contribute less in production than the legal minimum wage. Employment of such workers will tend to be reduced. Those workers affected will have no income rather than low income. Total production will be reduced, although this impact will be cushioned somewhat by the substitution of capital for the now more expensive labor.

A second example is the restriction of exports of basic food items. These restrictions are usually imposed in the name of maintaining low food prices for domestic consumers. This is usually accomplished in the short-run. Again, however, there are undesirable side affects. By limiting the size of the market available to producers, incentive for employment of resources is reduced and production is lower that it would otherwise be. The lower prices reduce incentive for investment to expand production and improve efficiency. Thus in the longer run this policy often not only retards

production and employment but also results in higher costs for consumers. Such legislation also limits the possibilities for specialization and trade whereby the country could exploit its comparative advantage thereby providing more consumption goods from its given resource base.

The above examples are not intended to imply that all policies which restrict opportunities and incentives for employment are bad and should be avoided. These policies are often effective, at least in the short-run, in achieving their immediate objective, whether it be political, social or economic in nature. However, it should be recognized that such policies have secondary effects on the development process which may be undesirable. Only when their impacts on the total system are recognized can rational policy decisions be made.

Productivity of the Economically Active Population

The productivity of a labor force depends on 1) the quality of the labor resource itself, 2) the quantity and quality of non-human resources combined with each unit of labor, and 3) the efficient allocation of human and non-human resources among production alternatives. Thus increases in productivity as a means of achieving more rapid rates of economic development depend on improvement in the quality of the human resources, the availability of and incentive to employ more and "better" non-human capital per unit of labor, and a system of rewards which not only provides incentives for the above but also to apply all resources where they contribute most to the economic well-being of society.

Improvement of the quality of the human factor, and making available more and better non-human factors both require investment. Thus, for a country to develop rapidly it must generate investment capital either

through internal saving (consume less than is produced) or though borrowing in international capital markets. International borrowing may be accomplished by formal borrowing or by allowing and providing incentives for direct foreign investment. The latter implies some degree of foreign ownership and control. Since most LDC's have limited capacity for saving because of low income levels, it is necessary that they obtain capital from external sources.

The quality of the human factor can be increased in three ways 1) education, 2) health and 3) nutrition. Investment in education has been shown to have a high payoff in both developed and less developed countries Becker has suggested that education increases labor productivity in three ways. These are:

1. By increasing the ability of the individual to perceive economic opportunities;
2. By increasing the ability to make allocative decisions (i.e. to use the human factor in combination with other factors in more productive ways) and;
3. By increasing the ability to learn and use new technology.

Improvements in health and nutrition tend to affect the amount of work an individual can do. Thus they have a quantitative effect on the human resource while education has a qualitative effect.

Even though investment in human capital, especially education, has a high return, the private capital market tends to underinvest in this area. This is true because the investment is embodied in a human being which in most societies cannot be used as security for a loan. Also a part of the return to education is in the nature of a public good which cannot be

captured by the individual investor. Thus investment in education must be, at least partially, a government function. LDC's have tended to underinvest in education especially in rural areas where the cost is high. The private cost of education also tends to be higher for rural than for urban residents. Therefore, the rural population tends to be less well educated than the urban population in most countries. This constitutes a barrier to agricultural development.

Investment in non-human capital is an integral part of the process of development and adoption of new technology. For many years it was believed that farmers in the LDC's were poor because they failed to rationally respond to economic incentives to reallocate resources, adopt new technology and invest in new inputs. Schultz and others have shown that these farmers are economically rational, and they are poor because they have small quantities of resources. They invest little because available investment opportunities (investment in traditional factors) offer very low returns. When offered high pay-off investment opportunities they do invest.

Griliches and others have shown that the increases in economic output which cannot be accounted for by increasing employment of traditional factors and which were once attributed to technical change causing some mysterious shift in the production function are really the result of increased use of "non- traditional inputs." These non-traditional inputs, education and research, have the effect of changing the quality of factors of production. Thus agricultural development was shown to depend on the availability of "high pay-off inputs." These high pay-off inputs are visualized as new technology embodied in human and non-human factors of production.

More recently Hayami and Ruttan have extended the theory by proposing an explanation of the process which induces technical change-- the development of new factors of production. They argue that an economy expands production by employing more and more of its natural endowment of resources until one or more of these factors becomes scarce. The scarce factor becomes relatively and absolutely more expensive; increasing cost of production, reducing profits and providing an incentive to substitute other factors for the scarce one. This stimulates a search for new inputs and production techniques which facilitate the substitution process.

Technical change then is motivated by the need for substitutes for increasingly scarce factors of production. The production of new technology embodied in new or different inputs requires research which represents a type of investment in itself. The critical point here is that technical change is induced by changing factor availabilities and costs. Thus technical change is an integral part of the economic system and not some mysterious, exogenous force. The need for particular types of technology is signaled by changing relative prices and rising production costs. The rising production cost presents an opportunity for economic gain from development and production of new inputs which will lower production cost.

The type of technical change which will contribute most to development in a particular country depends on the factor endowment of that particular country. This explains one of the difficulties encountered in attempting to stimulate agricultural economic development of the LDC's. Most research has been conducted and technology developed in the more developed countries and is suited to their resource endowments and their relative factor prices.

These are often quite different from those exhibited by LDC's. Thus the direct transfer of technology between more and less developed countries has been less successful than anticipated.

This means that rather substantial investments in research must be made in the LDC's themselves and this research must be directed toward relieving the resource bottlenecks of the country in question. Due to the nature of agricultural research and the agricultural sector, only a limited amount of the necessary research can be economically performed by either the agricultural sector itself or the industries that service agriculture. Thus in most developed countries the agricultural research function has been socialized.

That the LDC's have failed to invest adequately in agricultural research is demonstrated by a comparison of annual research expenditures per farm in the U.S. versus two groups of less developed countries. The United States invests $93 per farm in agricultural research annually. In contrast, average annual research expenditure in South America and South Asia are equivalent to only $1.50 and $0.43 per farm respectively. Even after adjusting for differences in farm size there is obviously a large difference. An indication of the impact of this difference in research investment can be obtained by comparing trends in grain yield in the more and less developed countries.

Grain Yield (M.T./Ha)

Year	Developed Countries	Less Developed Countries
1934-38	1.15	1.15
1952-56	1.37	1.15
1969-70	2.14	1.41

If adequate investment in the right kinds of research are to be induced two conditions must exist. First, the economic system, whatever its nature, must correctly reflect the relative costs of the different factors of production, the relative value of different goods and services, and provide a reward for development and adoption of new technology. This does not imply so much a need for positive pricing policies as it does the need to refrain from policies which distort relative and absolute price levels. Income redistribution, trade and welfare objectives must be pursued through policies which produce the minimum distortion in the economic signal received by farmers, consumers and investors.

Secondly the government must be willing to invest large sums in agricultural research and be perceptive of the economic signals which indicate the type of research needed. This is most difficult because the immediate political rewards often do not reflect the long-run economic pay-off. Even technical assistance programs by the developed countries often fail to correctly perceive the research needs of the LDC.

In summary stimulation of rapid agricultural development requires a set of conditions which

1. Provide opportunities for productive employment
2. Provide incentives for participation in economic activity
3. Provide for investment in education and research, and
4. Allows the economic forces to correctly reflect relative cost of factors, relative values of goods, and provide rewards for production and adoption of new technology.

Unique Characteristics of the Tropics

There are some characteristics of the Tropics which make development problems there unique and which partially explain why such a disproportionate number of countries in the tropics are classified as less developed. The unique characteristics of tropical countries derive in part from the fact that they are tropical and in part from the fact that many of these countries were colonies until relatively recently. A few of these characteristics and their implications for agricultural development will be discussed below.

The tropical regions of the world, in general, are subject to a climate characterized by very distinct wet season, dry season rainfall patterns. This rainfall pattern conbined with tropical temperatures and day lengths have induced a dependence on rice as the principal food grain. Rice, as produced in most LDC's is a very labor intensive crop during the planting and harvesting seasons. Thus large numbers of laborers have been dammed up in agriculture but there is little opportunity for productive agricultural employment during the dry season. This means that farm labor is productively employed only during a part of the year resulting in an average productivity which is very low. The agricultural production system which has developed is characterized by labor scarcity during brief periods and surplus labor during the remainder of the year. Research is needed which will reduce the peak season labor requirements and which will facilitate diversification of agricultural production so as to increase the opportunity for year-round employment.

Soils of the Tropics possess a variety of problems which limit their productivity. In the high rainfall areas they tend to be badly leached resulting in low fertility, mineral inbalances which cause toxcisities are

common and high acidity causes low base exchange. Even in the lower rainfall areas, rain tends to come in very intense downpours causing severe erosion problems. High temperatures lead to rapid decomposition of organic matter. Lighter soils that are easy to cultivate with primative tools usually have low fertility, while the heavier more fertil soils are difficult to cultivate.

Utilization of land during the dry season is usually dependent on irrigation which requires considerable investment and different management practices. The ability to produce multiple crops with irrigation presents a significant opportunity in tropical areas. However, there is need for research to adopt temperate zone plants to the photo-periods of the Tropics. Also, disease and insects are often serious obstacles where sub-freezing temperatures are not available as a natural control.

Tropical climate and soils combined with the relatively high labor to land and labor to capital ratios characterizing the resource base in many LDC's make transfer of technology from most developed countries inappropriate and difficult. Large research investments are, therefore, more critical to development than would be the case were conditions more conducive to direct technological transfer. The international research centers are an effort to achieve a critical mass of research inputs on a multination basis and avoid the waste of duplication. There have been some striking successes but there is also a real danger. The international centers cannot reproduce the varied conditions that exist in the many countries of a region. Thus they are limited in their ability to perform adaptive research. A more serious danger is presented if the publicity given these centers is used by individual countries as an excuse not to develop endogenous research capability. Previous research in most tropical countries has focused on export crops to the exclusion of basic food crops and livestock.

It is possible that the warm climate of the tropics relegates clothing and shelter to the category of luxury consumption rather that necessities for survival and thus reduces the incentive for economic activity. Probably this has had much less effect on incentives to work than has the tendency to develop rather comprehensive social welfare programs often structured in such a way as to reduce the economic advantage of working. Such programs often do not apply directly to agricultural labor but do provide a non-productive lure to the city.

Little has been said thus far about population growth rates. However, it is obvious from the definition of development adopted that a rapidly increasing population accompanied by a changing age structure make achievement of development more difficult. The Tropics were until recently subject to many diseases resulting in high rates of mortality, especially among children. Under these conditions high birth rates were necessary to maintain population. Success in transplanting modern medical science has drastically reduced death rates. Birth rates have remained high resulting in exploding population growth. Not only has total population increased rapidly but the proportion of children (nonproductive) to adults (productive) has increased also.

Some LDC's have attempted to implement family planning programs in an effort to reduce population growth rates. Others have resisted for a number of reasons. Experience has shown that acceptability of contraceptive technology is closely linked to the level of economic development of a country. That is, people reduce family size when it is advantageous to do so. Large families tend to loose their economic advantages and even become a disadvantage as incomes rise. Thus, declining rates of population growth may occur as a result of more rapid economic development and may be very difficult to induce as a means to economic development.

Being newly independent of direct colonial control many of the LDC's have not yet developed a stable political system. Their long domination, and often exploitation, by colonial powers has left a residual fear and distrust of foreign investment. Many are attempting to modify the existing income inequalities by confiscating and redistributing wealth. In concert these factors produce a climate which is unattractive to potential investors, both foreign and domestic. Thus there is an artificial scarcity of investment capital so necessary for rapid agricultural and general economic development.

Colonial emphasis on export oriented agriculture and dependence on imports for consumption goods, especially manufactured, (and more especially luxury consumption goods) and capital goods has produced a reaction on the part of many LDC's. This reaction takes the form of policies designed to move the country toward self sufficiency not only in agriculture but also in industrial goods. Emphasis on development of the industrial sector in earlier development theory reinforced this reaction and resulted in policies which badly distorted relative prices and diverted government attention from needed investment in agricultural research.

Rapid rates of population growth, migration into the large cities, and emphasis on development of the industrial sector have made attractive policies designed to keep food costs down. These policies have distorted relative prices, reduced investment incentive in agriculture and retarded agricultural development. These conditions have also made social welfare programs politically attractive. Since these programs are often financed through employment taxes, the relative cost of labor and capital have been distorted resulting in socially inefficient resource use and inducing inappropriate technical change.

This brief attempt to identify characteristics of tropical countries which make the development process and appropriate development policy uniquely different from nontropical ones leads me to the conclusion that there are few important ones. Instead the lack of more rapid development most often is attributable to adoption of policies designed to treat symptoms rather than problems and a failure to consider the multiple impacts of policies. There has also been a general failure to recognize the importance of investment in agricultural research and, to a lesser extent, in education. These shortcomings in policy making appear to be more directly related to the political history of the country than to the fact that it is located in or out of the tropics. However, bad economic policy is certaintly not confined to tropical or excolonial or poor countries. There is no doubt though, that the poor countries of the tropics can ill afford bad policy on top of all the other barriers to development that exist.