PROPOSALS, RESULTS AND RECOMMENDATIONS OF TECHNICAL EVENTS SERIES - NO. 255

PROCEEDINGS OF WORKSHOP ON PLANNING AND MANAGEMENT OF AGRICULTURAL RESEARCH

IICA

INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE

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PROCEEDINGS OF WORKSHOP ON PLANNING AND MANAGEMENT OF AGRICULTURAL RESEARCH

HELD AT

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PROPOSALS, RESULTS AND RECOMMENDATIONS OF TECHNICAL EVENTS SERIES - NO. 255

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PREFACE

In December 1981, the Inter-American Institute for Cooperation on Agriculture (IICA) in collaboration with the Ministry of Agriculture (MOA) sponsored a workshop on Planning and Management of Agricultural Research in Guyana with particular reference to the Central Agricultural Station (CAS). The papers presented, together with a summary of the discussions of those papers are included in this document. Emanating from the workshop was an IICA/MOA team which generated a document on 'Improving the Agricultural Research System in Guyana'. This latter document was forwarded to the Minister of Agriculture in January 1982. It is included here as Appendix 1.

CHAIRMAN'S REMARKS by Dr. R.E. Pierre

In planning this seminar/workshop, it was envisaged that the first paper would have been presented by someone in a high managerial position in the Ministry of Agriculture. The topic identified was "The Role of the Central Agricultural Station in Agricultural Development in Guyana" - a paper which was expected to examine:

- the major areas of work at the Central Agricultural Station and the kinds of output expected;
- the relationship between agricultural policy and research at the Central Agricultural Station; and
- the responsibility of the Central Agricultural Station in terms of use of research results.

But in spite of agreement to the above, the necessary steps were not taken to prepare the required paper and at very short notice, Dr. McKenzie was asked to fill in.

In his brief address, Dr. McKenzie first thanked the organisers of the seminar/workshop and expressed the hope that the seminar would define the 'road to travel' in terms of research and suggest strategies to overcome existing problems.

He explained that while the Ministry of Agriculture has recognised the importance of agricultural research in pursuing the developmental goals of the country, research was not and should not be a function of the Ministry only.

"Agricultural research should not be monopolised by any agency or Ministry", he stressed and invited participants to view research not only in

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terms of Crops and Soils at the Central Agricultural Station, but also to include the Livestock and Planning sections as far as the Ministry's research goes.

Dr. McKenzie noted that historically, agricultural research has been supported by local agencies other than the Ministry of Agriculture as well as foreign agencies. Local agencies such as the Guyana Sugar Corporation, Guyana Rice Board and the National Science Research Council are all involved in agricultural research. He said that ISNAR was the most recent of the International agencies to look at research in Guyana and pointed out that this agency will commence work in January, 1982. The role of IICA in supporting the Ministry in this area was also noted.

Dr. McKenzie pointed to the need for the country to reorganise more efficiently its support services to systems for the generation and transfer of technology in agriculture, and expressed the view that the political will was both favourable and responsive to concrete recommendations at the present time.

In closing, he noted the declining production in agriculture and indicated that research productivity was not in keeping with government's expectations. Finally, he charged the seminar to look beyond the Central Agricultural Station and take a wider approach to research. "Deal not only with technical matters but with subjects like leadership and management because people in the Third World countries must learn to manage".

RESOURCES FOR AGRICULTURAL RESEARCH IN GUYANA

WITH REFERENCE TO THE CENTRAL AGRICULTURAL STATION

by

H.B. Persaud & M. Granger

INTRODUCTION

The Central Agricultural Station (CAS) is located about 15 km east of Georgetown at Mon Repos. It occupies a narrow strip of land extending 11 km inland from the Public Road on the sea coast to the Lamaha Water Conservancy Canal with a width of some 380 m. It covers an area of approximately 420 ha. This area was previously a sugar estate with its own factory. Vestiges of the sugar mill and a manually operated irrigation sluice can still be seen. Mon Repos was acquired by Government in 1955 and work on the establishment of the station commenced in 1956.

The main building, some 3 km inland from the Public Road, was completed and formally opened in 1962. It provides office and some laboratory facilities. Other buildings provide residential quarters for both professional and sub-professional staff. Facilities are also provided for other specialised laboratories, a mechanization centre, stores and storage bonds, a mechanic workshop, and a production unit for specialized insecticides.

The station, established primarily for research in various aspects of agriculture, is the main research station of the Ministry of Agriculture. Also sharing some of the available landscape of Mon Repos are: The Guyana School of Agriculture, the Prison Services, the Veterinary and Livestock Science Division, the Veterinary Diagnostic Laboratory and the Regional Education Programme for Animal Health Assistants (REPAHA).

Only two divisions of the Ministry are actually housed at CAS. These are the Crop Science and the Soil Science Divisions. The Veterinary and Livestock Science Division maintains a farm and research unit on Mon Repos lands but its offices are at Triumph.

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OBJECTIVES

The general objective of the Central Agricultural Station is to conduct integrated research and develop programmes in various sub-disciplines of Agriculture to improve the level of available technology.

More specifically, CAS aims at

- developing improved crop, soil and farm management systems and appropriate husbandry practices;
- providing diagnostic, advisory, regulatory and supporting services to farmers and production agencies; and
- improving agricultural knowledge and/or skills of extension agents, farmers and personnel from production agencies.

HISTORICAL DEVELOPMENT

To focus on CAS as one of the agricultural research centres in Guyana one has to review the historical development of the Ministry of Agriculture. Fletcher (1977) in presenting such a background states that:

> "Most of this development (agriculture research) evolved under a system or organization that now represents the state bureaucratic agency responsible for Agriculture, i.e. the Ministry of Agriculture. The establishment of an agricultural research system arose through an obvious need by the farming community for education and instruction in the science of farming. Agricultural extension was in those early years intimately associated with investigational work of a fundamental nature, and provided a direct linkage to the farmer, since the personnel involved in research also worked in the field of extension.

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Formal agricultural research was initiated in Guyana in 1881 with the breeding of sugarcane varieties resistant to disease, and investigation of a variety of crops, including cocoa, cotton, pineapple, mango and fodder grasses. This research activity arose out of necessity and initially benefitted the plantation system of agriculture. It was not until 1927, with the establishment of an agricultural department that any organized policy for agricultural experimentation to benefit indigenous farmers was laid down. Agricultural stations were set up and officers appointed to organize educational work among farmers. These stations were also to be centres for experimental work on various crops being grown by farmers.

Livestock research has had a more recent history having been initiated in the era of the Rupununi Cattle Trail in the early 1940's when beef cattle were walked several hundred miles to the coast from the Rupununi Savannahs. During this journey, there was a period of rest in the Intermediate Savannahs where the animals were grazed on the native range. It became obvious that the native grasses in this location were nutritionally poor resulting in physiological disorders in the animals. This led to the establishment of a station to investigate and rectify the problem. The Ebini Livestock Research Station has since developed into the major beef research unit in the country. In the late 1960's considerable assistance was received from the University of Florida through a co-operative research programme. Work was intensified in the areas of range management, establishment of improved pastures, soil fertility and animal nutrition."

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ORGANIZATION

An organizational chart for the Ministry of Agriculture, Department of Agriculture, is set out in Fig. 1. The technical administrative head is the Chief Agricultural Officer who advises (or used to advise) the Minister directly on technical matters and handles technical organization through four Principal Agricultural Officers responsible for each of the major sections - Crop Science, Soil Science, Veterinary and Livestock Science and Extension and Education. Organizational charts of the Crop and Soil Science Sections are set out in Figs. 2, 2a, 2b, 2c, 2d, 2e and Fig. 3. Research activity is restricted primarily to the first two named divisions which are located at CAS and to a lesser extent the Veterinary and Livestock Science Division.

The Ministry is responsible for crop research in all necessary areas with the exception of sugar and rice which, as the two major export crops, possess autonomy with regard to research. Rice research was previously part of the Ministry's programme but achieved its autonomous status in 1972. Until the early 1970's, crop and soil research were grouped together. However, because of the increasing importance and magnitude of the soils programme, a separate division for Soil Science was formed.

The major livestock development programmes in Guyana now fall under the direct supervision of the recently established Livestock Development Company Limited (LIDCO). LIDCO is charged with both the National Dairy Development and Beef Cattle Development Programmes. Its function is primarily developmental and commercial production and as such there has been very little research activity within this company since its formation in 1975. The Veterinary and Livestock Science Division of the Ministry of Agriculture is actively involved, on a small scale, in some aspects of swine and small ruminant (sheep and goat) research and nutritional research, using by-products of local feed. Quite recently the Division has had its diagnostic capability strengthened by the completion of Veterinary Diagnostic Laboratory facilities at Mon Repos.

In the mid sixties, with the diversification drive involving crops other than rice and sugar, emphasis was placed on individual crops rather than agricultural production systems. This approach to research had its obvious limitations both in terms of its relevance and applicability to on-farm problems. Such a system was conducive to compartmentalization, as invariably, an individual officer was asked to handle all aspects of a single crop and/or a group of unrelated crops e.g. Cotton (Gossypium hirsutum L.) and Married-man-pork (Lippia micromera Schau). Sometimes such a task required that the officer perform in disciplines that his prior training did not cater for. Several inconsistencies resulted in:

i. a tendency towards crop specialisation;

ii. 'specialised' labour-gangs;

iii. inequitable distribution of work load: In the case of secondments, transfers, resignations, etc., that work load is transferred to an individual officer to whom this area may be completely new;

iv. lack of a multidisciplinary approach: Programme planning, development and implementation;

v. narrowing of the technical base of individual officers; and

vi. disadvantages due to frequent changes in National priorities. This has led to a situation characterised by inefficient utilization of scarce human and other resources.

After careful and critical analysis of the above in relation to the total local agricultural environment the need to reorganize the Crop Science Division became evident.

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REORGANIZATION

Crop Science:

The reorganization of the Crop Science Division though unofficial is functionally more effective and is centred around three major facets of developmental work, encompassing both annual and perennial crops. The functional units are as follows:

- Genetic Resources;
- Technology Development/Transfer;
- Orchard Crops; and
- Plant Protection.

Genetic Resources Unit: The objectives of the Genetic Resources Unit (G.R.U.) are to introduce, identify and evaluate suitable cultivars of crop types required for local production. This unit is also responsible for making available, in adequate quantities and at the right time, high quality seed of the appropriate cultivars, in addition to maintaining Breeder Seed of adapted cultivars wherever possible.

Technology Development/Transfer Unit: Production Technology utilizing cultivars recommended by the Genetic Resources Unit is developed by the Technology Development/Transfer Unit (TDTU). Such technology includes the optimising of cultural practices and the development and/or modification of equipment for small-scale operations. The package of practices thus derived is tested and appropriately modified at the farm level before final transfer to the farmers.

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Orchard Crops Unit (OCU): This Unit, in addition to identifying and evaluating suitable cultivars of orchard crops (Genetic Resources), is also responsible for the development and transfer of the production technology appropriate to these crops.

Plant Protection Unit (PPU): The Plant Protection Unit works in close collaboration with the Genetic Resources, Technology Development/Transfer and Orchard Crops Units. The unit identifies, monitors and recommends effective economic control measures for important pests and diseases of the crop types identified. In addition, the Plant Protection Unit is responsible for the plant quarantine services and for pest management programmes of national significance, e.g. Moko disease of plantain and banana (Musa spp.).

Each Unit is run by a team of trained personnel who share the responsibilities of the work which is co-ordinated by a team leader.

Each section will document for storage, dissemination and utilisation, pertinent information on projects and reviews.

It is envisaged that this system will lead, inter alia, to:

- more equitable distribution of work load;
- more complete professional advancement;
- more effective utilisation of limited human and other resources;
- ease of continuity in the event of secondments, transfers, resignations, etc.;
- more integrated approach;
- more meaningful orientation of new/trained personnel;

- better exploitation of available training opportunities; and
- more equitable distribution of representations at workshops, seminars, etc.

Soil Science:

Within the scope of the broad objective of CAS, the Division of Soil Science is committed to the following:

i) Maintaining a national inventory and classification of soil resources and providing guidance for land use and management of these resources by:

   a) executing soil and land use surveys and describing the morphology, genesis and classification of soil resources;

   b) providing physical, chemical, mineralogical and biological information about different kinds of soils; and

   c) interpreting the above characteristics for various land-use, planning and management purposes and recommending the best possible use of the soil resources.

ii) Developing programmes and recommendations for the economic and ecological use of fertilizers, lime and other soil amendments or ameliorants by:

   a) providing chemical information on the labile nutrient pool, toxic conditions of soil and water, and on nutrient status of plant tissues;

   b) providing information on nutrient release and adsorption characteristics of soil to added nutrients along with critical and sufficiency levels of each nutrient as correlated with crop response; and

c) ascertaining through the generation of growth response-to-added-nutrients curves, the nature, source, and quantity of each nutrient element and combinations of these that will optimize economic crop growth.

To achieve these objectives and enhance its effectiveness some major reorganization was found necessary. In 1979/80 some unofficial changes in organization were implemented. The reorganization provided for five distinctly functional but interrelated sub-sections along with a supporting services unit, as follows:

a) Soil and Landuse Surveys Unit;

b) Soil Characterization and Management Research Unit;

c) Soil Fertility Research Unit;

d) Routine Soil, Plant Tissue, Stockfeed and Water Analysis Unit; and

e) A Special Analysis Unit.

Soil and Landuse Surveys Unit: This sub-section, formerly referred to as "Soil Surveys", is pedology oriented and is charged with maintaining a national soil classification system and inventory. It executes official soil surveys; studies the genesis, morphology and classification of soil resources; interprets soil characteristics for various landuse, management and planning purposes.

Its functions include the identification, delineation in space of the different kinds of soils in Guyana and recommending their suitability for different landuse practices.

Within the context of landuse and management are embodied such dependent activities as soil and water conservation; erosion control;

suitability of soils for mechanization, agricultural development, afforestation, and reforestation, recreational activities, construction of roads, sewage and household waste disposal, environmental quality enhancement and maintenance.

Soil Characterization and Management Research Unit: This sub-section is both field and laboratory oriented. It is designed to provide physical, chemical, mineralogical, and biological information on individual pedons and polypedons to aid in ascertaining behavioural patterns of various kinds of soils relative to their behaviour predictability under given management systems and landuse patterns.

Soil characterization embodies soil physics, soil chemisty, soil morphology, soil biology and microbiology, soil mineralogy, soil fertility, and soil genesis. Thus it supports, directly, the Soil and Landuse Surveys sub-section and is involved in the nature, properties and response of soil management units. It is also involved in the study of soil structure, soil structural aggregation, and soil structural behaviour in terms of ploughing characteristics, tilth maintenance, puddling characteristics, shear-strength, compressibility and compactibility, linear extensibility, potential volume change, soil density, water movement (saturated and unsaturated flow), retention, release and available characteristics of soil water, etc.

Soil Fertility Research Unit: This sub-section is charged with the development of programmes and recommendations for the appropriate economic use of fertilizer and lime materials for various crops on different kinds of arable soils in Guyana. It is responsible for the identification of plant nutrient imbalances, nutrient deficiences, toxicities and other chemically related soil problems as manifested in plant tissue and soil materials.

In essence, the sub-section holds responsibility for soil-plant-fertilizer interactions and the correlation of chemically measurable

parameters with crop growth. It liaises with other divisions and agencies in field trials, varietal, fertilizer trials, etc. in the use of soil amendments and ameliorants and in identifying soil related variables. It is laboratory and greenhouse oriented with a significant field component.

Routine Soil, Plant Tissue, and Water Analysis Unit: The sub-section is responsible for the routine analysis of water and soil material and the recommendation of economic fertilizer and lime use for farmers' crops based on quantifiable labile nutrient pools. It provides chemical information on plant and animal tissue i.e. plant parts, stock feed in terms of quality control parameters, fruits in terms of proteins, fats and oils, crude fibre content, etc., quality of forages for livestock feed, and plant nutrient levels.

Special Analysis Unit: This sub-section does the non-routine analysis of materials including pesticides, fertilizers, unknown agricultural chemicals and environmental quality control and monitoring. This section is also involved in developing and testing suitable analytical methods for use in other sub-divisions, maintaining quality control in other analytical facilities and assisting other agencies in special analyses.

RESOURCES

In a 1977 paper Fletcher reported that there was an alarmingly high rate of staff turnover in the Ministry's research sector. This, he said, together with the fact that the majority of the new staff then consisted of new graduates and diplomates, resulted in a staff composition that was young and markedly deficient in experience. During the period 1973-77 the average age of the professional staff was 30 years and the level of experience was three years.

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The staff situation during the period 1973-77 is shown below with a summary of the status in 1981 for Crop and Soil Science Divisions.

	73	74	75	76	77	81
Professional staff	25	27	28	28	27	24
Sub-professional staff	34	42	45	47	45	65
Auxiliary staff	90	90	95	85	80	164

The available expertise of Professional Staff at CAS in 1981 is presented in Table 2.

Table 2: Available Expertise at CAS - 1981

Area of Specialization	No. Available	Level of Qualification PhD	MSc	BSc	Dip/Cert.	Others
Agriculture (general)	12	-	-	12	-	-
Entomology	1	-	1	-	-	-
Horticulture	1	-	1	-	-	-
Microbiology	2	-	2	-	-	-
Natural Science	2	-	-	2	-	-
Plant Pathology	3	-	2	1	-	-
Soil Chemistry	1	-	1	-	-	-
Soil Science	1	1	-	-	-	-
Soil Surveyor	1	-	-	-	-	1
TOTAL	24	1	7	15	-	1

FINANCE

CAS derives its primary financial support through the state financing machinery. Funds are included in the annual budget of the Ministry

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under the two main sub-divisions of recurrent allocations for programmes of a routine or continuous nature and capital allocations to cover new or special projects which may involve infrastructural expenditure. Funding for research programmes is also made available through regional and international research and funding organizations for specific projects or programmes identified for such assistance. In such cases, technical assistance and training are also integral parts of the package.

The budget for Crops and Soils is shown below (G$).

Year	Recurrent	Capital	Total
1977	636.660	229.540	866.200
1978	619.000	310.600	929.600
1979	792.000	36.000	828.000
1980	992.000	497.000	1,489.000
1981	1,546.000	48.000	1,594.000

Funds are approved by Parliament at the beginning of the calendar year which corresponds with the fiscal year and are then made available to the Divisions in accordance with phased projections of expenditure.

INFRASTRUCTURE

Infrastructure at CAS for research and support activities includes:

1. Offices for specialist research staff and administrative support staff;

2. Laboratories - Entomology, Plant Pathology, Microbiology, Soil Chemistry, Seed Technology, Plant Quarantine and Greenhouse facilities;

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3. Basic laboratory equipment for laboratories including equipment for rapid routine and specific analyses of soil, plant tissue, stockfeed and water samples;

4. Fleet of vehicles including five (5) Land Rover type vehicles, one van, and one tapir pick-up;

5. Complete set of machinery and equipment for land preparation, crop production and pasture maintenance; and

6. Approximately four hundred (400) hectares of land.

Supporting field units include the Ebini Research Station, the Kairuni Research Station and the Central Horticultural Station.

Identity	Location	Agricultural Area	Activity
Ebini Research Station	Intermediate Savannahs	Brown sand savannahs	Livestock/Crop research
Kairuni Research Station	Soesdyke/ Linden Highway	Forested brown sands	Crop research
Central Horticultural Station	Demerara River	Riverain area	Crop research

The Ebini Research Station was established for crop, soil and livestock research in the Intermediate Savannahs. Crop research facilities comprise a field station and approximately one hundred (100) hectares of land available for field trials. Basic machinery and equipment are also available for field operations.

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Major research in beef production on native and improved pastures has been done here. Recently this facility was converted to a commercial unit under the Livestock Development Company Limited, but nutritional studies with sheep and goats are still conducted by the Veterinary and Livestock Science Division of the Ministry of Agriculture. Facilities include:-

1. Pens and paddocks plus sixty (60) hectares for sheep and goat studies;
2. Animal nutrition laboratory (not yet fully functional); and
3. Housing and office accommodation for research staff.

Kairuni Research Station is located on twenty (20) hectares of brown soils at Kairuni. Research at this location is specifically on crops adaptable to these inherently infertile soils.

Facilities include:

1. Storage bond, machinery shed, field office;
2. One tractor and basic machinery and equipment for field operations; and
3. Some housing facilities for workers.

The Central Horticultural Station is essentially a propagation station for orchard and perennial crops. Apart from investigations into systems of propagation, some crop research specific to the particular soil type is done. Research facilities include:

1. Established fields of fruit crops on which investigational work on production techniques and pest and disease problems is done;

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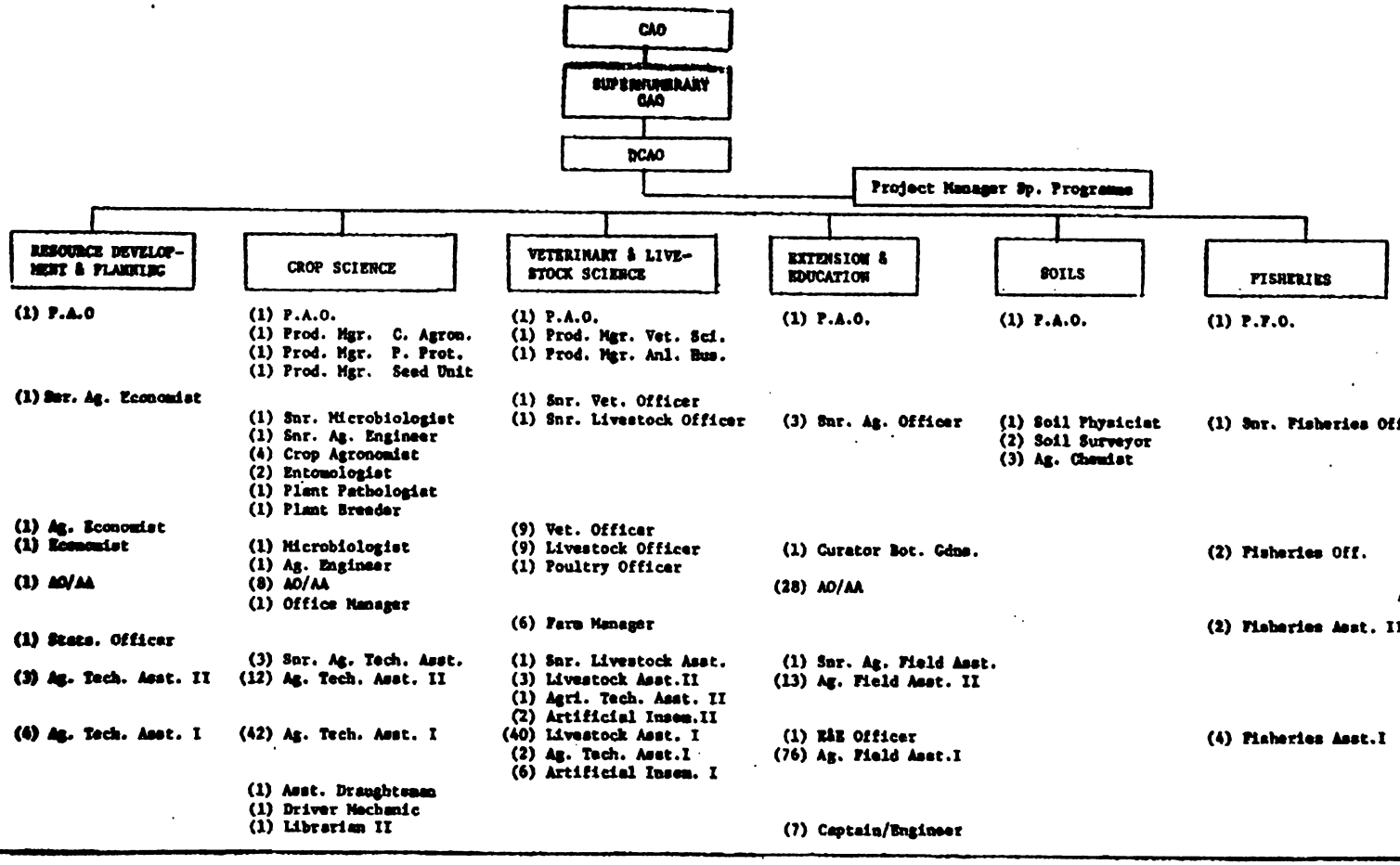
2. Greenhouse and mist propogation facilities;

3. One tractor and land preparation equipment; and

4. Field office and staff quarters.



Also Shown:

Food & Nutrition Development

(1) Snr. Food Scientist	A27
(1) Food Scientist	A24
(1) Agri. Tech. Asst. II	A15
(1) Agri. Tech. Asst. I	A13

N.B.:

New Departments

(a) Fisheries Department

(b) R.D. & P. to Agri. Sector Planning Dept.

Organograms have not been presented.

FIG.1. ORGANISATIONAL CHART OF THE DEPARTMENT OF AGRICULTURE

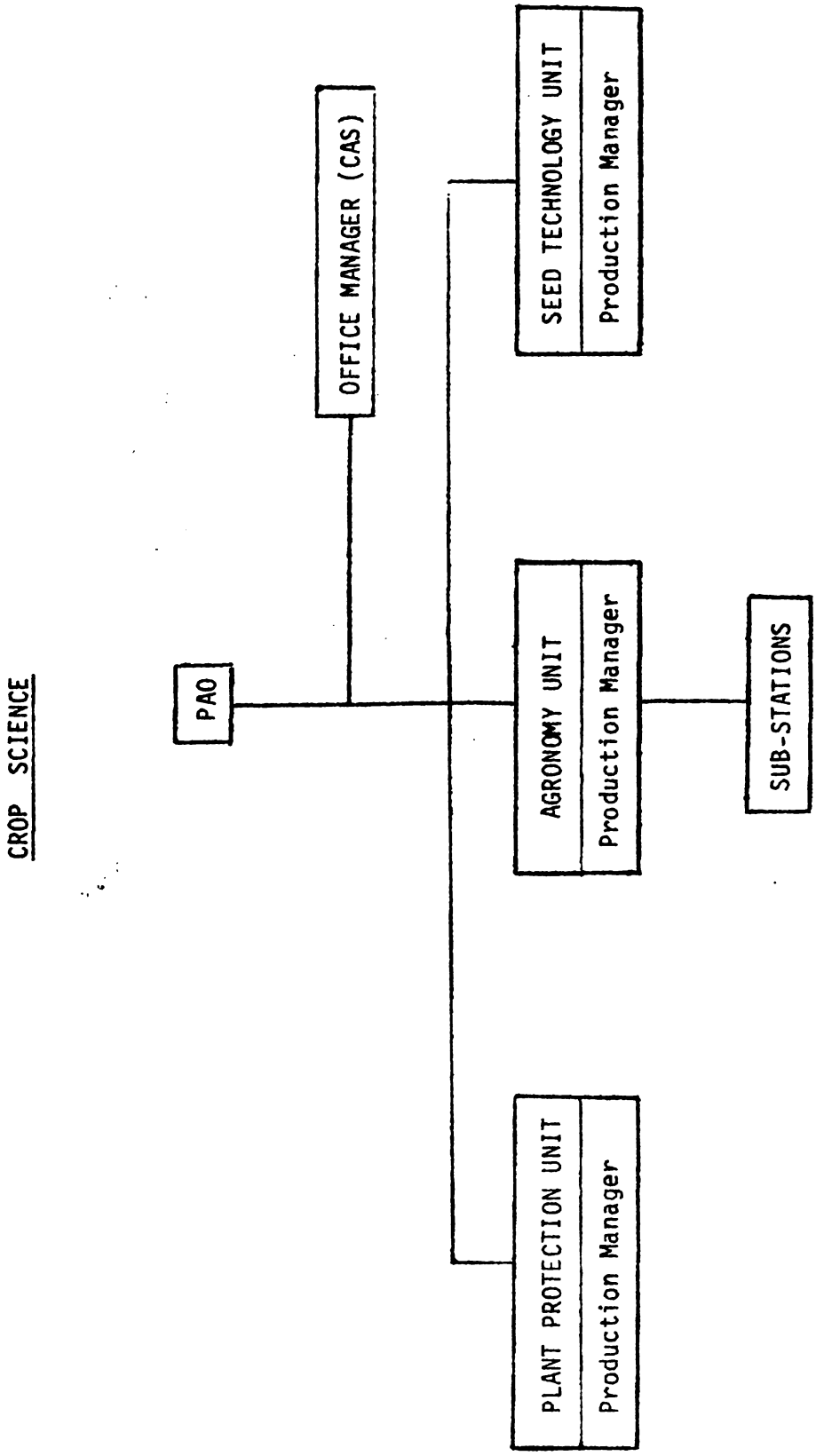


FIG 2: ORGANOGRAM OF THE CROP SCIENCE SECTION OF THE DEPARTMENT OF AGRICULTURE

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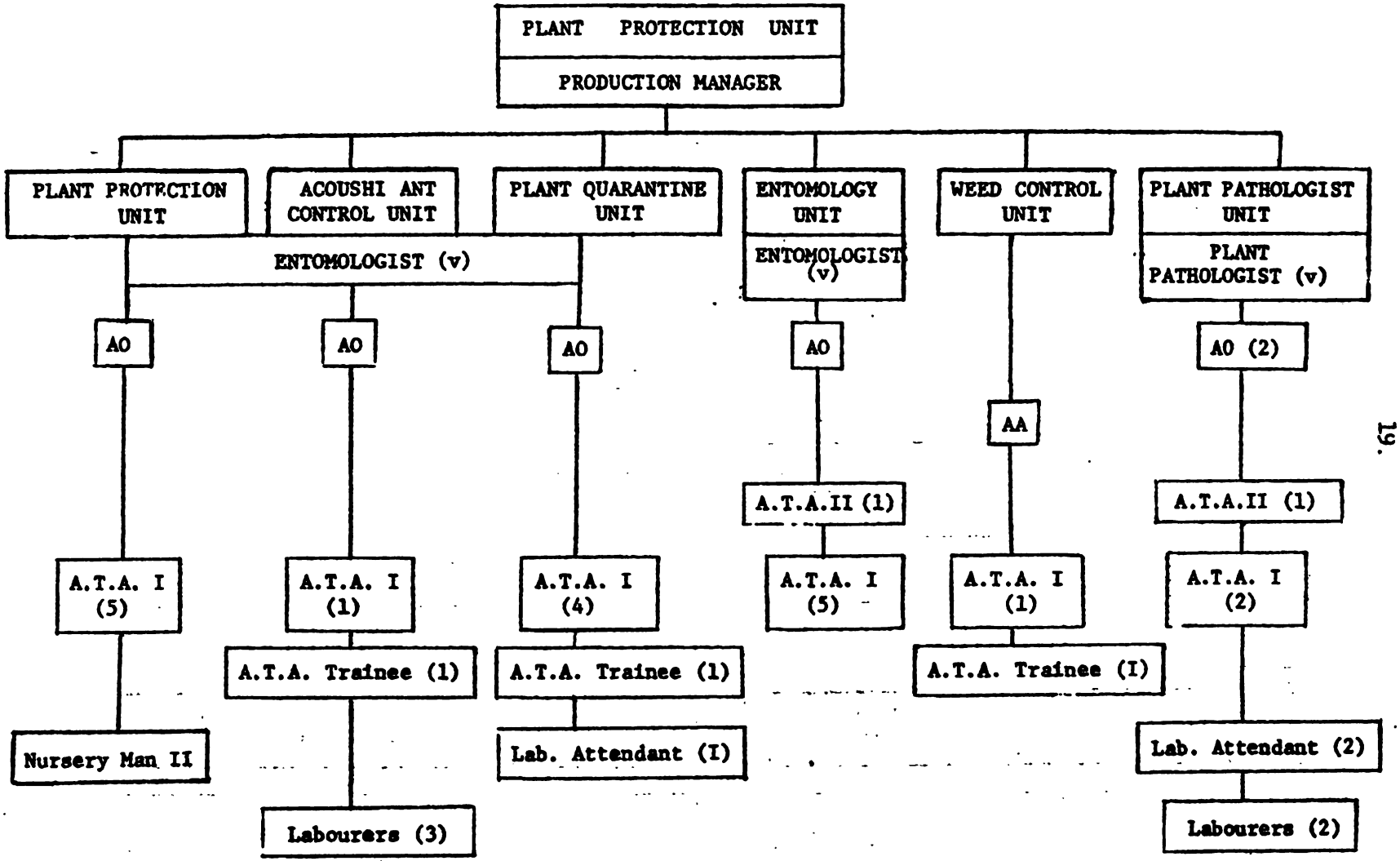


FIG. 2a: ORGANOGRAM OF THE PLANT PROTECTION UNIT. v = vacant

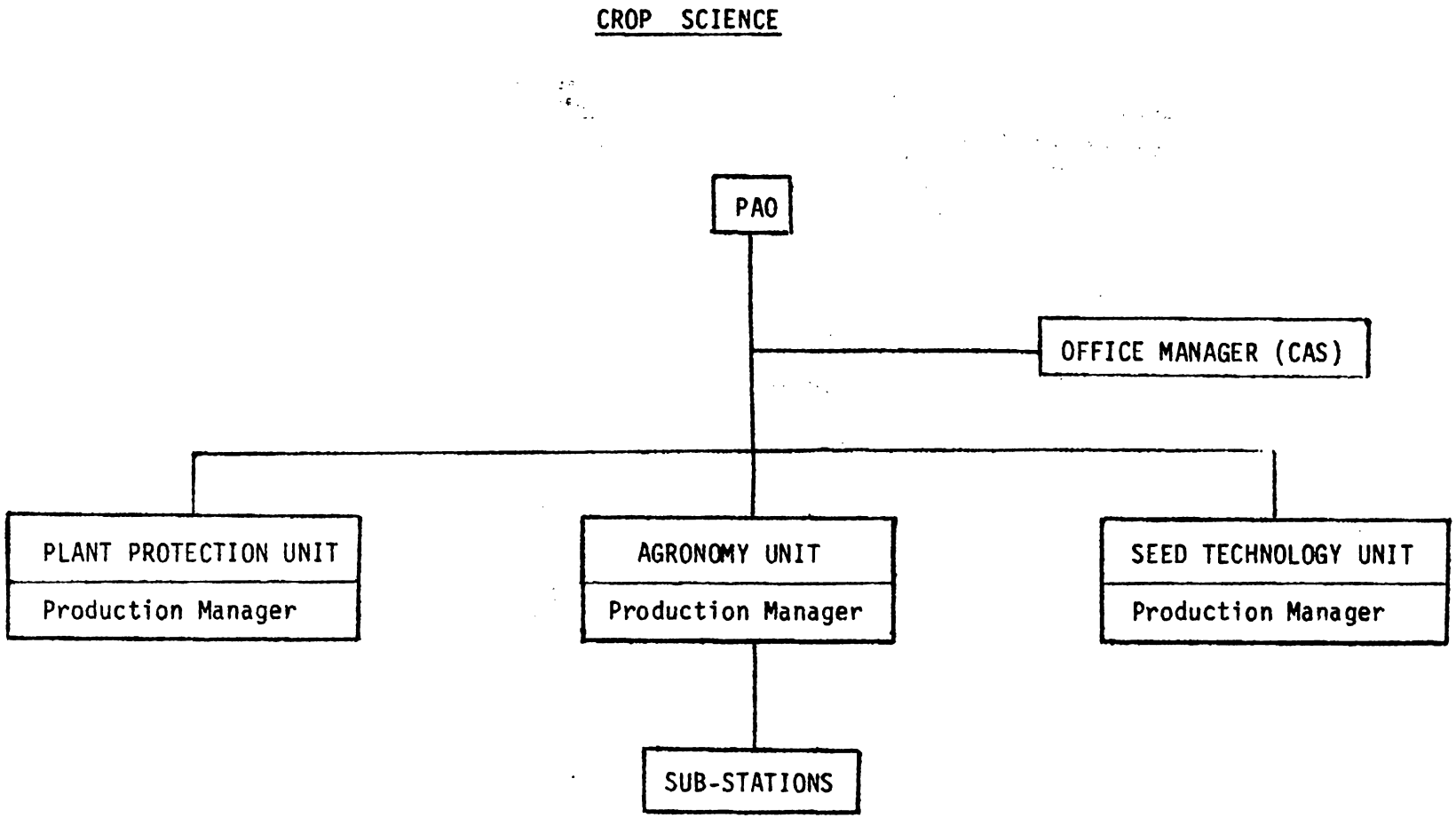


FIG 2: ORGANOGRAM OF THE CROP SCIENCE SECTION OF THE DEPARTMENT OF AGRICULTURE

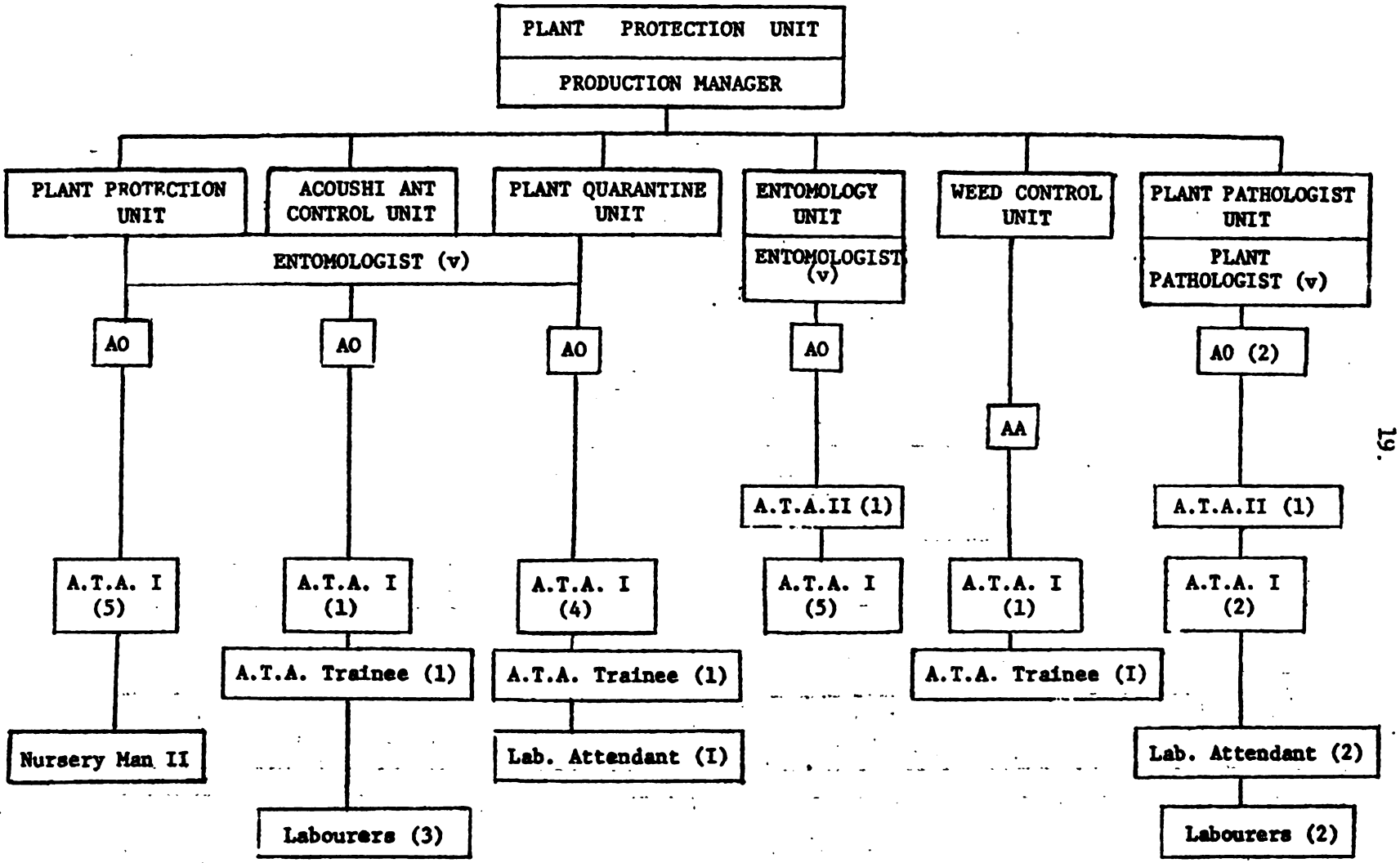
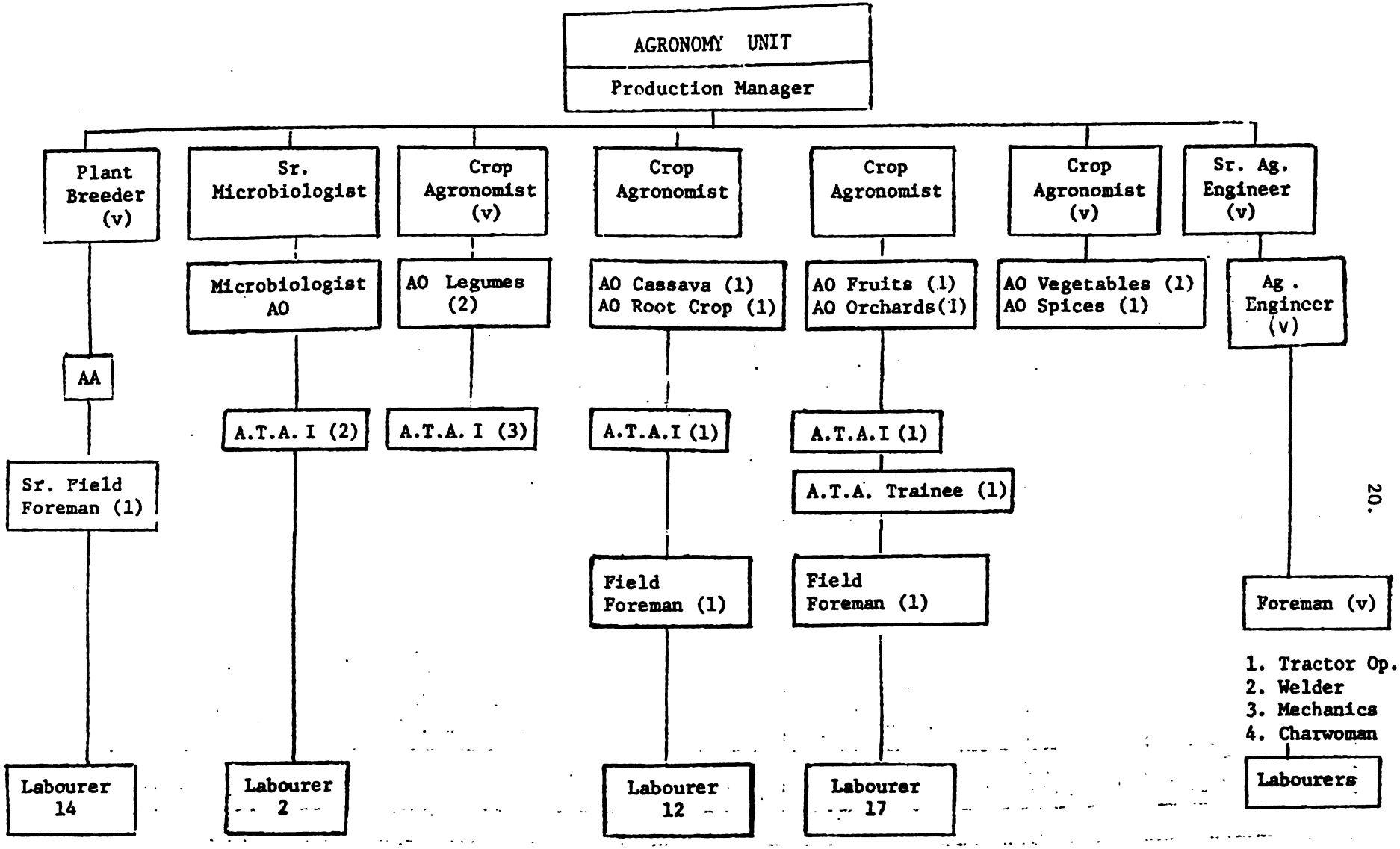


FIG. 2a: ORGANOGRAM OF THE PLANT PROTECTION UNIT. v = vacant



v = vacant

FIG. 2b: ORGANOGRAM OF THE AGRONOMY UNIT

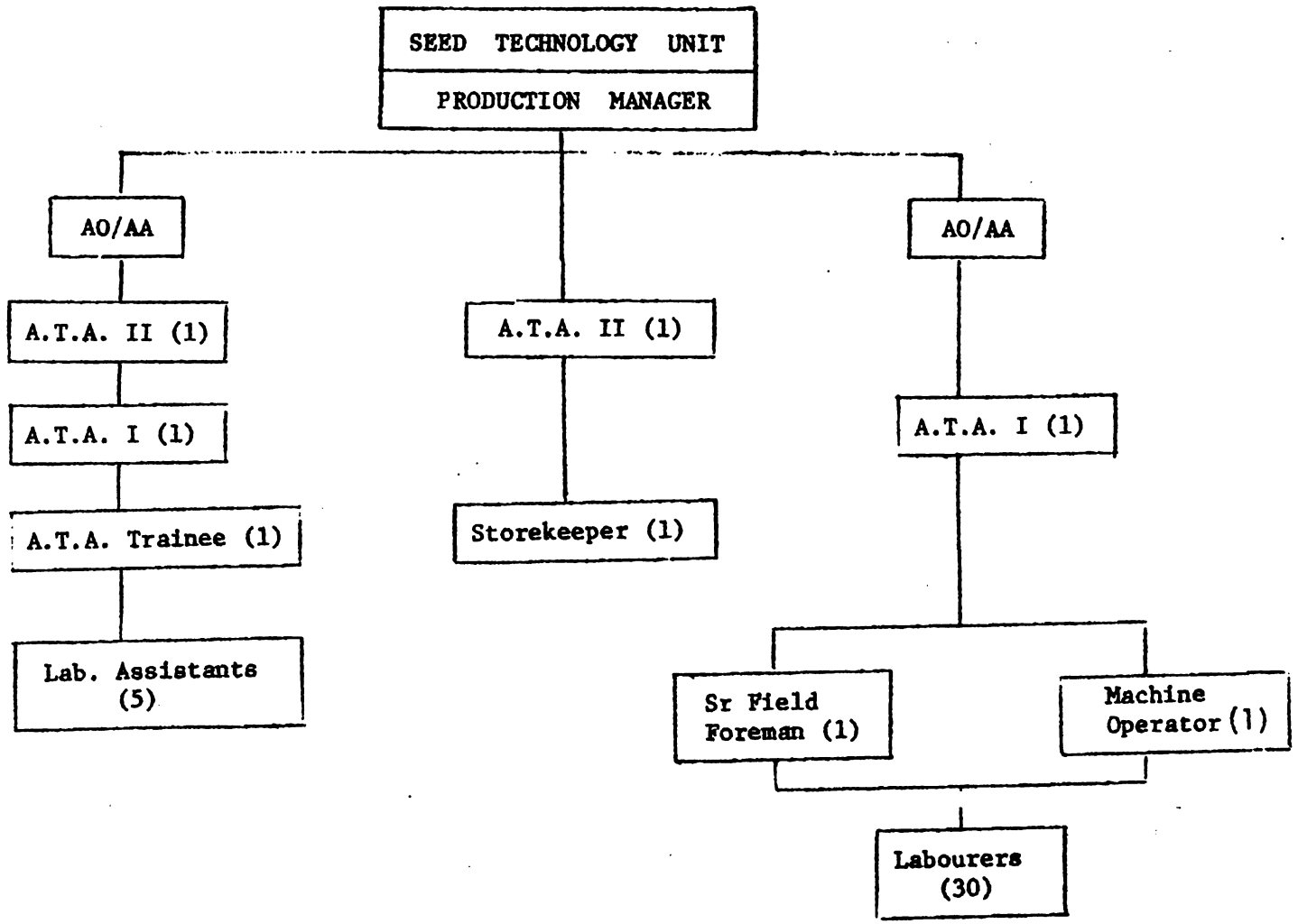


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FIG. 2a: ORGANOGRAM OF THE SEED TECHNOLOGY UNIT

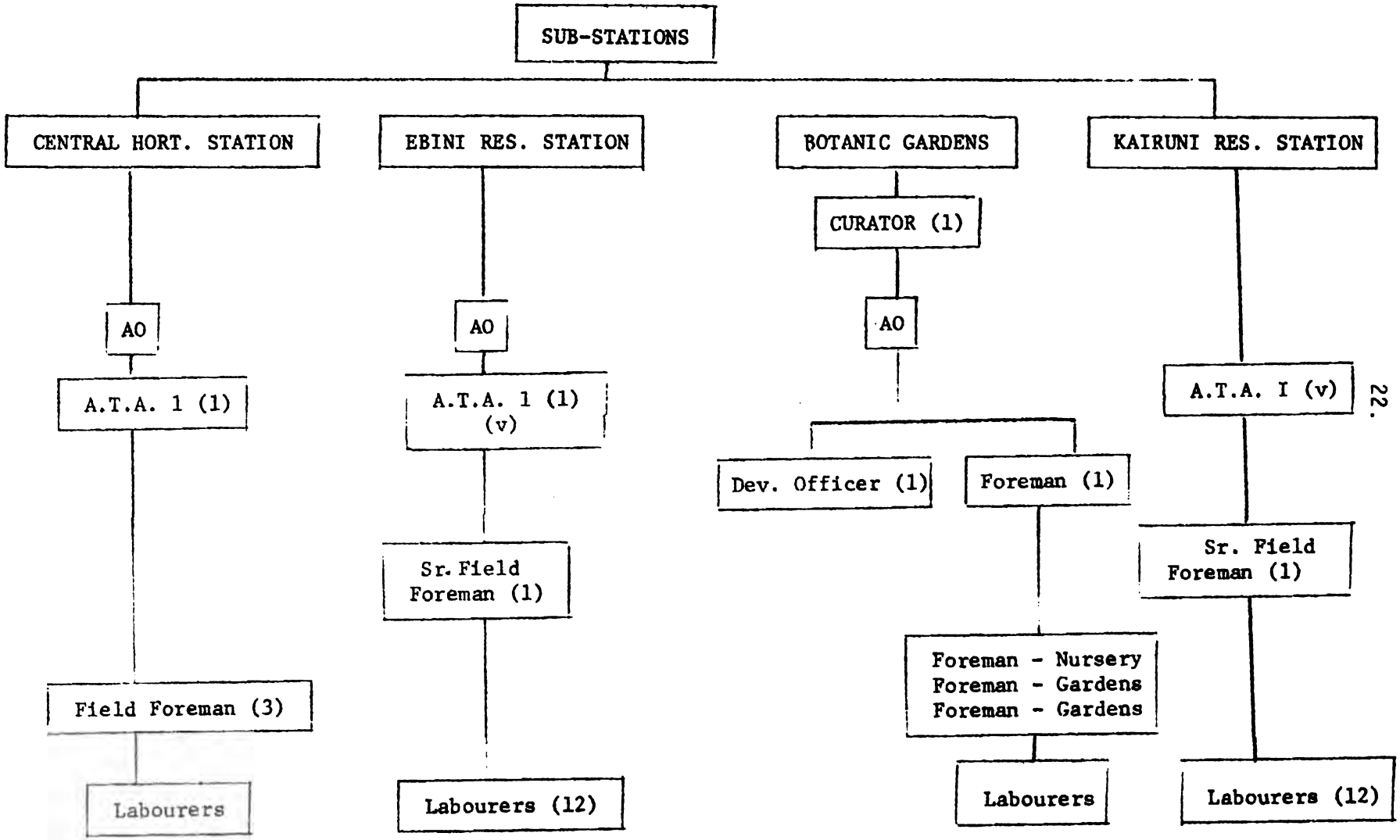

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FIG. 2d: ORGANOGRAM OF THE SUBSTATIONS.

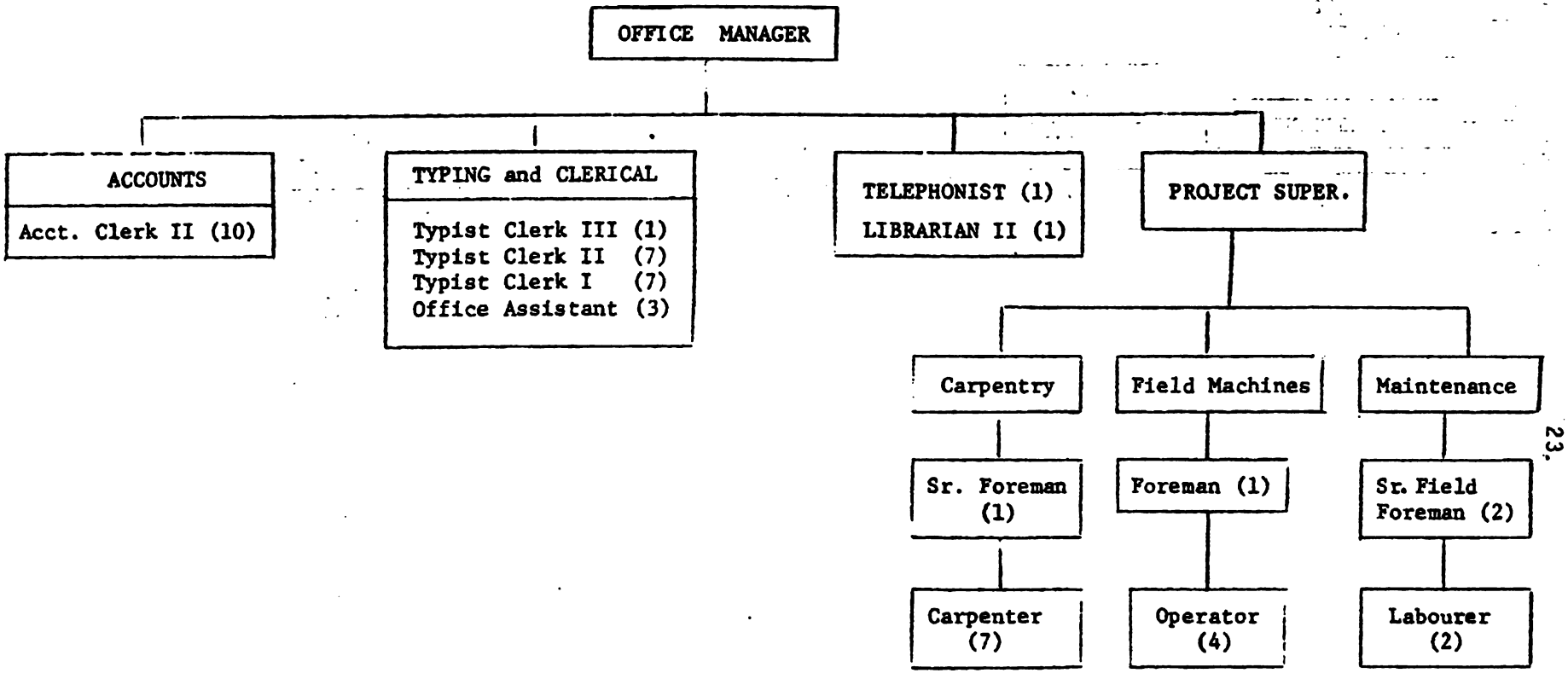

FIG. 2e: ORGANOGRAM OF OFFICE MANAGEMENT OF CENTRAL AGRICULTURAL STATION

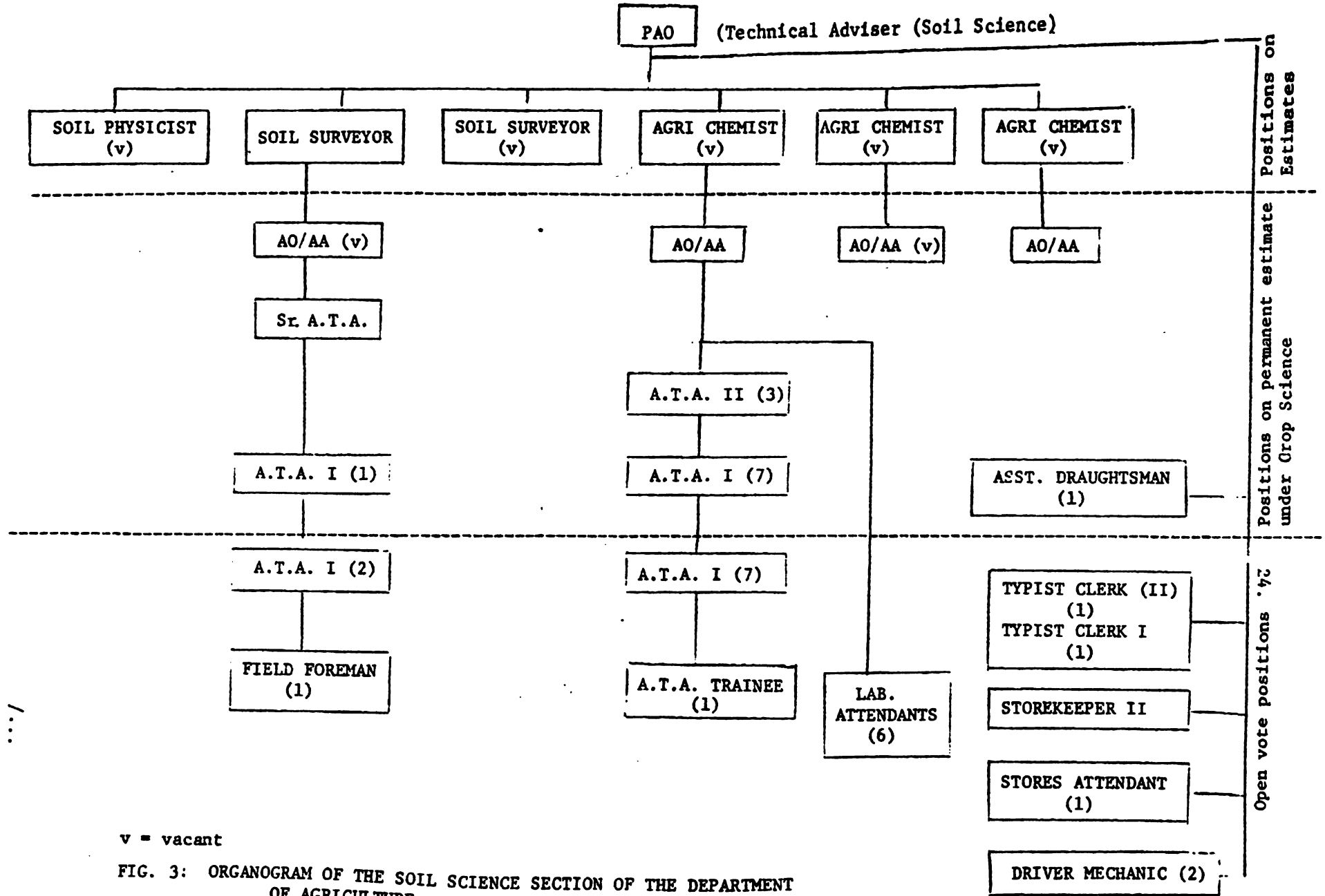

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FIG. 3: ORGANOGRAM OF THE SOIL SCIENCE SECTION OF THE DEPARTMENT OF AGRICULTURE

DISCUSSION ON PERSAUD/GRANGER PRESENTATION

The discussion on this paper focused on some of the major factors affecting the work at the Central Agricultural Station as follows:

- Given the resources available at the Central Agricultural Station, the anticipated goals were unrealistic. There is need, therefore, for an analysis of available inputs, their management and a revision of goals and objectives to make them more realistic.

- The limited resources presently available within the Central Agricultural Station were not efficiently utilized because of poor structural programming. The research administrative framework needs revision both from the standpoint of its form and how the units characterizing it relate to each other. What is needed is an improved system, generated on the basis of past experiences and in keeping with what is intended to be achieved, to make effective use of the available resources.

- Introduction of a multidisciplinary team approach should serve to eliminate present isolation both between and within Divisions.

- The effect of the Central Agricultural Station on farmers and hence on production is minimal for various reasons. It was noted that the present system does not incorporate farmer ideas as inputs into the research environment. The need for improved communication with farmers and on-farm research was stressed.

- The research work of the Central Agricultural Station is influenced by several factors which affect agricultural production and the Central Agricultural Station should make efforts to impact, in some way, on these varied factors. Among the most critical cited were:

  - prices of agricultural produce and pricing policy;
  - input supplies and input supply systems; and
  - farmer communication systems.

Generally, it was felt that a greater level of flexibility and innovativeness should characterize the Central Agricultural Station, but it was accepted that the general economic environment (scarce resources, low salaries, etc.) has had its toll on research and on the agricultural sector as a whole.

AGRICULTURAL DEVELOPMENT IN GUYANA THROUGH RESEARCH AND EXTENSION

by

J.R.D. Ford

OVERVIEW

The need for agricultural development in Guyana and the importance of research and extension as contributors to this development are accepted by the cross-section of professionals working in the directly related areas. However, beyond this general acceptance there is much disagreement regarding questions such as how these areas should relate to each other, how resources in each area should be allocated, what is the organizational structure that should characterize each area singly and all the areas as a whole. This disagreement is a reflection of the complexity of agricultural development in general, and of the complexities involved in generating research systems, extensions systems and research and extension systems in particular. These problems are major ones and must be faced if agricultural development is to be advanced and resoures are to be utilized efficiently in these areas.

This paper seeks to do four things. Firstly, by way of introduction it outlines the technology development process in two stages and general problems related to this process. Secondly, it treats the first stage - research/policy systems in isolation - from two standpoints, the national, sectoral or policy standpoint and the operational, institution or station standpoint. Models representing both standpoints are introduced and some of their benefits and shortcomings discussed. Thirdly, the second stage - research/extension system models are treated and analysed. Finally, proposals are made for a technology development system as this relates to the Ministry of Agriculture in Guyana.

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INTRODUCTION: THE TECHNOLOGY DEVELOPMENT PROCESS

Technology development (TD) has transformed man's ability to provide for himself and has led to the generation of agricultural surpluses which have been utilized for general economic development. The high correlation between technology development, agricultural development and general economic development in the temperate zone is no mere coincidence.

The development of mechanical equipment has increased both efficiency and productivity by improving methods of land preparation, crop protection and harvesting. Biochemical innovations have had a similar impact. Unfortunately, however, these gains have been largely confined to the temperate zones.

Technological progress and/or technological development comes from two main sources broadly classified as internal or external.[1] The external source has been the main source and is treated normally under the heading of 'transfer of technology'. The failures of the external source are well known and have led to increased emphasis on the neglected source - internal. The internal source continues to be marginal because of almost complete reliance on formal and poorly devised research systems which generate little output and, even worse, little useful output.

The technology development process is a continuous interrelated process that includes essentially two stages, the first stage being research

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[1] *The same distinction as made between economic growth and economic development can be made here between technological progress and technological development. The latter being a wider concept encompassing socio-economic goals. In other words, agricultural research has changed, it is no longer adequate to justify agricultural research in terms of making "two blades of grass grow where one grew before", the wider questions of how the changes will affect distribution of income, nutrition, the environment need to be taken into consideration.*

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and the second being extension - diffusion and application[2]. It is important to stress the interrelated and the continuous aspects of the process because this has been one of the major drawbacks of TD programmes in developing countries. Either they have separated the two stages, in some cases they have not got past the research stage, or they have neglected the feedback mechanisms which are critical for TD.

The research stage is the generation of technology stage and has been the most emphasized stage. So much so that it is often said that this aspect of TD should be discontinued and efforts be concentrated on the other stages until the gap is less wide. One of the problems characterizing this stage is its neglect of inputs from the environment in which it is working. For example, biological research has proceeded along purely scientific lines without involving those active in the agricultural production. In other words, generation of biological technology must take place both on farms and in laboratories.

The extension stage is discussed in terms of two sub-stages, diffusion and application. The diffusion stage is the transfer of technology stage. The importance of linkages for successful TD should immediately become apparent. If those involved in technology generation are not involved in the technology diffusion the chances of success at this stage are severely limited. Yet this division characterizes organizations in all fields of TD in developing countries. Within agricultural sectors the diffusion of technologies is often the responsibility of extension agents who are poorly integrated and often less qualified than those at the generation stage. The diffusion sub-stage is an intermediary stage between research and application.

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[2] *Halty-Carrere, M.H. (Technological Development strategies for Developing Countries", Institute for Research on Public Policy, Montreal, 1979) divides this process in three stages. The author draws on Halty-Carrere's work but feels that the process is better represented in two stages, essentially overlapping.*

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The application stage is the actual putting into practice of the technology developed. This is the ultimate linking of the supply (creation of knowledge, generation) and demand (application stages of TD). In the models to be analyzed in the next section the point will be made that because of the present structure of some research systems and the socio-economic conditions of the countries, the supply/demand interaction which is critical for appropriate TD never takes place.

To sum up, TD can only take place when internal and external sources of technology are linked with the diffusion and application of technology. In other words, the users or demanders of technology must have a say in determining the supply of technology. If little demand is reflected domestically, little relevant technology will be generated domestically and the search for external sources of technology will continue.[3] Once this cycle is not broken, technological underdevelopment will be a characteristic of developing countries.

Problems affecting the Technology Development Process

The creation of knowledge and the use of available knowledge through research and extension are the most critical dimensions of the technology development process. Three facets of this research process complicate the tackling of the research problems of developing countries. Firstly, technology development, research and extension take time and development-minded individuals tend to want results over a short period. Secondly, technology development work is costly, often involving high priced professionals and expensive equipment for them to work with. Tech-

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[3] *Foreign technological dependence is attributed to four aspects of developing countries: (1) the dual nature of their economy - the modern sector is the main source of present demand and it is financially and technologically linked to foreign sources, (2) the presence of transnational corporations in developing countries, (3) the fact that developing country scientists are trained in developed countries and often endorse the "advanced" technologies, (4) international financial practices are biased towards foreign technology transfer.*

nology development is also risky and largely intangible. Thirdly, technology development successes are not highly visible in the short run. They are usually spread out and apparent only to those benefitting directly from the technology developed. Given these reasons and the budget constraints of developing countries, the sums allocated for technology development have been minimal.

Finally, the tropics itself. In the 1930's grain yields in the temperate and tropical zones were approximately equal at about 1.1 tons per hectare. By the 1970's however, yields per hectare more than doubled in the temperate zone, increasing to 3 tons, while for the tropics, yields per hectare moved only to 1.5 tons.

The tendency to assume that the gains of the temperate zone can be transferred in totality and without modification to the tropics has led to the neglect of research in the latter zone. Needless to say, this indicates a gross misunderstanding of tropics physically, biologically, economically and sociologically.

The tropical environment is different from the temperate environment. The work within the tropical environment can benefit from work in the temperate zone but much basic work on the peculiarities of the tropics needs to be carried out before the growth rates and levels of development evidenced in the temperate zone are reproduced in the tropics. Without being pessimistic about development in the tropics, Andrew Kamarck seems to suggest that the problems of development in the tropics are much more than in the temperate zones:[4]

> "Continuous heat and the absence of frost mean that life and reproduction go on throughout the year. The great executioner

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[4] *Kamarck, A.M. The Tropics and Economic Development, A World Bank Publication, John Hopkins University Press, 1976, p. 17.*

> of nature, winter, is absent. No winter temperatures constrain continuous plant growth or the continuous reproduction and growth of all other kinds of life: weeds, insects, birds, parasitic fungi, spider mites, eelworms, microbes and all kinds of viruses, pests and parasites on man, his animals and his crops."

A direct result of this environment, therefore, is the increased chance of any agricultural activity failing because of the presence of some pest or disease. Further, it is agreed that the extremes of heat and floods as evidenced in the tropics are damaging to a proper soil environment. The extreme heat burns away the organic matter and kills the micro-organisms. The floods, on the other hand, affect the structure of the soil, resulting in subsoil being sealed off from the air and it leaches out minerals which would have been available to the plants.

If agricultural production and productivity is to expand in the tropics the way it has in the temperate zone, much gathering of knowledge and transformation of knowledge about factors of production needs to be completed. Technology development systems to tackle problems in this peculiar tropical environment are still largely in the formative stages.

TECHNOLOGY DEVELOPMENT: RESEARCH/POLICY SYSTEMS

> "... The first step in an agricultural development program should be initiation of a substantial, highly integrated research program, directly connected to farm problems at one end and to basic research and foreign efforts at the other."[5]

The above quotation from Mellor's work, more than ten years ago, has even more significance now than when it was written, both because of the failures of the non-research efforts of the seventies and because of recent research efforts which are too removed from farmer problems. Infrastructural works (drainage and irrigation), transfer of technology (temperate zone based, both mechanical and biological) and associated support systems (credit) have dominated past development efforts. Yet, little impact has been made in transforming the production systems of the third world. This section supports Mellor's statements and presents research models at two levels, the national, policy or country level and the institutional or operational level. In the former case the questions surround the open or closed nature of the model and how centralized or decentralized the model is. At the other level, the department, station, institute level which is largely the operational level, the key questions surround the organization of agricultural research. The two levels, though separate, are very much affected by each other and consistency of purpose and action at both levels would be needed if agricultural growth and development is to result from the research system.

Before treating the models at the two levels it is important to clarify some definitional problems.

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5 *Mellor, J.W. Prospects, problems and lessons. Developing Rural India; Plan and Practice. Ithaca, N.Y. Cornel University Press, 1968.*

There are generally two types of research - basic and applied research. Conflict between the amount of resources committed to mission-oriented (applied) or more fundamental (basic) research continues and will be an issue in all dynamic research systems.[6] This paper leans towards applied research for two simple reasons. Firstly, the country in focus is a small country and the cost of developing effective domestic capacity for basic research would be very great. Secondly, the regional and international systems have given indications that they are gearing their research systems to fill this need.

National/Policy Level

At the national or country level two dimensions are used to characterize technology development systems.[7] The first dimension is the nature of the political system - its decision-making aspects. In other words, where along the centralization/decentralization continuum does government intervention fall? This dimension focuses on the internal system and how it affects technology development.

The second dimension focuses on the external system affecting TD. The continuum here is represented by the degree of openness that characterizes the policies of the government. The 'openness' of the society affects considerably the kinds of policies and strategies followed. On the basis of this typology country models can be shown as in Figure 1:

	Centralized	Interventionist	Decentralized
Semi-Closed	EAST		CHINA
Protectionist	BRAZIL	JAPAN	
Open			WEST

Fig. 1

[6] *Other classifications of research such as exploratory research (basic or applied), insurance research (preparedness), education research (thesis) are not treated here.*

[7] *Halty-Carrere (above) uses this classification.*

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Halty-Carrere argues that this representation is important because it has a direct relation to the supply and demand for technology. He claims that the demand for technology is affected mostly by the degree of centralization/decentralization while the supply of technology (both from indigenous and foreign sources and the balance between them) is affected greatly by the openness of the economy.

Focusing on the two extremes, East and West, one essential point is made. The West has advantages in the process of innovation, the East has advantages for effective regulation and control of the process of technology transfer. Essentially, the point being made here is that the competitive pressure that characterizes the Western model creates a greater demand for technology. Hence greater levels and kinds of innovation result. The East being more autarkic, there is greater need for control of technology imports. However, where the West has advantages that increase the rate of technology innovation - '<u>quantitative innovation</u>', the East has the advantage in terms of the orientation of technology development - 'qualitative' innovation.

Innovation is simply the transfer of possibility into actuality - it unites both the supply push and demand pull aspects of TD. According to Halty-Carrere (H-C) the demand aspects are the most critical, to quote:

> "More than the scarcity of technology supply, the lack of pressure for technological change and the absence of concrete demand seem to explain the very low levels of innovation in LDC's. Certain studies confirm that the central stimulus for about two-thirds of innovations come from economic demand, while only one-third arises from T opportunities".

In other words, the absence of the demand for technology is a major constraint to technology development in developing countries.

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In order to make the demand for innovation more widespread H-C seems to be arguing for the existence of competition and a market mechanism. The absence of competition meaning that there is no penalty for 'non innovation'. The fact that competition characterizes the Western system therefore suggests that the rate of innovation would be greater there than in the Soviet system.

A further deduction from the presence of competition affecting innovation applied in this two-model comparison would be that because in a competitive system decisions respond to the profit motive then the innovation taking place would not always be in the best interest of the society. The Eastern system being more controlled is thus better equipped to produce innovations that greater serve the needs of society. Empirical research in the Soviet Union did not however bear out any major distinction in project selection criteria between the East and the West. Rather, the competition between the two systems was found to have led to the East following Western leads.

The Japanese model is considered the "in between" using the best of the Western and Eastern models. Basically, the policy was to combine protectionist mechanisms and competitive measures. The instructive aspect of the Japanese model for developing countries is in the use of protectionist measures as part of a strategy of TD as opposed to ends in themselves. In other words, the management of how foreign technology affected internal technology and hence the country's development. Three aspects of the Japanese strategy should be highlighted:

(1) Imported technology was spread across several firms - leaving them to compete on the basis of utilization of the imported technology and improvement of it;

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(2) Market shares were divided between foreign technology and internal technology - promoting utilization of internal technology and evaluating its ability to compete (technology protection); and

(3) By forcing use of internal technology, the policy forced - modification of foreign technology, development of indigenous technology or a combination.

Basically, transfer of technology was regulated. However, the key difference between Japan and developing countries is that gradual liberation did not take place in the case of the latter. The Japanese policy is referred to as a strategy of TD "in reverse". Not the classical, internal, research-based supply push but rather an approach based on external inputs. Given the heavy dependence of developing countries on foreign technology, this approach may be relevant. (Too open, ldc's can't survive; too closed, too slow and costly).

The Chinese model is important in that it is off the "classical diagonal" or off the continuum, represented by the extremes of the Soviet and Western models. It is a separate model; it presents a new and different line.

The essence of the Chinese success lies in the fact that they did not build up institutions to bring about TD; they built a system (i.e. no National Science Research Councils (NSRC's) or National Research Institutes (N.R.I.'s)). Chinese policy tied together the scientific and productive systems - i.e. by making both systems coincide, the linkage problem between science and production practices becomes a "non-problem".

'Mass Science' is the critical underlying variable in the Chinese technology strategy - workers are involved in TD process. In no other model is the work of technical functionaries as open to popular scrutiny, sug-

gestions and innovation. The major gain here is that not only are additional technology generating resources made available but demand for technological change is tied to user participation.

The Chinese model differs considerably from the other models in that it does not stress "accumulation first and distribution later" (i.e. modern sector and trickle down theories). They adopt a more balanced approach - they stress distribution and accumulation simultaneously (walking on two legs, modern sector without disregarding the traditional sector). The effort is made constantly to link the modern and the traditional sectors - to break down the dualistic characteristics of the country. Diffusion of technology is critical in linking the modern and the traditional sectors as the "higher" organisational unit helps a "lower" to increase its technological level.

The recommendations of the Chinese model for developing countries are immense:

(1) It is a dual model suited to dual economies which is basically what developing countries are. It links the traditional and modern sectors through the activities of local, rural and small scale industry;

(2) It emphasizes agriculture, the common base of all developing countries;

(3) It considers developing country factor endowments: labour surplus, capital shortage and technological weakness; and

(4) The major stumbling block of traditional Western and Soviet development strategies is tackled: low employment generation of the modern industrial sector.

Institutional/Operational Level

At the institutional or operational level there are essentially four types of research system models:

i) the integrated research, extension and education model;

ii) the autonomous or semi-autonomous publicly or privately supported research institute;

iii) the ministry of agriculture model; and

iv the agricultural research council model.

The integrated research, extension and education model is perhaps best represented by the western system in the form of the US land grant system. This system became institutionalized in the US in the 1920's and according to Ruttan "it clearly took 50-70 years of persistent effort to effectively organize a productive agricultural research and extension system in the United States". The main features of this model are the land grant college, supported both by federal and state funds, the state experiment station directly associated with the college, its teaching and research programmes and the extension system directly associated with both the experiment station and the college.

The autonomous or semi-autonomous publicly or privately supported research institute comes out of the English experience and is presently particularly associated with the development of large-scale production, plantation and export crops. Its main feature is its specific commodity focus.

The ministry of agriculture model is essentially the research station model. It is associated with small countries and the focus of the

research work is mainly domestic food crops. In large countries it would be a subset of another model and would be associated with particular states or regions.

The agricultural research council model comes out of twentieth century English experience (in 1931 an Agricultural Research Council was established in England). It is more an umbrella organization for co-ordinating other research systems in existence than an organization for research in itself. In other words, it is more a research advisory board with agricultural research planning capacity than a research unit itself.

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TECHNOLOGY DEVELOPMENT: RESEARCH/EXTENSION SYSTEMS

This section tackles what has been referred to as the second stage of technology development. It is very important, however, that these stages, although treated separately here, not be seen as separate. They are stages in a continuous interrelated system. The separation is often not only made for presentation purposes but in fact the stages are implemented in a uni-directional phased manner. If there is one serious weakness and cause of failure of technology development systems in the developing countries, it results from the operational divide that exists between the two stages. In this section, this inefficient separation of the technology development system into research and extension components is brought to the fore.

Two models of successful research and extension systems are dealt with here, one which could be referred to as a Latin American (Ampuero) model and one working very successfully in Southeast Asia (India, Nepal, Sri Lanka, Burma, Thailand) known as the Training and Visit System developed by Daniel Benor.[8]

Ampuero's model is based on experiences in several Latin American countries and its particular characteristic is the involvement of the farmer in the research and extension process. The spirit behind his model can be summarized in his own words:

> "Planning handed down from above without the required perception of the rural reality leads to many failures and wasted resources and does not alleviate the stagnation of the rural sector."[9]

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[8] *Ampuero, E. "Organization of Agricultural Research for the Benefit of Small Farmers in Latin America, Cornell International Agricultural Mimeograph No. 85, 1981.*

[9] *Benor, D. & Harrison, F.Q. Agricultural Extension - The Training and Visit System, World Bank, 1977.*

Essentially, Ampuero is saying that for a research system to be successful - success here being measured largely by how much improved technologies are adopted by farmers - the farmer system needs to be understood first. He is particularly critical of research systems whose point of focus does not begin and end with the farmer. In order to focus on the right problems and generate beneficial results, the farmer system must first be understood. Contrary to how most research stations operate, Ampuero says that farmers do not maximize yields per crop per hectare; rather, they maximize total plot production, assure subsistence and decrease risk. Thus research needs to focus on traditional areas (improved varieties and increased yields per crop) as well as such areas as crop mix as it relates to most efficient land utilization and spreading of risk. Further, researchers need to be familiar with the attitudes of farmers they are working for - attitudes towards certain chemicals/powders, attitudes towards credit. Ampuero points out that this shortcoming of research institutions presently is reflected by the absence of social science departments in these institutions.

In promoting the involvement of farmers in the research system the Latin American model is particularly concerned about small poor farmers who have been bypassed by the traditional research and extension systems. These traditional systems are limited because when trials are not on experiment stations they focus on best farmers with best conditions and use best facilities. The Latin American model calls on production researchers to live in the production regions and carry out trials among the marginal farmers. It is felt that this should be done not only to benefit the poor small farmer target group but in order to bring about the continuous interaction between farmer and researcher which is necessary to ensure the relevance of the research at all times. Finally, the Latin American model encourages farmer organizations through which the demand for research can be articulated. Farmers can give their opinions on the alternatives developed (i.e. whether they should be commercialized) and provide input in regard to modifications and what should be the next problems researched.

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Throughout the Latin American model the researcher and extensionist work hand in hand. The extensionist is involved in surveys, execution of experiments, analysis of results and in the planning of the next experiments. This is a critical aspect of the Latin American model because it increases the level of confidence and respect between the researcher, extensionist and farmer. This is vital because a lot of the failure of research systems stems from the lack of confidence and professional jealousy that exists between researchers and extensionists.

Whereas the Latin American Research/Extension system stresses the research components, the Benor system stresses the extension components. However, the Benor model recognizes that an extension system not closely intertwined with the research system cannot work and a research system without feedback from farmers soon lacks relevance. In Benor's own words:

> "Without a continuous flow of practical recommendations suited to farmers' needs, the extension service rapidly runs out of anything to extend. Without a close link with extension and feedback from the field, research becomes excessively academic and unrelated to farmers' real problems."[10]

To ensure that the linkages are made, the Benor system calls for a single line of command from the governmental agency responsible for agriculture to the field extension worker. This single line of command is referred to as "... perhaps the most essential management principle to be followed."[11]

This line of command is particularly critical in agricultural development systems where the research and extension linkages are poor. Further, Benor stresses that the research/extension workers have particular skills and are trained to develop technology, extend it and advise farmers. They are not seed sellers, input suppliers, statistics collectors and should not be utilized as such.

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[10] *See Benor, ibid, p.8.*

[11] *See Benor, ibid, p. 10.*

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The Benor system is referred to as the Training and Visit system. The essence of the system is to ensure that the village extension officer is trained - regularly and systematically in what is to be extended and that he visits farmers' fields frequently to pass on his training. The position of subject matter specialist (SMS) is introduced into the framework. The subject matter specialist (SMS) is for Benor's system the critical link between the research, extension and farmer systems. The SMS is based in the field and spends one third of his time training the extension offier, one third in field visits (assisting extension workers with their field work and field trials and attending particular farmer problems) and one third of his time visiting research facilities, conducting research and maintaining contact with the latest research findings. Generally, in each area there will be an agronomist, plant protection specialist and a training officer.[12] The training sessions for the extension staff are an integral part of the system and are expected to be conducted on weekly/fortnightly periods. The schedules of work, duties and responsibilities are clearly specified and closely supervised at all levels. The dates and subjects of training sessions as well as location and dates on which this information is to be passed are publicised. No more than one third of the training sessions is intended to be spent on lectures, the remaining time spent on practical field demonstrations of what is taught and on discussions.

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[12] *The ratio is in the area of 3 SMS to 125 extension workers.*

TECHNOLOGY DEVELOPMENT: GUYANA

The focus on technology development in Guyana in this section is primarily on the Central Agricultural Station. The lessons drawn and organizational changes recommended pertain wholly to that institution and its relations to the remainder of the research environment. In other words, such issues as research council organization and co-ordination of research in Guyana and information flow problems are not treated. The basic tenets on which this section proceeds are as follows:

(1) An effective and relevant agricultural technology development system is a prerequisite to agricultural development in Guyana;

(2) Modernization implies a progressive modification of the institutional framework in which technical innovation takes place. However, these modifications are not independent of broader historical, economic and social forces operating in a particular country; and

(3) Technology development is successful only if improved technologies are adopted by farmers.

The major problems characterizing the research environment of the Central Agricultural Station can be summarized under the following three points:

(1) Technical staff and financial support do not appear consistent with what is expected of the CAS;

(2) Continuity and effectiveness are lacking in the definition of goals, management policies and lines of supervision of the technology development system; and

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(3) Research/extension/farmer linkages need to be established both to increase transfer of technology as well as to increase relevance of research.

In putting together a framework or a model to tackle these weaknesses, the first question to be posed should be: What drives the technology development system? Possible answers include:

(1) self-interest - the involvement of farmers would be significant and with that the urgency for accomplishments will increase;

(2) professional advancement - the scientists themselves can be motivated to make an impact because the rewards include not only significant gains in salary but also gains in status and rewards. This would also increase the rate at which academic research is translated to affect target groups and will increase the quantity and improve the quality of research; and

(3) altruism - the need to generate technology would be recognized but the urgency would be absent. The time pressure and profit orientation that is thought to be needed within a national environment would not be present.

Thus, in terms of the energies behind the institute, a system must be created whereby self-interest and professional advancement are ingredients in driving the research organization. The major concern here is to stop the loss of agricultural technicians to administrative positions because of lack of job satisfaction when working in the technology development area.

Given that the driving forces are in place, what is the best organizational model for the CAS? In outlining this, requirements at three levels will be put forward: the organizational level, the process level and the policy level - no one single model can be recommended, hence the agglomeration of ideas will be called characteristics of the proposed Guyana model.

The critical characteristics of the organizational level are as follows:

(1) Rather than a research and an extension system separate, there should be one system - a technology development system of the Ministry of Agriculture;

(2) The technology development system should be located at two levels - the national level and the regional level. This is different from the present system where researchers are only based at the national level. The regional level should also be given a degree of autonomy;

(3) Farmer involvement in identifying research areas at all levels should be encouraged;

(4) The linkages between the technology development system and the education system should be rationalized so as to share physical and human capital in the areas of teaching, research and extension;

(5) Social science departments and multi-disciplinary approaches to research must be utilized; and

(6) An agricultural communication section tied closely to Mon Repos should be developed. This section would not only process research documents (internal) and circulate them but it would also screen incoming (external) information, select relevant materials and give them wider circulation domestically.

At the process level the critical characteristics are:

(1) Extension personnel must be involved in research (hopefully in in the past and certainly in on-going research):

(2) Research personnel must be involved in training and extension work. There should be few if any appointments that are full-time research. Vice versa with extension;

(3) Research personnel must live in regions and conduct research in regions;

(4) Production activities must be screened carefully for relevance to technology development and once developed should be removed from within the technology development system;

(5) Marketing activities are not part of the technology development system (Sales); and

(6) A system of contracts and commissions and/or incentives for specified applied research should be instituted. This will ensure that analysis is done and jobs are completed.

At the policy level the CAS must:

(i) have a lobby which can convince the political framework that the crops being handled by the TD system are not the insignificant crops (whether seen politically or economically). Success in this area will go a far way in solving the staffing and financial problems;

(ii) point to the interplay of a successful technology development system with the larger economic environment which must be publicised constantly. Among the most important aspects being the need for effective pricing mesaures and for effective input supply systems; and

(iii) call for a more centralized co-ordinating system to enusre that priorities are focused on, to allocated scarce resources (human and financial) and to control dominance of foreign technology.

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The above dimensions are considered critical to strengthening the CAS as a technology development centre. If success is to be gained, perhaps the challenge of B.M. Kappell on applied agricultural research should be the final words:[13]

> "The challenge is not learning to choose, but first choosing to learn. The challenge ... is to match the diversity of the problem with diversity of institutional and intellectual resources."

It must be done with purpose and results.

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13 Kappel, B.M. *Food Policy Options for secondary regions, - A framework for applied research, Food Policy, Vol. 6, No. 1, Feb., 1981*

DISCUSSION ON FORD PRESENTATION

The paper presented proposed a reorganisation of the present technology generation and distribution system so as to increase the independence of the research unit as well as the immediate relevance of the research work done. The key areas of discussion were as follows:

- The degree of autonomy which such a system could enjoy was a major consideration. The main variables affecting this autonomy would be the political goals of the government, as this affects the research areas to be stressed, and the ability of the unit to generate its own financial resources. It was felt that given the low level of effective demand for technology and the critical role of the government in the development process, meaningful autonomy could not be achieved in the short run.

- The need for research both at the national and at the level of the various regions in the country was stressed. At the regional level the activities should be mainly at the farm level and at the national level, field stations.

- The need for improved agricultural communication and research documentation was stressed. It was felt that the Central Agricultural Station needs to take additional steps to see research work through to its publication and utilization stages.

- The schematic proposed for the reorganisation of the Central Agricultural Station was discussed at length and several aspects for improvement were identified. Among these were:
  - The need to increase the prominence of the Social Science/ Economics component;
  - The need to include a communication/dissemination unit; and

- The need to include a policy/planning section is critical in order to minimise conflicts which might arise between political and technical approaches within the framework.

A decision was taken at the end of this session to appoint a committee to study and propose an organisational system for improving technology generation and distribution in Guyana. The members of the committee were as follows:

- Mr. Edward A. Hubbard
- Dr. J.R.Deep Ford (Co-ordinator)
- Mr. Peter Ramsammy
- Mr. Walter Matadial
- Mr. Harry Persaud
- Mr. Courtney Bullen

The report of this committee is included as Appendix 1.

PROJECT PLANNING AND MANAGEMENT IN AGRICULTURAL RESEARCH

by

H.H. Stagno

INTRODUCTION

There are so many differences between planning and management of agricultural research that they could be treated as separate processes; nonetheless, they are but two faces of the same coin. This paper will restrict its scope to the experiences we have shared within a national research system in its initial stages of development, and the problems typical to these early stages such as scarcity of human, physical and financial resources and organizational inadequacies (4).

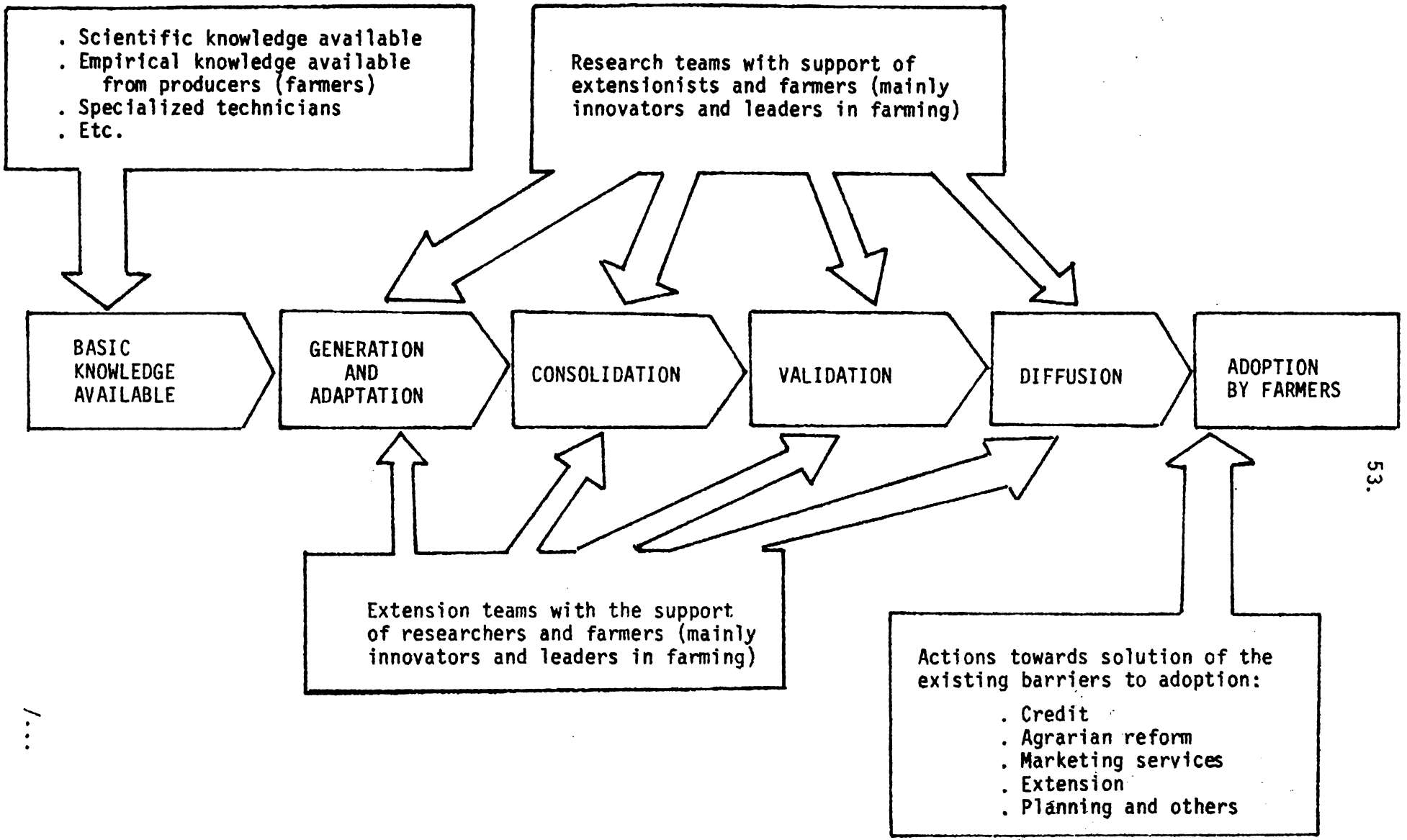
GENERATION, TRANSFER AND ADOPTION OF TECHNOLOGY

Although it is customary to speak of the process of technology generation, transfer and adoption, many people think of this process as if it was composed of isolated stages or phases. In fact, rather than stages, these are aspects of the process whose differentiation is merely heuristic, emanating from the need to assign functions to the Government services between which, by their nature, resources and direct beneficiaries, it is useful to distinguish. In practice, what is aimed at by this differentiation of a continuous process into phases, is the improvement, separately, of decision-making in research, extension and input provision, with the objective of raising the technological level of agriculture and, as a consequence, fostering rural development.

In the schematic representation of the technology generation and transfer process, the starting point is the potential to obtain technological innovation and the terminal point is the adoption by farmers. This process occurs as a continuum. In this process (Fig. 1) the stages of technology generation and adaptation, consolidation, validation and diffusion are distinguished.

From the viewpoint of institutional functions, specialization tends to isolate the organizations devoted to research, extension, etc, emphasizing

FIG. 1 TECHNOLOGY GENERATION AND TRANSFER PROCESS



the differences among these stages, and this is often the main cause of technological transfer failure. On the other hand, if the existing barriers to adoption and the ways technological innovations could overcome them are not analysed beforehand, adoption could not be expected to occur. Sometimes the barriers are not removable within a reasonable margin of available time and resources. If this is the case, it is needless to produce the technological innovation since it will not be adopted anyway. The art of good programming is, therefore, to determine - before it is produced - the technology that will have real possibilities of being adopted. In this way, sterile results can be avoided and resources may be assigned instead to the production of technology that will be effectively utilized.

Very often, agricultural research does not go further than to obtain a new plant variety or the publication of the results produced for the benefit of a given public. For example, it may be mentioned that extension workers sometimes do not understand the papers published by researchers and consequently they find it difficult to incorporate this information into a communication system for the farmers. Our position is that the researcher himself should choose the methods and means appropriate to the beneficiary of the technical innovation, that will facilitate communication and accelerate the transfer. In a few cases, actions are considered to facilitate transfer but the researcher almost never takes the time to formulate concrete plans to overcome the barriers that may hinder permanent adoption. This failure in most cases has its cause in the narrow range of analysis that impedes the recognition of the factors acting on the three aspects mentioned (generation, transfer and adoption) which are equally important. In this paper we shall attempt to illustrate how those factors affecting each one of the aspects in the technological change process have been taken into account.

CURRENT APPROACHES TO RESEARCH PROGRAMMING

At present there is a tendency to differentiate in a somewhat

simplistic fashion, inasmuch as the differencesare not sharp and clearcut, between research programmed by product and research planned by the production system approach.

When agricultural research is programmed bearing in mind the importance of the value of the products as a means to relate the goals of socio-economic development to the establishment of research priorities, the impression is given that an effective contribution is being made to the achievement of the goals of national programmes of product promotion and development, as well as rural development. In underdeveloped market economies, however, research planned with this approach fails to take in account (3) that:

- the structural rigidities and the irrelevance of market prices offset the usefulness of product value to establish priorities. Frequently in these countries other factors must also be considered, such as the ability of the new technology to generate or replace employment, to improve income distribution, or simply new potential agricultural products whose market value is not yet known.

- technology is not neutral, which means that it produces important impacts according to the social group to which it is related, insofar as it not only increases the productivity of one factor (mainly land) but at the same time it affects the productive structure and the distribution of income.

- regional dualities in the economy of these countries determine specific needs for regional development with the support of technology adequate to each region.

- the diversity of types of farming enterprises does not permit in all cases the proper use of the factors required by technological innovation.

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This approach to research programming generally results in the generation of what is usually called technological packages. In theory, these packages, developed either separately or globally, supply the technical innovations for production in such a manner as to make various combinations possible. This would allow one also, in theory, to put together the pieces of the puzzle of the technological package adequate to each zone and each group. In practice, however, the model followed is that of a temperate zone mono-production model involving large farms endowed with an abundance of production factors.

Researchers in developing countries have had to confront the fact of non-adoption of new technology when they realize that their results have not reached the farmers. Faced with this situation, they have begun to think in terms of the production systems approach to orient the generation of technical innovations within a more realistic context.

Although there exists a diversity of criteria in regard to what is meant by the term "production system", it is acknowledged that it represents a forward step over the previous tendency to use product or thematic programming. With the systems approach the researcher begins, usually, by studying the barriers of adoption, then the possibilities of transfer and finally he determines the basic knowledge available and the knowledge missing, so as to base the research programme on these premises. Yet the model sometimes presents complications for the development of new technology, because it requires so many new studies that one or another resource is nearly always lacking. Because of the complexity and diversity of agricultural research, the matrix organization in the structure of a research team is not appropriate simply due to the lack of resources. This can limit the possibilities of the systems approach in programming choice.

The study of systems, in effect, has its strength in the action of interdisciplinary teams; yet each micro-region, each typical enterprise, and the market perspectives and service structure in each country, combine to

present areas for which the interdisciplinary teams are unprepared. For this reason implementing this approach for the introduction of new technology is so costly that only few countries can utilize it on a large scale. In the experience to be reported here it will be shown how programming by product will be gradually changed, within certain limits, towards the production system approach, while striving to maintain a reasonable equilibrium between the country's needs, the possibilities to obtain saleable products and the availability of resources.

THE PROGRAMMING MODEL IN THE PRESENT CASE

The situation faced in the present case required adapting the system of decision-making on research programming and also introducing changes in the organizational structure, if institutional effectiveness and efficiency were to be raised. The problem then consisted in passing from a programming system almost entirely product-focused to one centred on production systems. Nevertheless, during the transition period, both approaches would overlap temporarily for two main reasons:

- the need to avoid interrupting the already ongoing development of technological packages and, at the same time, the wish to integrate them into production structures specifically defined in terms of type of farmers; and

- the need to experiment to find out whether the changes of focus would really give good results.

It was assumed that the progressive transition between the approaches would result in a better equilibrium between the research activities and the use of resources. Insofar as the experiment is still in progress, it is not possible to assert that the change will prove to be beneficial, although this is expected.

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The instruments employed are:

- the National Plan;
- the Programmes;
- the Projects; and
- the Activities of Research (Fig. 2)

in the order that they are listed.

In order to facilitate the allocation of resources, programmes were classified in two types:

- technical programmes; and
- complementary programmes.

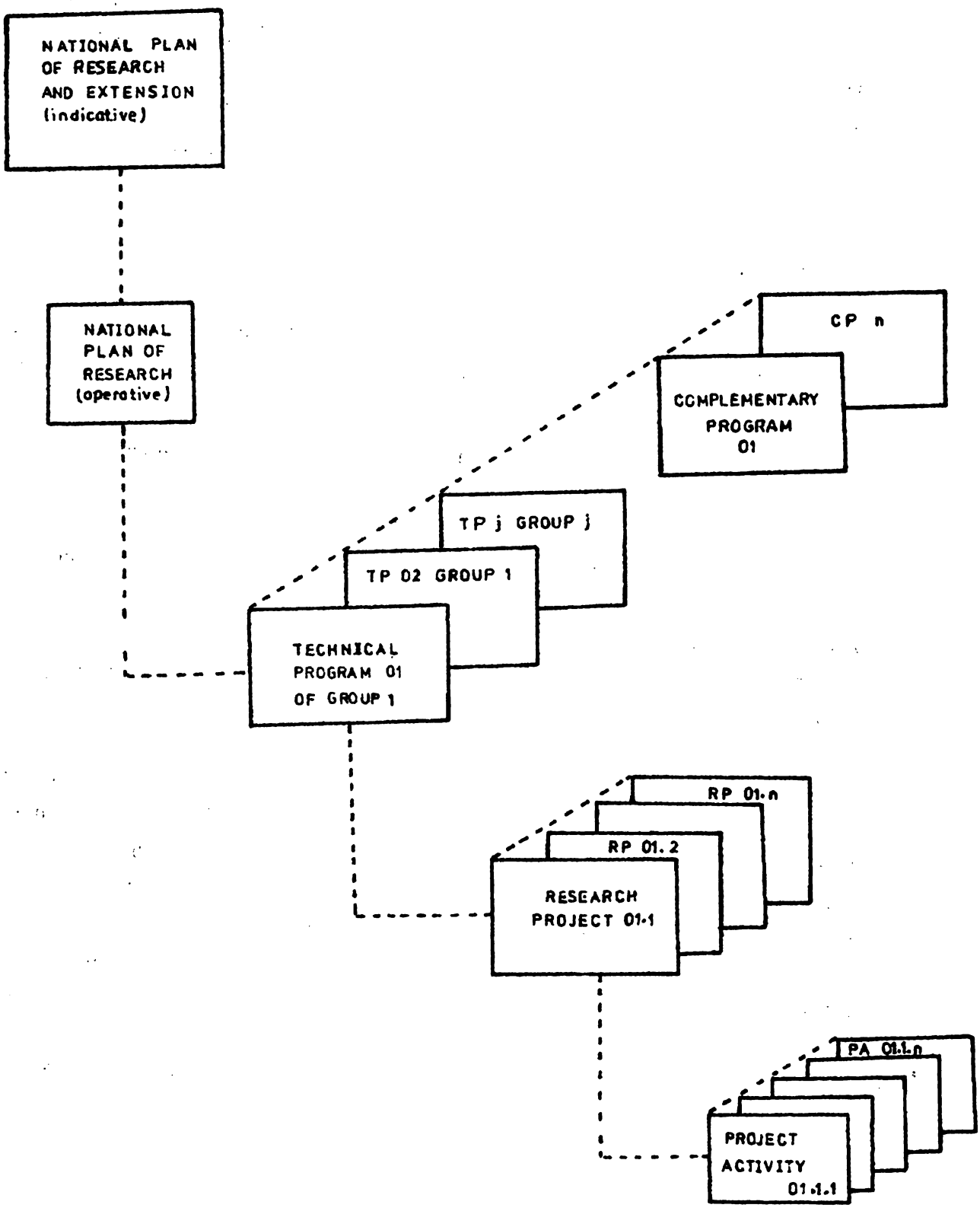
The technical programmes include 5 groups:

- basic crops;
- animal production;
- intermediate technology transfer;
- production systems; and
- resources for the future.

Intermediate Technology Transfer is defined as the transfer of technology from research to the extension service. Owing to the fact that innovations do not easily leave the research unit, the transfer programme is designed to operate through trial farms and demonstration farms. Researchers, extension workers, agricultural economists and farmers with certain characteristics (innovative farmers employed as "linkages" by the current extension system) all participate.

The complementary programmes are aimed at the expansion and conservation of the physical inventory and human resources. They are concerned with the resources that, to a certain extent, are not totally programmable because they consist of largely fixed expenditures supporting the functioning of the whole research structure.

FIGURE 2: INSTRUMENTS OF THE ILLUSTRATED RESEARCH PLANNING SYSTEM



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The above-mentioned set of programmes helps to distinguish the efforts being made to change the research approach and, at the same time, serves the purpose of facilitating the analysis of the allocation of resources to those activities that should be strengthened in accordance with the demand of technological information and available resources. The established mechanism is of course more complex than the description presented here, but for the goals of this paper it is less important to enter into details than to describe the general pattern of programming.

The Information Required for Programming

Besides the existing information on technology, for the puspose of programming, two significant groups of information material have been considered:

- the situation of agriculture and the rural sector; and
- the country level situation of each product.

For the Intermediate Technology Transfer Programme, Production Systems Analysis Programme and Resources for the Future Programme, each project requires a diagnosis because of the micro-environment in which each of them will operate. The sectorial diagnosis is useful to identify groups of projects that can be included in these three programme types.

In order to provide coherence in the formulation of the (indicative) National Plan of Research and Extension , PLANIE (7), a procedure was developed that would ensure that the plan would serve as a basis for the elaboration of the National Research Plan, PLANIA (6), specifically directed to the orientation of research and intermediate transfer activities. Its purpose is especially operational, covering a three-year period. The different research programmes are adjusted according to their directives.

The information supplied by the planning instruments cover two

large areas, separately identifiable:

- general information which orients the basic lines of research; and
- product-specific information which orients the programming activity.

General Information in the National Plan

The following basic information is contained in the various chapters of the National Plan, for the elaboration of the component programmes:

1. Introductory Information:
   - Explanation of the plan's content;
   - Methodology used in its elaboration;
   - Objectives - principal and secondary;
   - Socio-economic and political justification; and
   - Relation of the plan with the government strategy for the development of the agricultural sector.
2. Synopsis of the Country's Agriculture:
   - Description of the main problems;
   - Characteristics of the resources devoted to agriculture:
     - soils and ecosystems;
     - enterprises and producers;
     - production;
     - technical inputs: machinery, agro-chemicals, irrigation and others;
     - agriculture as an employment generator: supply and demand of farm labour;

- Role of agriculture in the satisfaction of national needs:
  - satisfaction of the internal demand for goods;
  - import substitution - present and potential;
  - generation of exportable surplus; and
  - agriculture as income multiplier; and
- Institutions concerned with agriculture and their operational capacity.

3. Diagnosis of the Present Situation of Research and Extension:
   - Resources:
     - human and material; and
     - physical and financial (including national and external resources).

4. Beneficiaries of the Plan:
   - Determination and quantification of beneficiaries; and
   - Justification of the exclusion of certain sectors and strategies to include them in the future.

5. Priorities by Products and by Subjects plus Bases for Programme Elaboration:
   - Synthesis of problems;
   - Objectives of the programme; and
   - Profiles of programmes and of their projects.

6. Recommendations for Necessary Institutional Adjustments for Plan Implementation:

   The function of the national plan is to orient the long-range actions, subject to periodic updating to ensure effectiveness.

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The Elaboration of Programmes by Product

This paper will not detail the information required to formulate programmes by subject (e.g. soil management and conservation, bioclimatology) but only for programmes by product, inasmuch as these are the ones that present the greatest difficulties in the determination of approach, when making the choice of research priorities. The formulation of programmes by product can be done in two stages: the first one consists of gathering information on the principal problems (present and potential) and the second relates to the decision as to the problems to be attacked.

First stage:

As a basis for the formulation of programmes by products, problems were considered from several viewpoints, taking into account the institutional possibilities to solve them. It is important to clearly define the institutional responsibility for research and for extension in the process of technological change that is oriented to socio-economic development in the rural environment. This information is contained in the "basic document" of the programme and includes the following aspects:

1. Problems Related to Production

   - Areas of present and potential production (known);
   - Comparative advantages among the production areas;
   - Varieties used and recommended;
   - Seed availability;
   - Crop mechanization;
   - Utilization of labour;
   - Utilization of irrigation;
   - Utilization of fertilizers; and
   - Pest and disease control.

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2. Problems Related to the Production System

- Dispersion of the cultivated areas (homogeneous zones); and
- Types of enterprises.

3. Marketing Problems

- The marketing system at the farmers' level:
  - Production and organization scale;
  - Producers' dependency;
  - Product marketing norms;
  - Product losses at the farm level;
  - Losses due to the centralization of the marketing system; and
  - Consequences of the lack of state participation;
- The marketing system at the intermediate level:
  - Degree of concentration of the economic activity; and
  - Problems of the marketing infrastructure.

4. Socio-Economic Importance of the Product

- Aggregate value;
- Contribution to the balance of payment (export-, import-substitution);
- Direct and indirect generation of employment;
- Quantity of production units; and
- Input demand.

Second stage:

With regard to the decision on what research to undertake, an analysis is made of the problems on the basis of the information contained in the basic document, with consideration given to two principal aspects:

- whether the problem is related to productivity, to production or to the farmers' income; and
- what institution has the responsibility and realistic possibility to solve the problem.

The first analysis helps to recognize the factors causing the problem as well as the means available to solve it; it allows a comparisor of the alternative solutions from various angles (national, regional, type of enterprises, etc.) and finally, it permits the identification of those aspects in which research will produce effective results. This analysis facilitates the evaluation and decision as to which institution has the greatest possibilities to solve the problem. In this way it will be possible to identify problems that can be solved by research, extension, input provision, research extension with other agencies such as credit, agrarian reform, etc., and by organizations not related to research and extension. This will make it possible to decide whether the "barriers" to the adoption of technical innovation can be effectively overcome and, even more importantly, whom will the new technology benefit.

The next step of programme formulation consists of the establishment of principal profiles for the projects. Project elaboration has a more technical context, adjusted to the socio-political framework supplied by the programme. For example, if the country needs to increase exports of one product, there are many ways of doing that. Assuming that the decision is to increase production, it may be analyzed if expansion would be horizontal (increasing production areas), vertical (increasing yields) or both, and from there, appropriate projects can be formulated. Evaluation and decisions as to the technological segment now rest on the interdisciplinary teams who will compare the possible innovations and adopt the decision that would have the greatest probability of success in the shortest period, given the available resources.

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THE MANAGEMENT OF RESEARCH PROJECTS

Within the context of the planning instruments, research is actually managed or administered through the project. The project constitutes the programming and administration unit of research as a function, inasmuch as the project leader is the main decision component, responsible both for its execution and for its technical soundness.

Once the project has been approved as part of the programme, its hierarchical linkage with the latter is secondary and the relationship between the programme co-ordinator and the project leader is more one of collaboration than of authority. However, for the activities that comprise the project, the relationship is somewhat different. The project leader must have authority to influence the activity leader in those cases where the activity being executed does not comply with what has been programmed as well as in the technical aspects. This difference in top-down or down-top treatment stems from the fact that generally, the person in charge of a project is a good specialist in the principal field of the project. Therefore, he masters the project subject technically better than the programme co-ordinator and probably has more experience than his colleague in the position of activity leader.

For these reasons the formulation phase is very important and in that stage the project must be thoroughly debated and analyzed so as to obtain sufficient legitimation for the validity and effectiveness of the project. Naturally, the objectives of the project must agree with the objectives of the programme and the objectives of the activities must agree with the objectives of the project.

When saying that the programming unit is the project, it is understood that it carries the responsibility for the execution of the allocated budget. The sum of the projects' budgets is the budget of the programme. The normative decisions of the programme as far as objectives, resources, etc. are concerned, constitute the framework against which the

recommendable projects are to be chosen. The selection of projects is done in group meetings by the programme technicians. This manner of programming is one of the more practical means to avoid biases in the thematic content of the project towards certain fields or specializations.

In the phase of project execution and depending upon its complexity, several control techniques can be applied (among them, C.P.M. and related methods); all of these are based on a good description of activities and the sequence in which they will take place. This operational ordering favours good performance in project operation and ensures the timely knowledge of future problems during execution. Progress reports are part of the execution itself and serve not only to advance the dissemination of valid information but also to take operational decisions unforeseen at the programming stage.

Evaluation is one of the most important aspects in the management of research projects. Evaluation is carried out in the first place in terms of achievement of the project objectives and, in the second place, in terms of its technical, methodological and executive aspects. From these analyses emerge the modifications of the project; however, if modifications are very drastic, a new project must be formulated and developed.

The responsibility of operational units (experimental stations) in the execution of projects is very clear, since they must make available to the executors the basic resources and structure for the normal development of the research. The fixed expenditures which originate in the provision of this "service" to the projects are as important a determinant of success as the variable expenditures (project's own costs). On the adequate balance of both will depend the output of the research organization.

TOWARDS AGRICULTURAL RESEARCH FOR DEVELOPMENT

In developing countries there exists a tendency to interpret the

problem of rural poverty as a problem peculiar to agriculture.

Whether this judgement is valid or not is of little consequence in view of the fact that rural poverty does exist and is associated with a broad complex of problems. Precisely because it concerns a complex of problems the solution is not simple. From the point of view of agricultural research, the professional obligation of researchers is to analyze in what manner technology may be transformed into an effective instrument for changing this state of affairs.

The study of production systems is a promising way in which to move with greater confidence towards the objective of rural development, but the scope should be widened somewhat by including two areas which are not usually taken into account by those who use this approach. These two areas are:

- research in agricultural market planning for the development of regional production resources; and
- institutional analysis of organizations operating in the region.

The first permits the evaluation of the potential for agricultural development based upon marketing development. Generally, the recommended strategy is to initiate the change process by the improvement of the "principal" product from the point of view of the efficiency of the existing regional market. This is followed by the diversification of the production by incorporation of "secondary" products, which are also determined from the point of view of market development potential (1). In the latter case, other aspects related to rural development are also taken into account, such as improvement of food supply in the region, balancing of rural labour supply and demand, adequate management of natural resources through community action, and so forth. In other words, the regional problems should be studied as if the region were in itself a <u>transformer</u> of a macro-system of production. Within this macro-system, typical farms are studied as principal

transforming elements from the point of view of agriculturists. It follows, then, that this is the point of primary interest of the agricultural researcher, leaving to other services those actions which fall outside the area of the farm production and resource use.

Institutional analysis of organizations operating in the region, which includes both public and private, has the purpose of evaluating their capabilities to overcome the barriers which block transfer of technology. Institutional analysis includes the components of leadership, doctrine, resources, programmes, internal structure, connections and internal products (2). This permits the selection of those organizations with which the research and development programme can operate successfully.

The above-mentioned areas of analysis should be incorporated in the study of production systems, giving special attention to a priori analysis of the existing barriers that impede technology adoption and of those means which are available to remove these barriers within the particular region. From that base agricultural research will provide the technological elements for improving production systems.

It is important to point out that even though the farm is the place where decisions are made on the use of resources, rural development will be achieved only when the region is taken into account as a unit (macro-transformer). Thus, to achieve rural development, a group of technologies (marketing, communications, etc.) should be introduced by the institutions which operate together within the region, based upon the possibilities developed by the agriculturists.

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DISCUSSION ON STAGNO PRESENTATION

The discussion focused on three critical areas which influence the effectiveness with which the Research Station would be managed. These were as follows:

- the methodological approach to management;
- the incentives within the research/extension environment; and
- strategy to ensure continuity of research work over time.

Two methodological approaches to management were discussed:-

- The project approach; and
- The programming approach.

The project approach tends to focus on particular problems or commodities in the research environment and hence commits the time of professionals to specific and often narrow areas of focus.

The programming approach is characterized by a broader focus and therefore allows a greater flexibility professionals. It was thought that given the present situation of scarce resources, this latter approach would be more beneficial because it would lead to greater levels of creativity and more efficient utilization of staff.

The need for incentive schemes whereby professionals gain recognition for outstanding performance was stressed. The absence of job satisfaction and hence lack of motivation was considered a serious constraint to production and productivity in research.

Associated with the last point is a high turnover of staff which often results in incomplete research work. As a consequence of this high staff turnover, assistance from personnel familiar with what went on before may be unavailable. It was felt that this needed continuity could be achieved through a stimulating and rewarding work environment which is likely to increase staff stability. However, the national constraints have to be borne in mind when assessing what is possible in terms of conditions of service for research staff.

APPENDICES

APPENDIX I

REPORT OF THE

AGRICULTURAL RESEARCH WORKSHOP COMMITTEE

ON

IMPROVING THE AGRICULTURAL RESEARCH SYSTEM IN GUYANA

One outcome of the "Workshop on Agricultural Research and Development in Guyana", sponsored by the Ministry of Agriculture and the Inter-American Institute for Cooperation on Agriculture (IICA), and held at the BIDCO Management Training Centre on December 3 and 4, 1981, was the formation of an Agricultural Research Workshop Committee to study the existing system and to make recommendations aimed at increasing its efficiency and effectiveness.

The Committee comprised the following persons, all of whom are Guyanese nationals, many of whom have had tremendous experience in the existing system:

Dr. J.R.D. Ford (Co-ordinator) - Farm Management Specialist, IICA

Mr. C. Bullen	-	Agricultural Officer (Soil Science), Ministry of Agriculture
Dr. A.V. Downer	-	Research Director, Institute of Applied Science and Technology
Mr. E. Hubbard	-	Chief Agricultural Officer, Ministry of Agriculture
Mr. W. Matadial	-	Principal Agricultural Officer (Extension), Ministry of Agriculture
Dr. G. Muller	-	Manager (Other Crops), Guyana Sugar Corporation
Mr. H. Persaud	-	Principal Agricultural Officer (Crop Science), Ministry of Agriculture

This report contains the recommendations of this Committee with inputs from Dr. R.E. Pierre, Director of the IICA Office in Guyana.

REP.
1982-01-22

INTRODUCTION

The need for agricultural development in Guyana and the importance of technology development systems as contributors to this development has been clearly recognized and accepted by the cross-section of professionals working in the directly related areas. Beyond this general recognition and acceptance there is need for agreement regarding the structure and components of a technology development system and how they should relate to each other. In other words, how should the research stage (generation of technology) relate to the diffusion and application stages (adoption or transfer of technology), and what is the best institutional arrangement for utilizing available resources in these areas effectively. These questions are critical because they affect both the rate (quantity) and relevance (quality) of products realized from the agricultural technology system and therefore determine pace, direction and effectiveness of the development of the agricultural sector. Agriculture is the major activity in rural Guyana which forms the larger part of the regional system. Thus, the development of agriculture in a dynamic and scientific way will do much for the development of rural and regional systems.

The existing system for the generation, development and diffusion of agricultural technology has, for some time now, been considered to be short of what is desired and necessary for the development of Guyana's agricultural sector. Generally, this is a result of a number of shortcomings of the system among which are the following:

i) An inability to retain research workers in a professional context;

ii) A very fragmented framework - several distinct and separate departments leading to problems in planning, policy-making and co-ordination, wastage of resources and narrowness of focus;

iii) A lack of emphasis on involvement of farmers which adversely affects the relevance of research work and the adoption of technology generated.

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iv) Inefficient and ineffective utilization of technical staff and financial resources in pursuit of the goals set for or by the system.

Recognition of these shortcomings is not recent; agricultural research seminars held in 1974 and 1977 pointed to these shortcomings and suggested changes for improvement which are here endorsed. The conclusions and recommendations of these seminars, given in Appendices I and II support the arguments advanced in this paper. It is felt, however, that the most recent workshop (December, 1981) on the subject placed the matter in focus and benefitted from time in three respects. Firstly, time has reinforced the feeling of the agricultural professionals that changes within the present structure as opposed to changes of the structure would be to no avail, hence both the structure and components of the system need attention. Secondly, an important feature of the present time is the regional system of administration now in force and this would be of critical significance to the emergence of a successful technology development and diffusion system. Research and extension would need to be spread throughout Guyana and to involve those who are actually engaged in the agricultural production aspects, i.e. the farmers. Thirdly, it is felt that the recent appointment of an agriculturalist to the post of Permanent Secretary to the Minister of Agriculture is of great positive significance and is indicative of the political appreciation of the gravity and urgency of the need for a new approach to agricultural development efforts at this time.

Discussion at the recent workshop led to the appointment of a "Research Workshop Committee" which was charged with the responsibility of examining the existing technology development and diffusion system and making recommendations for improvement thereof.

This presentation, accordingly, attempts to:

- evaluate the impact of the existing system;
- suggest modifications to make the system effective;

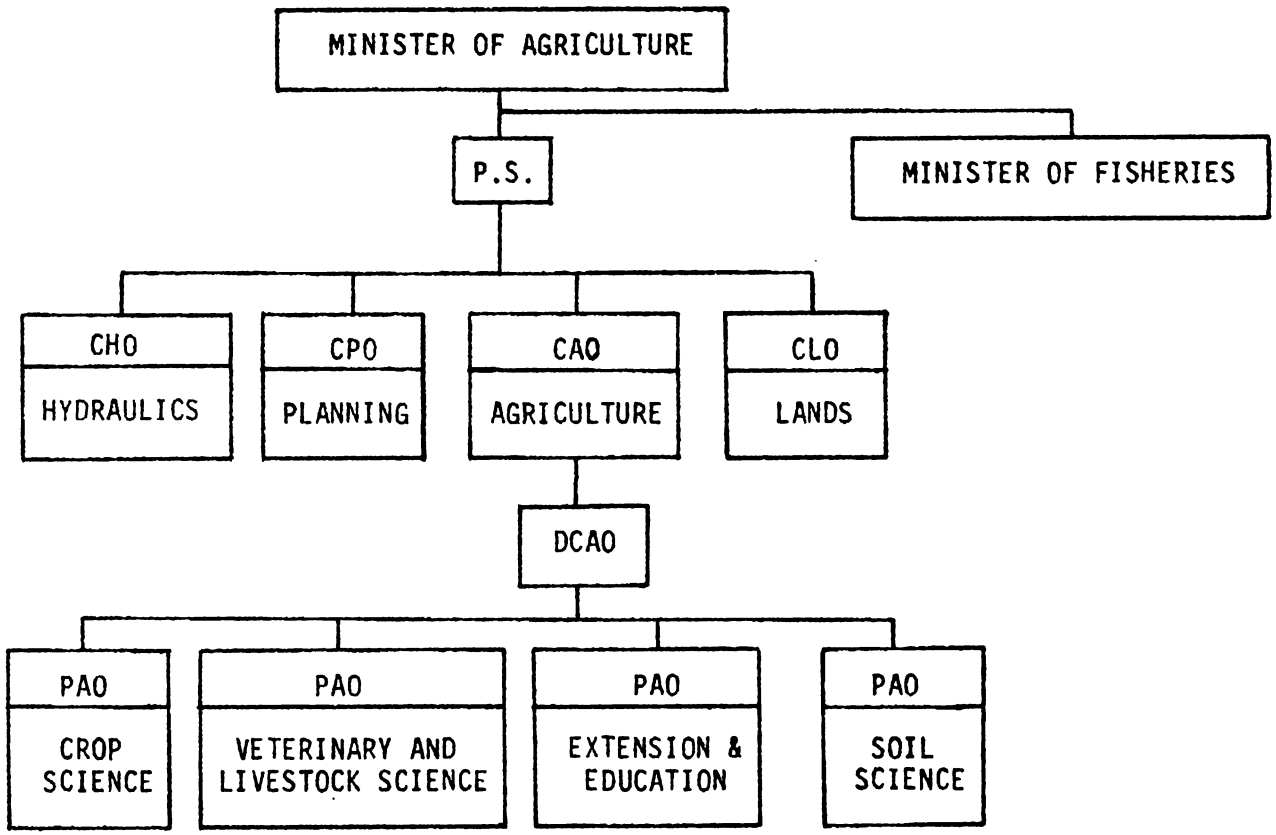
- discuss the anticipated impact of such modifications; and
- give some consideration to the transition from the existing to the modified system.

EXISTING SYSTEM

The existing technology development and diffusion system comprises the research and extension services of the Ministry of Agriculture with the Central Agricultural Station (C.A.S.) being conventionally regarded as the research entity. In fact, four separate units, headed by principal agricultural officers (P.A.O.) within the Ministry of Agriculture, are geared towards the performance of Research, Extension and other service functions. These units, as shown in Figure 1, are Crop Science, Veterinary and Livestock Science, Soil Science and Extension and Education. The Extension and Veterinary and Livestock Divisions have representatives distributed over the country. The Crop Science and Soil Science Divisions are essentially located at C.A.S. There is also a small Livestock unit at C.A.S.

For reasons of history, C.A.S. is associated with the Research function while the Extension Division bears responsibility for a variety of functions including collection of production data, sale and/or distribution of inputs, forecasting of productivity levels, provision of technical information to farmers, etc. Until relatively recently, the Extension Division bore responsibility in both the areas of Crop and Livestock production, a direct consequence of the era in which the Ministry of Agriculture consisted of three components - Research, Extension and Veterinary Science - each under an Assistant Director of Agriculture. It was during this era, the 1950's, that C.A.S. was conceptualized and developed. At that time, C.A.S. was considered to be optimal in location if only because it straddled three of the four types of soil then known to occur in the country and all the coastal soils. But it is now known that C.A.S. merely covers three of some sixty (60) soil types in the coastal area.

FIGURE 1: PRESENT GOVERNMENTAL SYSTEM SHOWING THE FOUR RESEARCH AND EXTENSION COMPONENTS



As C.A.S. developed, it provided facilities for laboratory analyses and field trials. It also accommodated the offices of the Extension arm of the East Demerara Extension district. But with the passage of time, the relevance and reliability of field trials have both suffered partly because of the location of C.A.S. and partly because of the research philosophy by which the station was directed.

In the course of its evolution, C.A.S. nurtured the Guyana School of Agriculture (G.S.A.) which has now grown up into an autonomous corporation with its own infrastructural works and farming operations. The duration and extent of involvement of C.A.S. in the national Agricultural Education effort has been not only unstructured but also very short-lived. It should be mentioned, however, that several members of the C.A.S. staff still serve as teachers at G.S.A.

In terms of the research function, C.A.S. has had, for the greater part of its existence, two sections, i.e. Crop Science and Veterinary and Livestock Science. In the relatively recent past, the latter was relinquished and the Crop Science Division was split into the Crop Science and Soil Science Divisions. The changes or developments over the last 25 years have succeeded in satisfying neither the government which provides funding nor the farmers who are the potential users of the technology generated.

The reason for this state of affairs is considered to be largely organizational in nature. Research activities are far removed from the farmer with the Extension service serving, in theory, to bridge the gap between Research and Production. But this has not been effective. Further, the introduction of the regional administration system encourages a prognosis that the efficacy of the system will degenerate even more because of the fact that agricultural field workers (extensionists) have become twice separated from the technology generating centre. It is noteworthy that during the 1974 seminar, the Permanent Secretary (Regional Development) was at pains to describe certain proposals for regional agricultural organization. He

indicated that this would hinge on farmer associations which would be commodity based and whose representatives would speak on behalf of the respective memberships at regional meetings. He strongly supported the need for a strong Farmer-Extension-Research linkage. This serves to reinforce the need for attention and change in this important area of support to agricultural development.

PROPOSED SYSTEM

Agricultural research and extension systems have been evolving rapidly throughout the world and the success stories in the developing world, such as EMBRAPA in Brazil, ICTA in Guatemala and Benor's system in Asia, are now fairly common knowledge among agriculturalists. The basic reason for the success of these systems seems to be that Research and Extension are considered in the context of Development and Diffusion of relevant and appropriate technology. Diffusion being recognized here as a process rather than an event. Like change, per se, the rate of the process of diffusion can be influenced by the quality of management devoted to it. Figure 2 illustrates the essential and tangible difference between the traditional (Research-Extension) system and the new concept of Technology Development and Diffusion which shows a reciprocal information flow between Researcher, Extensionist and Farmer.

One Unit:

The proposed system advocates the creation of one unit - a semi-autonomous Agricultural Research and Development Institute. The system presented here adopts aspects of successful efforts elsewhere where it is felt that they are relevant to Guyana and are applicable in the national situation. Figure 3 gives an overall view of how the proposed Institute is envisaged to fit into the Ministerial System

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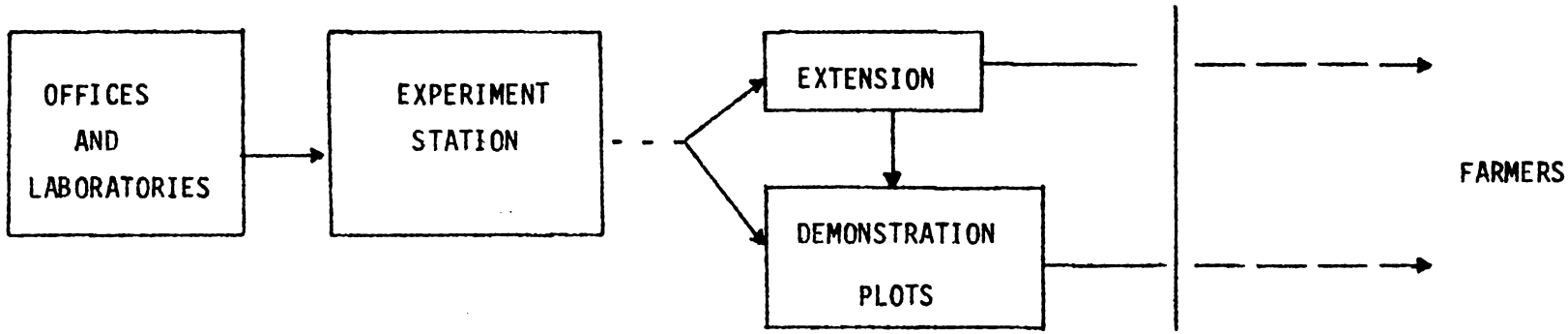
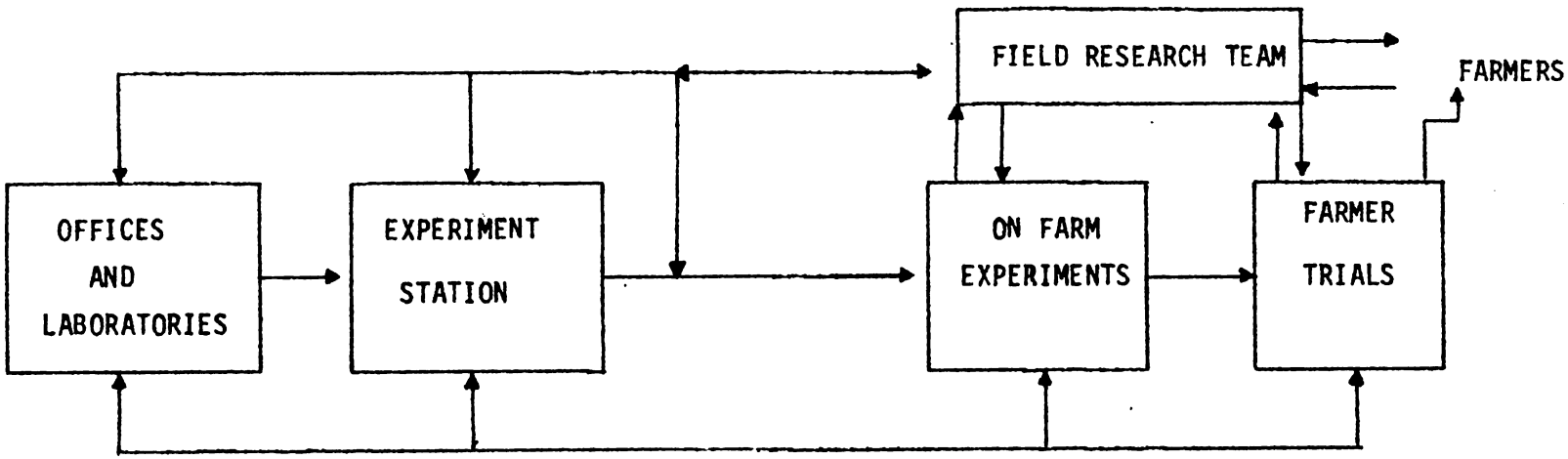
FIGURE 2: TRADITIONAL AND MODERN CONCEPTS OF AGRICULTURAL TECHNOLOGY DEVELOPMENT AND DIFFUSION

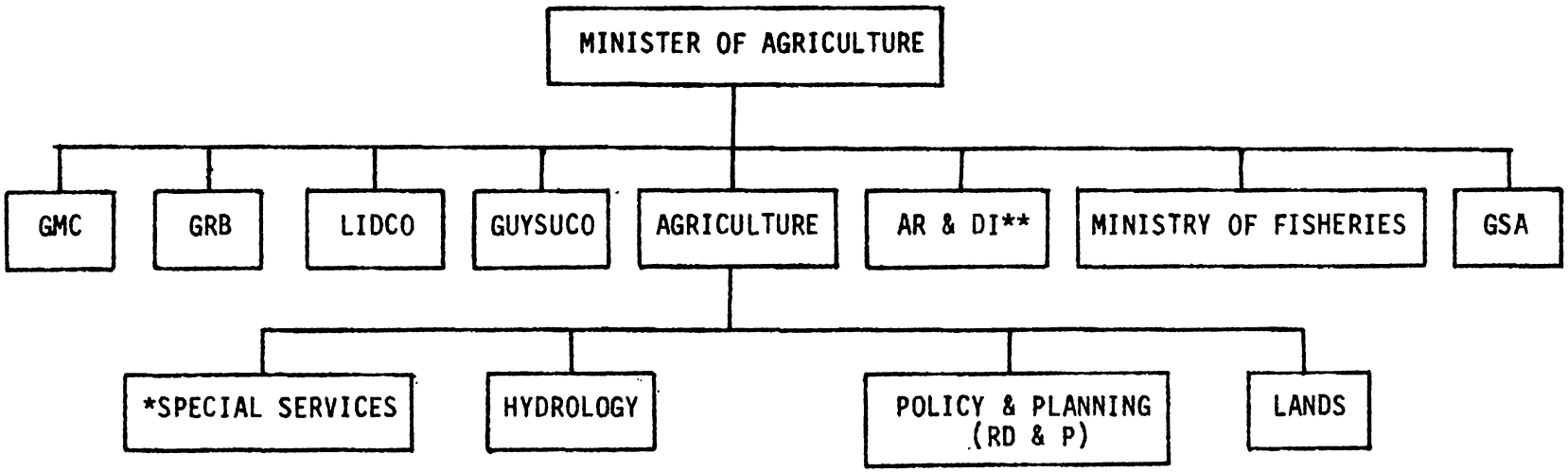


TRADITIONAL AGRICULTURAL RESEARCH AND DEVELOPMENT MODEL



MODERN AGRICULTURAL RESEARCH AND DEVELOPMENT MODEL

FIGURE 3: EXISTING MINISTRY RELATIONSHIPS WITH SEMI-AUTONOMOUS AGENCIES AND PROPOSED INSTITUTE



* - PLANT AND ANIMAL QUARANTINE
- PRESERVATION OF WILDLIFE
- PROCUREMENT OF INPUTS (SEEDS)
- LEGISLATION
- AGRO-METEOROLOGY

** - PROPOSED INSTITUTE

The composite, shown in Figure 4, is developed on the basic tenets that:

- an effective and relevant agricultural technology development system is a prerequisite to agricultural development in Guyana;
- technology development is successful only if improved technologies are adopted by farmers. This implies effective diffusion;
- modernization implies a progressive modification of the institutional framework in which technical innovation takes place. It is noted, however, that these modifications are not independent of the broader historical, economic, social and political forces operating in the country.

The proposed system is intended to tackle the shortcomings of the present system and thereby put in place a dynamic and effective technology development and diffusion system which will lead to:

i) identification, analysis and solution of critical problems faced by Guyanese farmers;

ii) generation and diffusion of improved soil, crop, livestock and farm management systems; and

iii) increasing the knowledge and skills of agriculturalists and personnel involved in agricultural production.

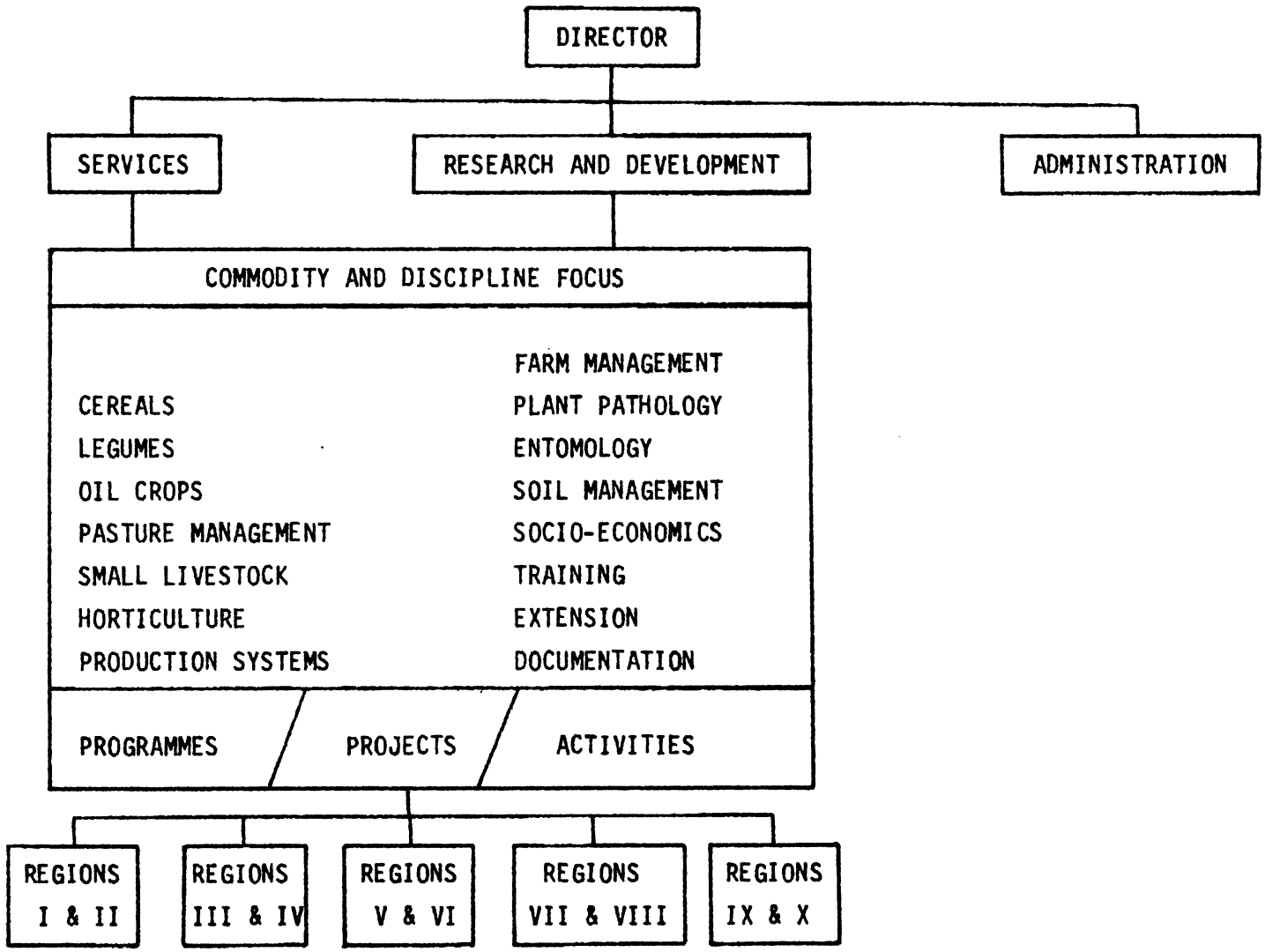
Functions:

The functions of the Institute would be two-fold:

- Technology Development (Research)
- Technology Diffusion (Extension and Education)

In discharging the function of Technology Development, a greater appreciation of the qualities and characteristics of specific resources as affected by location (region) or composition as relevant will be essential.

FIGURE 4: ORGANOGRAM OF PROPOSED AGRICULTURAL RESEARCH & DEVELOPMENT INSTITUTE



Therefore, activities will be organized on a regional basis. The agricultural profile of the region as determined by its ecological conditions will determine the commodities to be emphasized, e.g. field crops, vegetables, pastures, fruits, etc. The stage of development of the existing technology for production in the region will determine the scope of the work programme and the disciplines to be emphasized, e.g. socio-economic, socio-cultural, managerial, agronomic, etc. Whatever technologies are generated will be validated on farms within the region as a first step in the process of Technology Diffusion.

The function of Technology Diffusion is the more complex but the more urgent. It encompasses both formal and informal education and the clientele will include farmers, extension officers and research personnel. Because of the location-specificity of agricultural technology, it would focus, of necessity in the early stages, on the synthesis of available data into forms useful in the various levels of agricultural education and training. Such synthesis would be the primary means of programming activities for the discharge of the Technology Development Function.

The discharge of the formal education component of the Diffusion process would rely on very close relationships with the Guyana School of Agriculture and the University of Guyana. The subject matter specialists of the Institute should conduct classes in both institutions according to the nature of their appointments and expertise. Further, research activities of the Institute would provide a means of on-the-job training, whether such training is through temporary attachments to the Institute from commodity-producing agencies, or through thesis research by individuals working towards a higher degree.

The inter-relationships obtaining between the two functions as well as the scarcity of suitably prepared and experienced individuals dictate that some staff members of the Institute should be given dual functions, i.e. the job activity of a given post would consist of both research and training components in appropriate proportions.

Professionals employed in this Institute would be hired on the basis

of discipline (social scientist, plant pathologist, agronomist, entomologist, soil scientist, etc,) but job activities would be as dictated by the need of multi-disciplinary teams for project implementation. The multi-disciplinary approach is intended to remove the linkage constraints which are currently experienced between the various specialists who are presently located in isolated units based on discipline. It is believed that the inclusion of a social science [(1)] component in the Institute should go a long way towards increasing the level of awareness and appreciation of the problems associated with adoption of technology by farmers and assist in the formulation of constructive strategies towards the goal of rural development.

The primary responsibilities of a scientist in the Institute would be to further the growth of the body of knowledge in Guyana within his discipline and to maximize the application of such knowledge to the production process. As earlier indicated, the vehicle by which this responsibility would be discharged would be the "multi-disciplinary Research Team". The teams would include all disciplines required for both the identification and satisfactory solution of specific problems in well defined projects.

This approach is intended to accelerate the growth of a body of adequately prepared scientists and technologists in a relatively short period, provide intellectual stimulus and job satisfaction to the staff, and provide an easy mechanism for evaluation.

The process of problem solving will rely heavily on the farmer. In the process, farmers' fields will be utilized as demonstration and verification plots and the farmer himself, directly or through his commodity organization or co-operative, will be an agent of diffusion of the technology generated.

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(1) It should be noted that economists and other social scientists in the Institute will not duplicate the work of professionals now employed in the Resource Development and Planning Unit as the latter's main focus would continue to be the analysis of data and observation of trends for policy making (largely macro-economics) while the work of the former would be mainly production economics and farm management (largely micro-economics).

Presently, the farmer is left out of the technology development system. His main contact with the agricultural administration is through the field extension officer, but the linkages between the field extension officer and the research system are virtually non-existent. Further, the present system does not have a teaching, farmer field trial network that is regionally oriented.

The proposed system seeks to incorporate the farmer and his views at several levels. It is suggested that an Agricultural Development Committee be established in each Region consisting of a number of farmers' representatives of the Region including the Agricultural Extension Officer and the Institute's local Agricultural Development Officer to identify production constraints which require research inputs and to suggest priorities for action. Figure 5 gives an indication of what is envisaged.

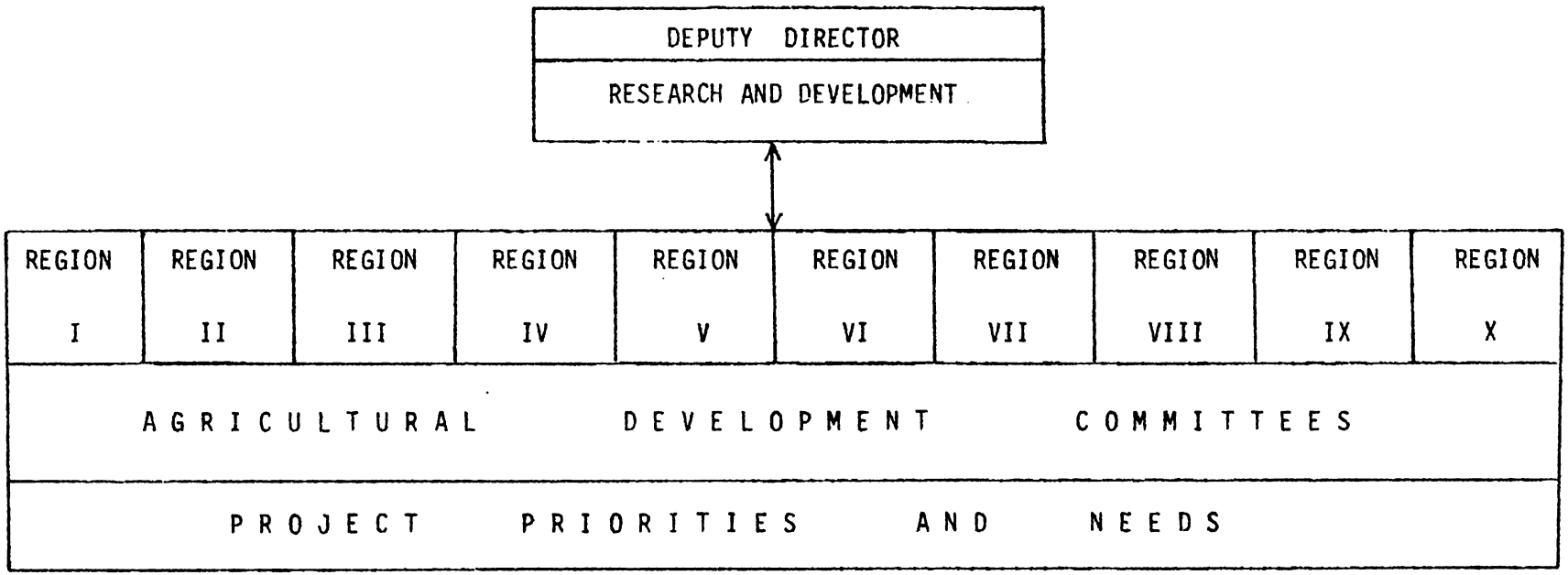
The Institute also should interface with other national science and technology entities, e.g. University of Guyana, Institute of Applied Science and Technology, National Science Research Council, and with the international agencies and Research Institutes (CIAT, IITA, AVRDC, IRRI, etc.) involved in agricultural research and development.

Management:

The four units currently comprising the technology development system are within the public service, forming part of the Ministry of Agriculture, but in this proposal the Institute would be under the Minister of Agriculture within the Ministerial system, but outside of the public service system. This would give the Institute a somewhat similar status to semi-autonomous entities such as the GSA (a corporation), LIDCO (a company), etc. and a degree of management flexibility which is essential.

The Minister of Agriculture has ultimate responsibility for the affairs of the Institute. The Minister would appoint the Board of Directors, the Chairman and the Deputy Chairman of the Board. The Board would be directly

FIGURE 5: COMMUNICATION LINKAGES BETWEEN REGIONS AND INSTITUTE



responsible for the formulation of policy and the general administration of the Institute consonant with national policies for the agricultural sector. The Board should consist of a number of Directors representing at least the agencies indicated below, together with the Director of the Institute:

- One representative of the Agricultural Development Committee from each region - (10)
- Two representatives from the Ministry of Agriculture, one of whom should be from the Resource Development and Planning Section - (2)
- One representative each from LIDCO, GRB, GSA, UG (Faculty of Agriculture) - (4)
- One representative from the agro-industrial sector - (1).

Any other areas considered relevant for representation could be included through appointment by the Minister.

The Board, with the approval of the Minister, would appoint a Director who will be the chief executive of the Institute with responsibility for its successful management, both from the standpoint of administrative control and general supervision of the work programme in keeping with the policies and goals of the Institute. The Director will be directly supported and advised by the heads of the three divisions - Administration, Research and Development, and Services.

The Institute will develop routine processes of evaluation from the aspects of accountability, improvement of methodology, documentation and communication but it should be noted that the multi-disciplinary project team approach in itself provides a reasonable evaluation and output-stimulating mechanism.

Linkage of Institute with the Regional System and Farmers: As envisaged, the linkage of the Institute with the Regional System of Administration and farmers

would occur through:

- The Board of Directors
- The Agricultural Development Committee, and
- Agricultural Extension Officer/Agricultural Development Officer collaboration.

At the present time, the operation of the Regional system is not well defined but it is assumed that the Region will have administrative responsibility for Regional staff of the Public Service, including the Agricultural Extension Officers. Assuming that this is correct, the lines of responsibility and major areas of activity envisaged are shown in Figure 6.

It should be noted here that although the Institute will have an extension (diffusion) function, it is not expected to exercise control over all extension staff. The majority of extension personnel are expected either to remain within the Ministry of Agriculture, possibly in the Special Services Division or revert to the Regional administration.

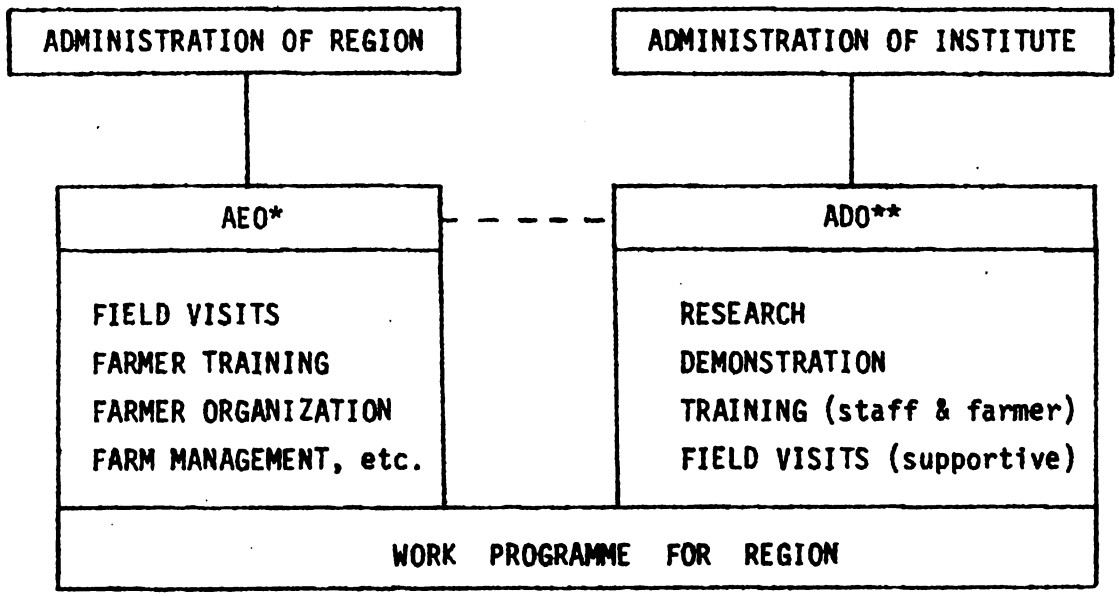
ANTICIPATED BENEFITS/IMPACT

Several benefits are likely to accrue from the implementation of the proposed system, among which are the following:

- increased output of relevant and appropriate technology owing to better management of research;
- increased level of farmer utilization of technology generated because of greater farmer involvement in the process;
- development of a more stable cadre of professionals in the service of agriculture; and
- increased financial resources for project implementation.

One of the limiting factors in the present system is the rapid turn

FIGURE 6: LINES OF RESPONSIBILITY AND COLLABORATION BETWEEN EXTENSION AND RESEARCH



* Agricultural Extension Officer

** Agricultural Development Officer

over of professional staff. Although there are several reasons for this, among the more important are lack of job satisfaction, poor remuneration and the limited possibilities of personal advancement in technical positions, the net result of the latter being the movement of technical personnel either to administrative positions or elsewhere.

It is anticipated that an institute of this nature would provide a better 'climate' for research and development and thus increase the job satisfaction of personnel involved. In fact, fewer Guyanese professionals are likely to leave and more are likely to return to join an institute such as this.

With regard to remuneration, we are not in a position to suggest levels, but it is envisaged that somewhat higher levels would be justifiable on the basis of expected increased output and a more obvious beneficial effect on the productive sector. It is also suggested that the Institute adopt a strategy which will permit advancement of a professional within his technical area of competence in a graded system - Grades I, II, III, IV and V - somewhat along the lines of the current system (A 24, 27, 31, 33, 36, etc.) but with uniform nomenclature, for example Agricultural Development Officer.

With regard to financial resources, it is felt that the proposed institute will be looked upon more favourably both by funding agencies and local government. The possible sources of funding are likely to include government subventions, grants from international agencies, internal contracts (GRB, GUYSUCO, LIDCO, etc.), and special advisory and consultative services to agencies involved in agriculture and related fields.

The Institute, in addition to impacting positively on the development of human resources and on the generation and diffusion of agricultural technology, will contribute to the enhanced productivity of the physical resources of the country. This would accrue from the pursuit of the research function in terms of characterization of natural resources and definition of the optimum means of utilization.

For success, it is essential that tangible efforts be made within the Institute to ensure:

- good communication flow along well defined lines
- efficient use of manpower and resources
- elimination of routine work by researchers
- creation of a 'climate of colleagues' through the inter-disciplinary approach to project implementation and elimination or reduction of the problems of co-ordination across disciplines
- better mechanism for monitoring and evaluation of activities
- adequate provision to facilitate interaction of its professional staff with their colleagues both locally and internationally.

Undoubtedly, out of these measures agricultural development in the country will be greatly advanced.

TRANSITION PERIOD

The proposals put forward here emphasize the need for change and have been made because of the fact that this need is accepted as a "conditio sine qua non" for national development. How this change will be effected and the time frame over which it will take place is not easily determined or described. However, it is readily appreciated that there will be a period of transition from the existing to the desired.

Should the conceptual framework be accepted, the key actions during this transition period would include the following:

i) Preparation for the process of change - the assembling of human resources which would be responsible for further developing the basic aspects of the proposal.

ii) Informative work so as to ensure clarity of concepts and operations being introduced. Much work at the national, regional and farmer level would need to be done.

iii) Investigation into allocation and re-allocation of present resources so as to conform to the new roles and dimensions of the proposed Institute.

iv) Efforts to obtain financial and technical support for the establishment of the institution.

Left to its own devices, nature effects changes which in their totality are described as the process of evolution. If the direction of change and the time frame over which such change is spread is to influenced, human intervention in the evolutionary process must take place. Agricultural development in Guyana now requires such intervention.

CONCLUSIONS

The changes proposed are considered to be critical to strengthening the Country's ability to generate and diffuse agricultural technology. The proposals urge the creation of an institutional structure and system which is highly integrated and which ties efforts in agricultural science more closely to the farm and farmer problems.

Appendix 1

Recommendations and Conclusions from 1974 Seminar entitled: Farmer/Research/Extension Link Seminar

SEMINAR RECOMMENDATIONS AND CONCLUSIONS

The participatns of the Seminar felt that:

In-Service Training

1. Extension Officers should attend research seminars. For the benefit of officers in outlying districts, papers presented, including questions and answers, should be posted to them.
2. Officers working on special crops should initiate meetings with the agriculture staff from each district where the crops are being grown. At any rate, some collaboration between research and extension should be aimed at educating field staff at monthly meetings or training sessions.
3. Seminars should also originate from the Extension Section, for the research division. An alternative could be sending reports to the research staff on extension techniques and progress.

Functional Professional Association

1. An interchange of future staff, between Extension and Research, should be considered. Serving periods in both sections would widen outlook and understanding, and integrate staff.
2. Subject matter officers should work very closely with the officers in extension. Special emphasis should be placed on demonstration plots, where joint involvement augurs well for the best, and commercial plots where collaboration is essential for success.
3. Feed back in the form of factual, timely reports should be made available to research officers by extension officers and vice versa.

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4. Even though this very close co-ordination is desirable, steps should be taken to see that the relationship of both sections with the farmer, is not harmed. The link, therefore, should be more on a personal basis between officers in both divisions.

5. Follow-up work should be mandatory by both divisions.

Other

1. A positive step should be taken to improve the centralised communication system of the Ministry.

2. The Annual staff conference should be held during the second dry season, with Crop Science and Extension having a mini-meeting before the general staff meeting.

3. There should be more control over the sale and distribution of seeds by commercial houses. Preferably, steps should be taken to see that preparation of seed laws is expedited.

3. More emphasis should be placed on taking soil samples from commercial farms. The idea of taking soil samples from back-yard garden plots should be discouraged.

5. The Regional Administration should be approached to facilitate movement of the research and extension staff in the various regions.

6. The salary disparity between the extension and research staff as well as the lack of incentives for officers in the rural districts must be looked into.

7. Positive efforts must be taken to see that as many of the conclusions reached at our seminar as possible are implemented.

Appendix 2

Recommendations and Conclusions from 1977 Seminar: Rationalization of Research in Agriculture and Related Fields

CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations from the Seminar aimed at the Rationalization of Research in Agriculture and Related Fields are as follows:

A. The national production base for agriculture should be structured as follows:

- Farm enterprises of top priority should include:

  Sugar, rice, cocomuts, cassava, fruits, grain, legumes, vegetables, cotton, corn, oil palm, coffee, pigs, poultry, cattle, sheep, goats, bees and fish;

- Production should be effected by individual farmers, co-operatives, corporations and other relevant state agencies in suitable parts of the country;

- Services available to producers should include:

  Marketing
  Meteorological information relevant to agriculture
  Supplies of necessary inputs
  Credit
  Extension
  Training in the management of farm enterprises.

The volume of, and desired rate of increase in, production to be generated from each farm enterprise and from each location/region should be computed in light of the national development programme. The availability of credit should be assured by an annual allocation of a fixed percentage of either the surplus from the agricultural sector or the G.D.P. to the G.A.C.D.B.

B. The research activities necessary for the attainment and maintenance of the desired quantity and quality of production were considered to include:

/...

Studies into:

- the organisation of production;
- the size structure and location of farms and the farm population, as well as the levels of production as revealed by regular censuses, should be analysed and the nature of necessary changes established with the collaboration of Rural Sociologists;
- the legal aspects of land tenure and the patterns of land-use, e.g. absentee ownership, fragmentation of holdings should be examined with a view to review/reform of land-use and tenure for more efficient use of land and therefore capital and credit;
- the ratio of farmers to extension officers should be examined with a view to increasing the impact and efficiency of the Extension Service;
- the organisation and management of co-operatives should be examined with a view to improving their efficiency and effectiveness;
- the socio-economic factors, which influence the mobilization of our human resources for agricultural production, e.g. sources and levels of income to farmers, attitudes to work by farmers and professionals, etc., should be examined with a view to identifying the constraints;
- the nature and value of the system of shifting cultivation should be established;
- the supply and management of water for agricultural uses, particularly in the intermediate savannahs, should be examined;
- the effect of dew on plant growth needs to be understood.
- the elimination of waste:
  - alternative uses for non- or under-utilized equipment and facilities should be identified;
  - systems for more efficient and/or intensive use of land should be developed, e.g., intercropping of cultivations, finding alternatives to flood fallowing, etc.
  - the use of machinery in agricultural production should be examined with a view to optimizing the impact on production;

- methods need to be devised for the conservation of fodder;
- the possibility of recycling irrigation water should be examined;
- the handling and distribution of food items, particularly fruits and vegetables, should be examined with a view to minimizing losses between the field and the consumer.

- development of new products/uses and standards for quality control:
  - new products should be developed from materials now considered as waste;
  - additional and/or alternative products/uses should be developed from existing produce, particularly sugar and rice.

- improvement of production levels:
  - systems of production and management of crops and livestock should be looked at in relation to soil conservation and the preservation of the quality of the environment;
  - the impact of the environment of production should be examined with a view to establishing production programmes suitable to the different ecological zones of the country, particularly the Mazaruni and Intermediate Savannahs;
  - improved seed stock should be developed or acquired;
  - study and revision of the G.S.A. curriculum in order to improve the content in the theory and practice of Extension techniques;
  - establishment of the nature and level of education required by and available to farmers;
  - strengthening the motivation of farmers and extension workers;
  - integration of existing extension services and the circulation of available information on the constraints to extension work for study by extension workers.

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- preparation of inventories of our:
  - soils and their uses;
  - water resources;
  - manpower resources and technological capabilities;
  - materials now considered as waste but which may have industrial use.
- analysis of existing projects to establish ways and means of improving their viability, if necessary, and to provide information which might be useful in the detailed planning and effective implementation of new projects.
- improvement of the acquisition, storage, distribution of information in agriculture:
  - documentation and circulation of all available relevant research data should be effected with the aid of specialists in the subject areas of priority;
  - research data generated in Guyana but not now in Guyana should be procured;
  - technical journals should be produced by the Agricultural Research Committee and by the Society of Professional Agriculturists of Guyana.

C. The Research needs should be satisfied by appropriate institutions. Among these should be:

A National Water Resource Authority;
A Market Research Centre;
A Pesticides Laboratory.

D. The Agricultural Research Committee of the National Science Research Council should co-ordinate and evaluate research activity and should review and catalogue all past and current agricultural research projects in Guyana and those done in other countries but of some relevance to Guyana. The Committee should provide information to the Curriculum Development Unit of

the Ministry of Education for the preparation of teaching material in agriculture in schools.

E. RESOLUTION

WHEREAS

Commonly accepted factors of agricultural production are land, labour and capital, history reveals that science and technology have appreciably increased production and productivity - its importance being amply borne out in discussions during the last three days, and whereas discussions at this Seminar have highlighted the fact that using advanced tools of production without matching local scientific information can be wasteful; and whereas science and technology can itself be considered as a tool of production, and like other agricultural inputs, costs money, points to a need for a policy on funding the science and technology.

AND WHEREAS

In 1975, sugarcane, paddy, livestock, fish, forestry and processing of sugar and rice contributed 437M dollars out of a GDP of 1093M dollars, i.e. 40%; it is not surprising that agriculture is considered to be the mainstay of the economy. And whereas, in advanced agricultural countries, about 2% GNP is spent on agricultural research and on this basis, about 22M dollars would need to be spent in Guyana for the development of science and technology in agriculture. There is great need for emphasis and expansion of agricultural science and technology. A policy statement that Government will increase the expenditure on agricultural science and technology to 2% of GDP in the next ten years will help in identifying and preparing projects and in organising facilities and institutions to serve the nation.

It is recommended that:

a) the level of expenditure on agricultural research be raised from a starting point of 1% of the GDP in 1973 by increments to 2% in a period of five years;

b) special emphasis needs to be placed on areas of priority to the production programme in the allocation and utilization of these funds.

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APPENDIX 3

P R O G R A M M E

THURSDAY, DECEMBER 3, 1981:

OPENING SESSION

CHAIRMAN: Dr. R.E. Pierre

09:00 - 09:10 hrs: Chairman's Welcome

09:10 - 10:00 hrs: The Role of the CAS in Agricultural Development in Guyana : Dr. P. McKenzie

10:00 - 10:30 hrs: C O F F E E B R E A K

SESSION II

CHAIRMAN: Dr. A.V. Downer

10:30 - 12:00 hrs: Discussion and Clarification of the Role expected of the CAS: Identification of Policy Guidelines

12:00 - 13:30 hrs: L U N C H

SESSION III

CHAIRMAN: Dr. J.R.D. Ford

13:30 - 14:30 hrs: Resources for Agricultural Research in Guyana with reference to the CAS : Mr. H. Persaud

14:30 - 15:00 hrs: C O F F E E B R E A K

/...

SESSION IV

CHAIRMAN: Dr. M. Granger

15:00 - 16:30 hrs: Discussion on paper presented in Session III

FRIDAY, DECEMBER 4, 1981:

SESSION V

CHAIRMAN: Mr. H. Stagno

09:00 - 10:00 hrs: Agricultural Development in Guyana through Research and Extension: Dr. J.R.D. Ford

10:00 - 10:30 hrs: C O F F E E B R E A K

SESSION VI

CHAIRMAN: Dr. G. Muller

10:30 - 12:00 hrs: Discussion on paper presented in Session V

12:00 - 13:30 hrs: L U N C H

SESSION VII

CHAIRMAN: Dr. J.R.D. Ford

13:30 - 14:30 hrs: Project Planning and Management in Agricultural Research: Mr. H.H. Stagno

14:30 - 15:00 hrs: C O F F E E B R E A K

SESSION VIII

CHAIRMAN: Mr. C. Bullen

15:00 - 16:30 hrs: Discussion on paper presented in Session VII