INFORMATION SYSTEM FOR PLANNING AND DECISION-MAKING IN THE AGRICULTURAL SECTOR

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Guyana
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1. - INTRODUCTION

Governments engage at all levels of planning in the nation state. The increasing specialisation of human activities has increas- the complexity of the planning process. This complexity is compound- ed by the process being multi-dimensional. There is often the inter- play of various socio-economic, political and natural forces in the planning process. Planners need to take into account all the sides of the"coin" before successfully executing a plan.

Once the committment to planning has been made, there is the ne- cessity for the institutional framework to be developed, resources to be made available and the necessary co-ordination to be done between participants to ensure success of the plan. These stages require that planners be well equipped with the necessary knowledge and ideas re- levant to the plan. The quantum and flow of information is perhaps crucial for effective planning. In other words, effective planning requires an efficient information system to collect, process and dis- seminate the information to those engaged in the planning and policy- making process.

In this paper, an attempt will be made to analyse a feasible information system with special reference to the agricultural sector. Section 2 of the paper will give a backgroud to our objective, out- lining the important definitions, concept and approach used. Section 3 deals with the system characteristics, while section 4 outlines the operational aspects of the information system. Wherever possible,

appropriate references will be made for an information system relevant to the agricultural sector in Guyana.

2. PLANNING AND SYSTEMS

2.1 Agricultural Sector Planning

The importance of the agricultural sector varies between countries. This mainly due to the size of the sector relevant to other sectors in the economy. In the developing countries however, this sector is considered to be very important as the source of development for these economies. Agricultural sector planning is important to effect the required development.

2.1.1 Objectives

The general aim of agricultural sector planning is to obtain a continuous rate of development of the sector. Diferent economies have then respective level and rate of development needed. These are usually associated with the existing developmental problems that exist in the sector. In some economies, the sector may contain a large subsistent sub-sector and a small, modern, capital-intensive sub-sector. The nature of subsistence in the large sub-sector may be the major problem of that agricultural sector, and the objective of planners may be to reduce the level of subsistence by attempting to modernise that sub-sector. In other economies, the problem may be different. Many of the developing countries however, such as Guyana, have as their main problems the following:

1) Low incomes in agriculture.

2) Underproduction, underconsumption, and malnutrition.

3) Rural unemployment and rural poverty.

These problems are incorporated into the specific objectives of the national plans for the sector. In Guyana, the main aims of agricultural sector planning as outlined in the national development plan are:

1) Increased food production for self-sufficiency in food supplies.
2) Increase employment and incomes in agriculture.
3) Better prices and improved marketing and distribution facilities.
4) Maximise foreign exchange earnings from agricultural exports.
5) Improve the nutritional status of the population and increase the quality of rural life.

To achieve the above objectives, sector planners and decision-makers need to be well-informed and equipped for effective planning. They must know of the existing potentials of the sector and the alternative courses of action that can be taken. The whole process of planning and decision-making from problem definition to plan execution and evaluation must be consistent and systematic. Whatever the approaches or the models that are used, quantity and precision of qualitative are very much needed.

Agricultural sector planning however, is a highly complex process. The agricultural sector is only a part of a bigger

whole or system which contains many sectors and sub-sectors. It is therefore important for planners and decision-makers to conceptualize all the interrelationships and problems of this sector with the economy as a whole. Many plans have failed to achieve their desired objectives because planners have failed to take account of the complex functional relationships between one sector and the overall economy.

Another reason for failure perhaps is that the problem solving approaches have been traditional; by this is meant that the approaches have been somewhat "narrow". Problems and solutions were considered in isolation of their related effects on other activities and institutions. The approaches have not been "broad-based" and integrated for common objectives. Each institution or agency pursued its policy in an isolated manner. This has not worked in basic agriculture. To modernise and have a dynamic agricultural sector is a highly complex task and many governments have failed because of a particular system. This would have outlined a consistent and systematic policy set for planning and decision-making. Using a systems approach in sector analysis, one can identify the priority project areas. It also allows a policy set to be maintained within the sector and consistent with the objectives of the overall economy.

Systems approach to planning and decision-making as will be shown later, emphasises the need for organised information

flows for effective planning. Planners often have to rely on a wide variety of data sources ranging in quality from carefully controlled experiments to guesstimates in their problem solution process. An organised system for collecting, analysing and disseminating information to agricultural sector planners is a prequisite for successfully reaching sector goals and targets. It is crucial to the whole planning process.

2.2 Concepts and definitions

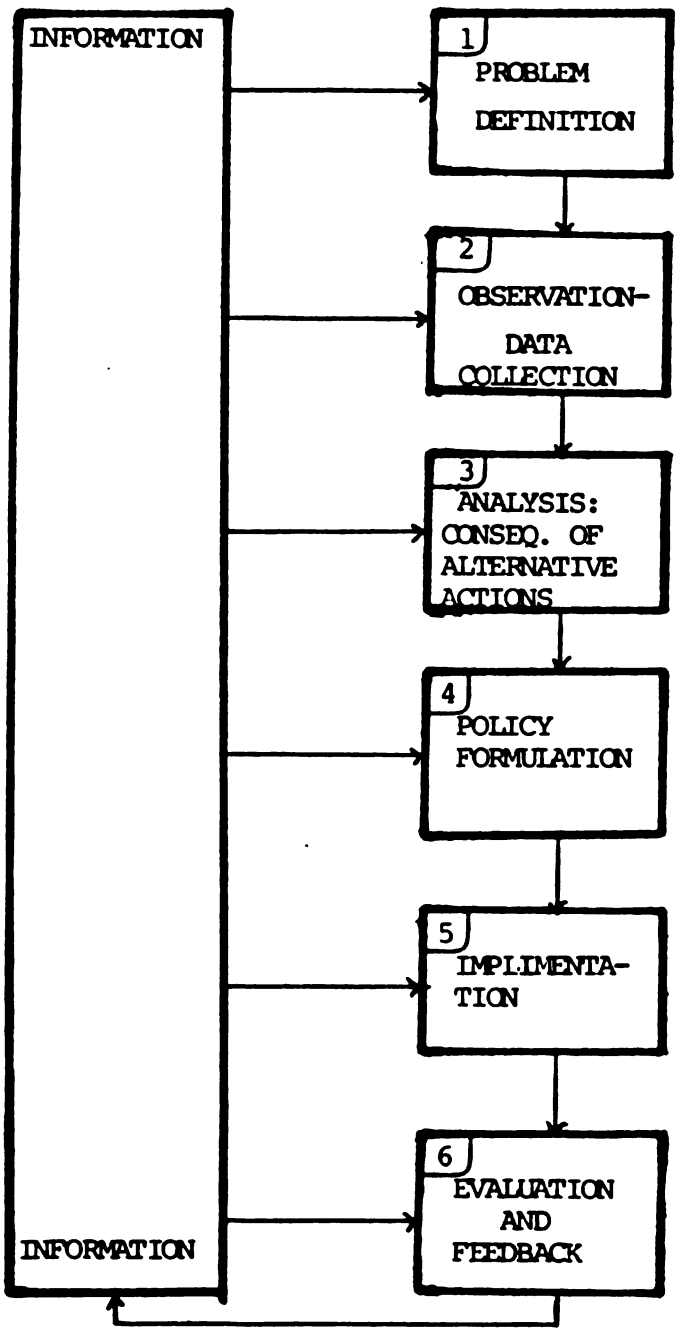
The development of the systems approach has contributed immensely to a more systematic and integrated approach to planning and decision-making. It provides an in-depth approach and a body of tools to overall problem solution. The system is basically a network of decision-making operations having a logical sequence of decisions. The sequential steps of the approach as outlined in figure 1, basically are:

1) It defines the problem(s) or issues that exist.
2) It allows for observations and analysis of the problems. This is concerned with data collection and its analysis.
3) Formulation of alternative courses of action.
4) Makes a final decision, i.e., it selects the optimum solution and evaluation of results.

2.2.1 Systems Outline

a) System - It is a set of entities and attributes which are bound together by a definite set of interrelationships.

Figure 1 - Decision - Making Process



b) Entities - These are events or activities when taken collectively constitute a group or a sub-system, having a set of objectives consistent with those of the overall system.

c) Attributes - These are a set of numeral or logical values that are relevant to the objectives of the system.

d) Objectives - The set of criteria for which the whole system operates. The types of objectives often determine the size and complexity of the system.

e) Environment - These are areas outside the boundary of the system whose attributes may effect changes in the system or may be affected by changes in the system.

f) Inputs - These are primary external variables that effect changes within the system.

g) Output - Changes in external variables caused by changes in the system.

3. INFORMATION SYSTEM FOR AGRICULTURAL PLANNING

An information system can be referred to as the methods, materials, media, producers and recipients involved in an organised way to effect information transfer within a specific area, activity or organisation. It is concerned with all the processes involved with collection of both quantitative and non-numerical data, analysis, storage into an integrated system, which serves many application requirements and retrieving such information for satisfying the needs of users. It consists of a complex collection of information "messages" of the persons who produce and use them and a set of behaviour patterns of their interrelationships.

The information system exists at the centre of many other systems, each having its respective behaviour patterns and interrelationships. However, it transcends all other systems and understanding the functional relationships with the other systems is extremely important if the information transfer is to improve. But of more importance are those that are related to the needs for and uses of information. One should take into account the potentional users of the system, identifying or predicting the users to which the information will be put, design a structure to meet such requirements, and then evaluate and revaluate the resulting system.

3.1 Objectives

The general aim of the information system is to provide information or data -knowledge, news or facts needed by the user in conducting his business. The system must provide information in a usable form and at the time when needed. In the information management system, the objective is to provide information for management

decision-making.

The agricultural sector can be looked upon as a business community where planning and management take place as in all other business units. The specific objectives of the information system for the sector would be:

1) To supply information regularly to management in order that they be aware of developments in all fields related to the agricultural sector.
2) To guide planners and policy-makers to achieve the goals and targets of the agricultural sector.
3) To plan for more optimal/rational use of agricultural resources.
4) To compliment the activities of other departments, institutions and agencies to obtain both sectoral and national planning objectives.
5) To acquire, organise, and exploit all documentary and other sources of information required for the above purposes.

3.2 System Characteristics

The complex nature of information systems creates a challenge for their design and evaluation. The system exists within a more superior system, and this must be considered in its design and evaluation since it may pose several constraints for the system.

There are several approaches in designing an information

system, which depends on type, needs, and uses of the system. The most important step is to study the type of information needed by planners and the information flow of the sector, and then build a system that brings the basic information together and makes it accessible to all functional groups. This approach allows the information originating from various sources to be brought to a central point so that a data base can be built, and information needed by all users made available.

The agricultural sector contains a multiplicity of activities, all of which are interrelated in the process of agricultural production. Each activity produces a chain set of reactions, each generating its own set of information. It is important to study all the activities of the sector, the objectives of such activities and the information flows relevant to these activities. The systems approach reduces all the complex interrelated flows into distinct components or entitities, each constituting a subsystem in the information system. On the basis of disaggregation, five main components or subsystems of the entire system may be identified. These are:

1) Farm subsystem.
2) Institutional or input subsystem.
3) Production subsystem.
4) Marketing and trade subsystem.
5) Research subsystem.

Each subsystem consists of a number of elements, many of them having the same types of attributes. These can be identified as:

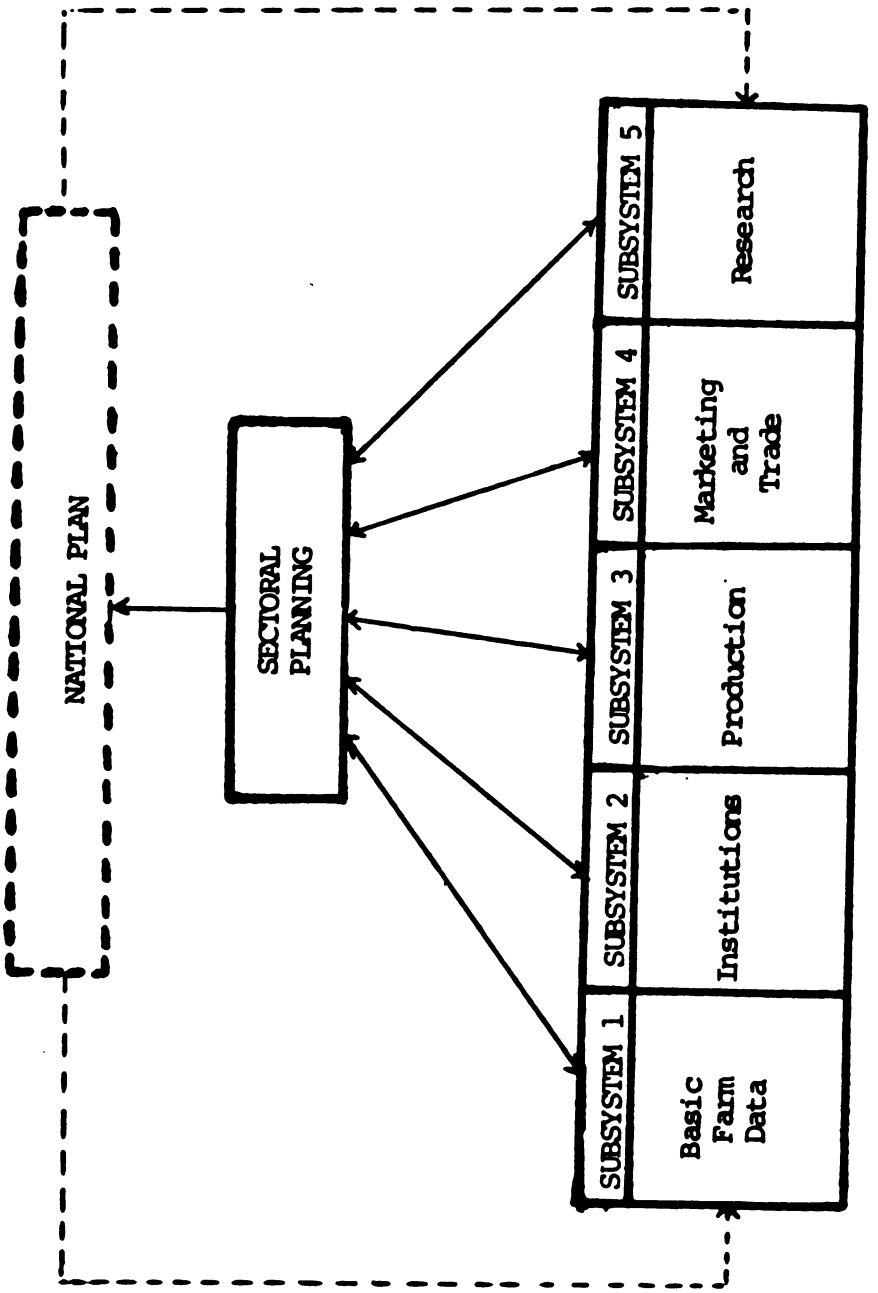


Figura 2 - System Components and Relationship

a) Spatial distribution - Region, Sub-Region, District, Village, Rural/Urban.

b) Types and contents of programs.

c) Resource availability and needs:

i) Manpower and personnel -skilled and unskilled.

ii) Financial

3.2.1 Subsystem 1 - Basic Farm Data

Elements:

i) Crops - Acreage and farm size of holding/plot.

ii) Livestock.

iii) Potential agricultural land -high/medium/low. This relates to monoculture/polyculture/pasture/forage (use).

iv) Tenure system.

v) Population:

a) Composition -racial/sex/age.

b) Distribution.

vi) Geography -topography, climate, and ecology.

3.2.2 Subsystem 2 - Institutional or Input Subsystem

Elements:

i) Financial or Credit:

a) Nos. and types of institutions.

b) Credit programs.

c) Financial resources.

ii) Extension/Education.

iii) Technology - Types.

a) Available - Technology.

b) Technology demand and supply.

c) Research oriented/transfer.

iv) Soil/Animal/Plant protection - programmes.

v) Land Development - programmes.

a) Irrigation.

b) Water management.

c) Conservation.

vi) Public utilities - rural/urban availability

a) Roads and transport.

b) Communication.

c) Health and education.

d) Water and electricity.

e) Energy demand and supply

vii) Other infrastructures.

3.2.3 Subsystem 3 - Production sybsystem - Production Unit

Elements:

i) Input mix and resource use - combination of inputs for production.

ii) Cropping and husbandry practices - early/late.

iii) Farm management.

iv) Water management.

v) Harvesting methods.

vi) Yields and income.

vii) Costs.

3.2.4 Subsystem 4 - Marketing and Trade sybsystem

Elements:

i) Transport.

ii) Processing.

iii) Storage.

iv) Distribution.

v) Consumption.

vi) Stocks.

vii) Markets.

a) Internal -wholesale/retail.

b) External -imports/exports.

viii) Volume and prices.

ix) Costs - related to transport, etc.

3.2.5 Research subsystem

Elements:

i) Sectoral -economic, technical, etc.

ii) Complimentary -inter-sectoral (joint).

3.3 System Relationship

These are two main levels of system relationships:

i) Internal relationship of the components to each other and,

ii) Relationship of the system to its environment.

3.3.1 Internal Relationship

This level of relationship is primarily concerned with the relationship of the components with and to the system as a whole. To understand this relationship, a brief outline of the logical steps involved is important.

1) The information system has been reduced to a number of components of subsystems.
2) Each component:
   i) Has a set of elements within a boundary.
   ii) Has a number of objective functions related to the overall objectives of the system.

Each component in the system generates a set of facts and information. It is important that the users of the system develop understanding of the system through a detailed examination of it. This would aid the planning process for users would then understand that the components complement rather than compete with each other. This complementary relationship is directed towards the achievement of the goals of the system (outlined earlier).

3.3.2 The System and the Environment

Figure 2 shows the components of the system and its relationship with its objective. This objective, however, is part of a bigger objective of the socio-economic system. This is an important aspect of the system's environmental

relationship. The system complements other systems in the wider environment towards the achievement of the national planning objectives.

The environment poses several constraints for the system (see systems operation). This information system must compete in an efficient manner with other systems if it is to prolong its life cycle. Overtime, it must adjust to environmental changes while still consistently operating for its goals and objectives. This depends on the internal flexibility of the system to adjust to the environmental changes. This is an important aspect for consideration when designing the system at the operational level. It must also take into account the market-like environment including all the economic, marketing, and competitive ramifications of the system.

4. - SYSTEMS OPERATION

Having laid the basic framework of the information system, we now turn to its operational aspects. The important guide for all its operations is that they must be related to the overall objectives of the system. The system's performance is based on its operations which aim at maximising its contributions to achieving planning's goals and targets. Two important considerations must underline all its activities - effeciency and effectiveness. These two criteria will in the final analysis determine the life cycle of the system.

The operations of the information system can be classified into four main areas. These are:-

1). Organisational considerations.

2). System's Development.

3). Services.

4). System's Maintainance.

4. 1. - Organisational Considerations

The organisational structure of the system is an important aspect for consideration in the design stage. This is the fundamen- aspect upon which all operations are determined, for a strong and efficient structure goes a long way to achieve the objectives

desired of the system. The design of the system's structure ought to be as objective as possible to achieve the purposes for which it was set up. It is thus necessary that the structure be related to the following:-

a). The mission of the system.

b). The goals of the system.

c). The required resources that are needed for both the present and anticipated goals.

In addition to the above, there are a number of considerations to be taken into account when designing the structure.

Each ministry, institution,or organisation has its own unique organisational structure that has evolved over a long period. The structures have been conditioned and moulded by the respective country's historical development. It is important to consider this factor when designing the structure. It would be wise that the structure design conform to existing patterns in government institutions. For example, organisational structures of government departments in many developing countries are patterned after the structure of the British Civil Service. The design of the structure may however be a constraint for the effecient functioning of the system. This can be remedied by minor modifications in the operational functions of the structure so as to achieve the desired level of effeciency. In addition, as part of the wider organisational environment, the structure may facilitate easier administration for its parent

organisation.

Understanding the environment and the nature of the system's activities is a prerequisite for designing its structure. The agricultural sector has always been looked upon as having greater risks and uncertainty for predicting the outcome of the sector's activities. It is thus necessary that the be efficient organisationally to minimize the risks and uncertainty of planners.

Many information systems are part of an institution or a department, i.e., the system has a parent organisation. Planning for a large sector like the agricultural sector in which many agencies and institutions operate, would necessarily require a separate department to handle such a large volume of information for its information system. The department must be comprehensively organised to handle the volume of information flow; it must also have greater autonomy rather than too much of organisational loyalties. This would give the system greater flexibility both for internal adjustments and adjusting to the environment over time. To a large extent also, there would be less institutional and administrative constraints for fulfilling the needs of its users.

Finally, there is the important question of centralisation or decentralisation of the system. Each has its advantages and disadvantages. Centralisation allows for greater efficiency, economy and

availability of resources. It increases effectiveness especially for management control. Decentralisation on the other hand permits greater convenience for usage, but may entail "weak" administrative control and direct supervision. Designing a system only for planning purposes may require a centralised system. Where consideration is being given for an information sytem of the agricultural sector, then many institutions and individuals would be directly or indirectly involved in its usage. Such a system can be decentralised at the operational level by having centres of information, each involved with the information flow of a particular component, while at the same time, a comprehensive network exists interlinking these centres into a component whole. While decentralisation may be permitted, it should not allow fragmentation of resources and duplication of activities for the same information.

Given a large agricultural sector as that existing in Guyana, with so many institutions and agencies, we can attempt to decentralise an agricultural information system by having a central agency being responsible for each of the component earlier described. This is shown in figures 3 and 4. For example, all information for subsystem 2, the production subsystem can be under the responsibility of the Resource Development and Planning Division of the Ministry of Agriculture. The sub-components of this subsystem are those such as the Crop Reporting Staff, Guyana Rice Board, Guysuco etc,. In figure 4, the Marketing and Trade subsystem is

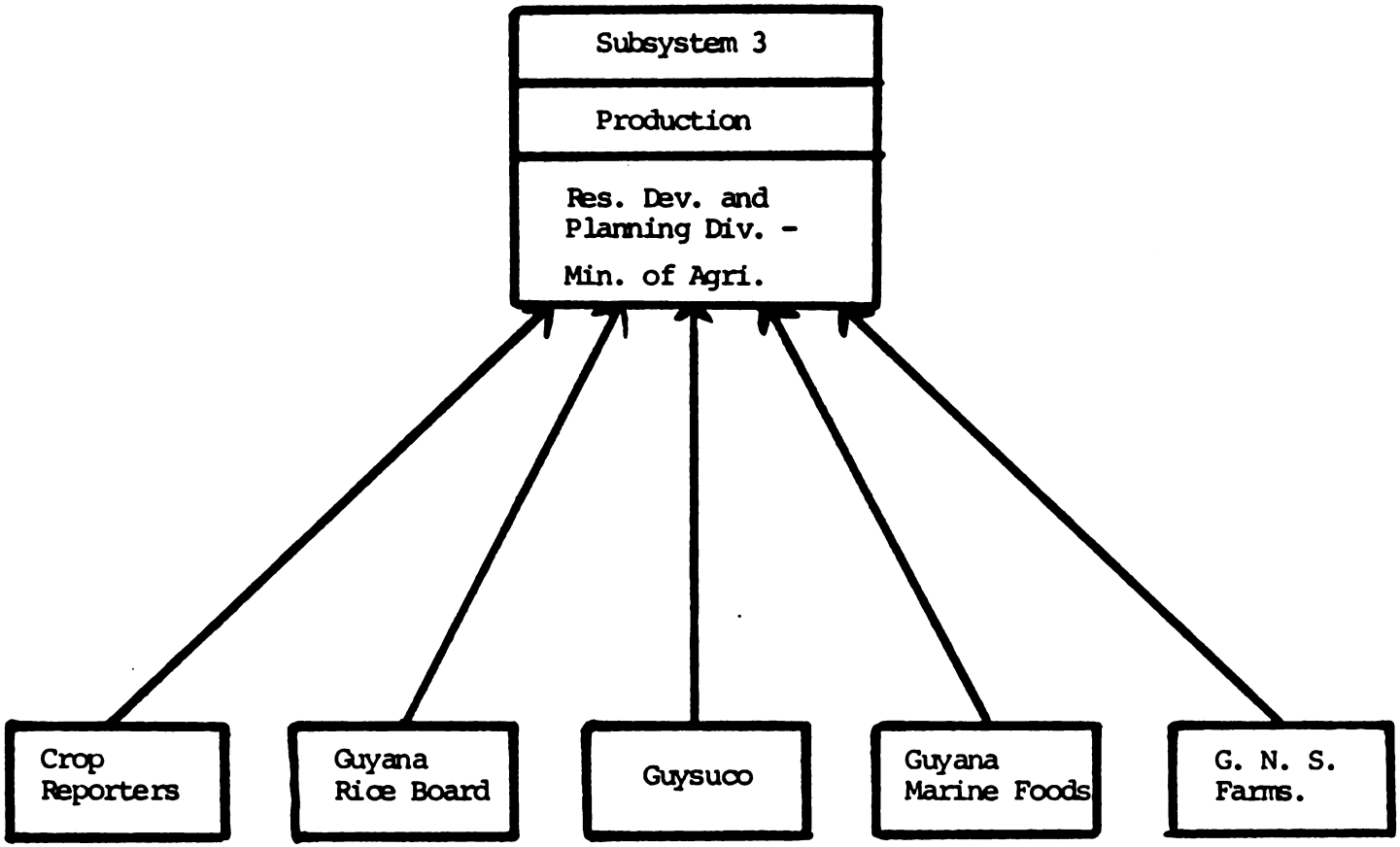


Figure 3. - Information Centre for Production.

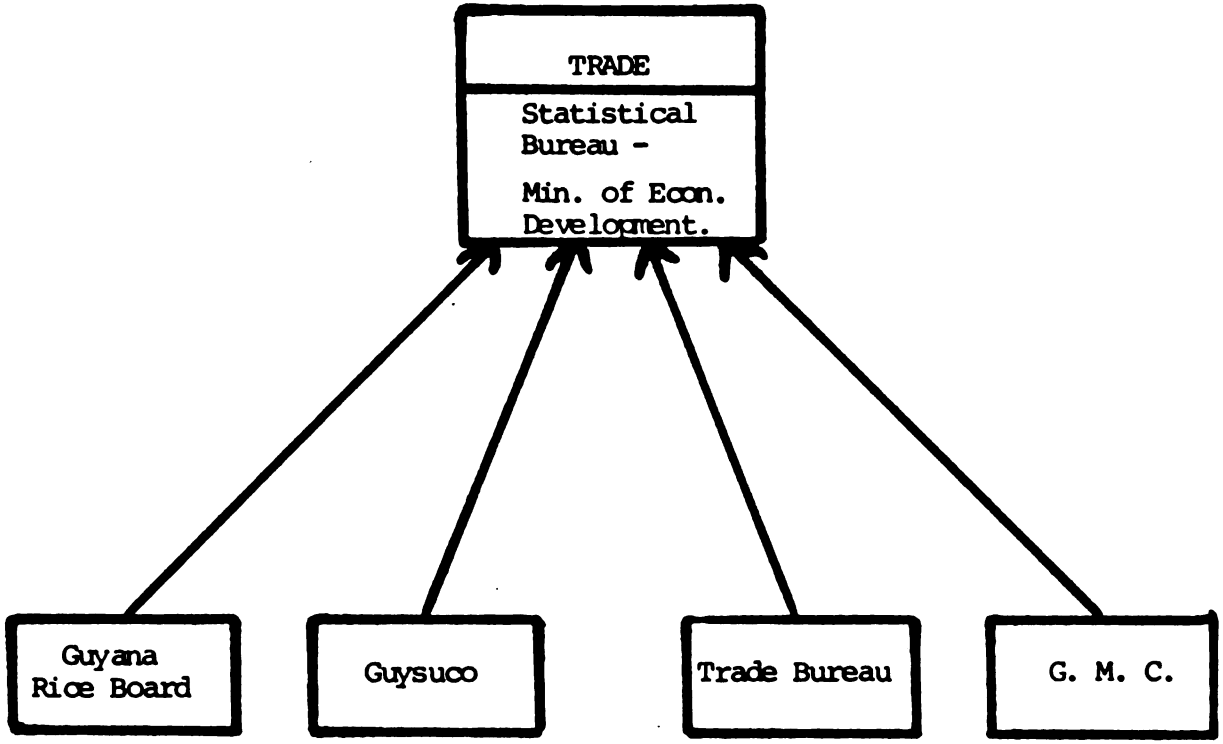


Figure 4. - Information Centre for Trade.

disaggregated into two sub-components. The Statistical Bureau can be the central agency for the trade information sub-component. These are merely examples to show how the system can be designed to reflect a particular level of disaggregation.

Figures 5 and 6 represent a conceptual framework of the organisational structure. Figure 5 shows that the activities of the system are divided into a number groups, each constituting a unit or a division. Each division is concerned with a specific set of activities or operations, and under direct supervision of a divisional head. For example, there is a head of the finance division, head of the processing division and so on. Figure 6 shows management control of the system. All activities related to information flow from acquisition to user must be efficiently supervised to achieve its direct objectives.

The structure is linked both vertically with management and horizontally between the various units. It is rather flat than too "hierarchical". The objective is to minimize its bureacratic organisation and have an effective communication flow between management and the lower levels. This increases the integration and efficiency of operations for achieving the system's overall objectives. Mutual communication between the upper and lower levels caters also for the users of the system to interact and participate in the system's planning, development and growth.

The locus of control of the system remains with management (fig. 6). Besides overall administration and supervision, management has the following important functions :-

1). To develop feasible goals, policies and plans consistent with the overall objectives of the system.

2). Establishing and maintaining effective operations and equipment facilities to impliment the above.

3). Establishing both professional and non-professional personnel requirements for operations and services.

4). Evaluating and revising operations to meet changes in objectives and requirements.

5). Developing effective programs to meet overall needs.

Before going on to systems development, it would be important to briefly discuss three important areas of organisational control - staffing, equipment and finance.

(a). Staffing and equipment facilities are functions of both the financial resources, complexity of the systems operations and the degree of centralisation/decentralisation of the system. While information science is a relatively new fielf in the developing countries, it is a highly specialised discipline that requires professional and specialised staff.

Table 1. shows the staff requirements for an agricultural information

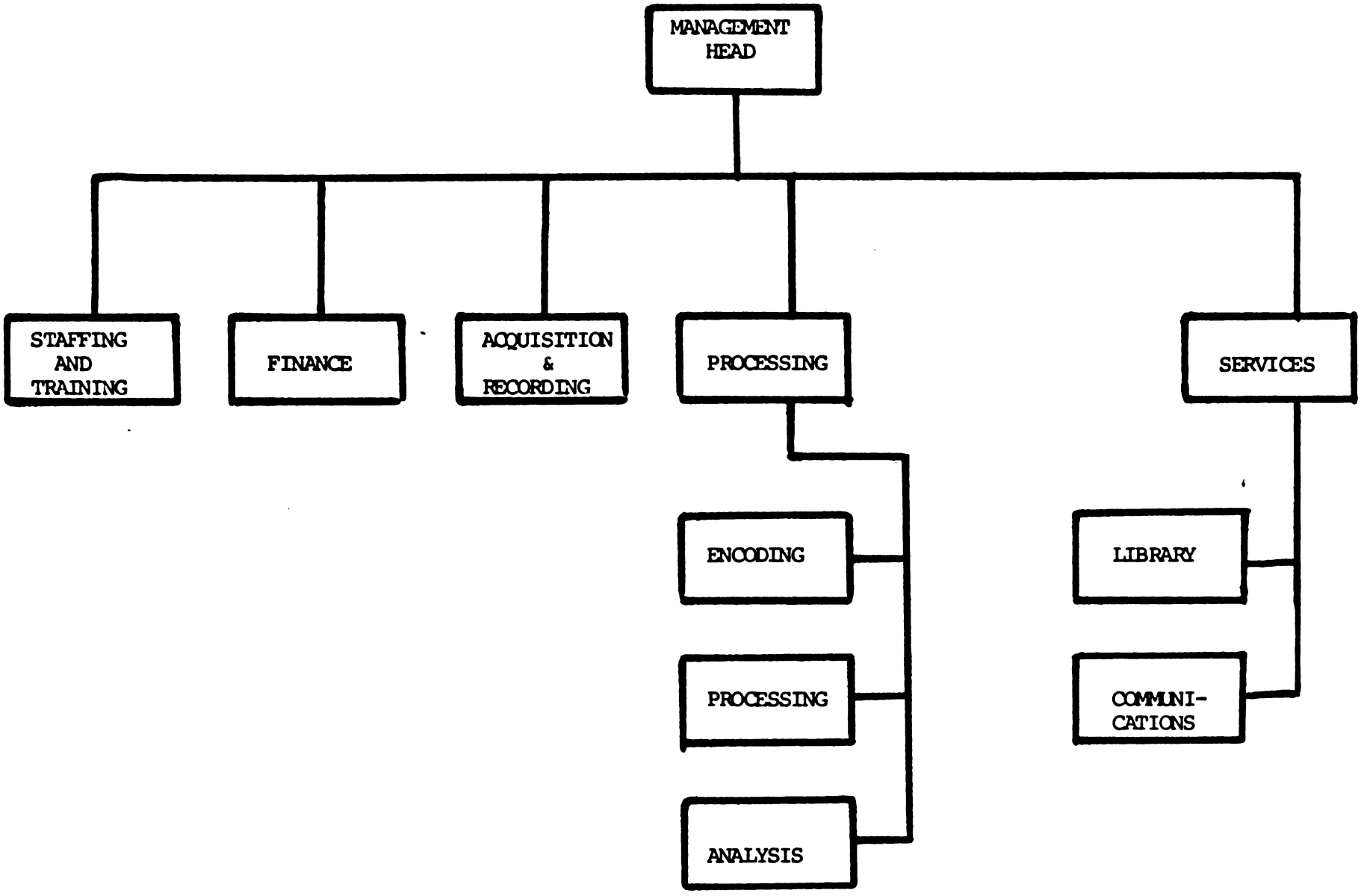


Figure 5. - Organisational Structure of Information System.

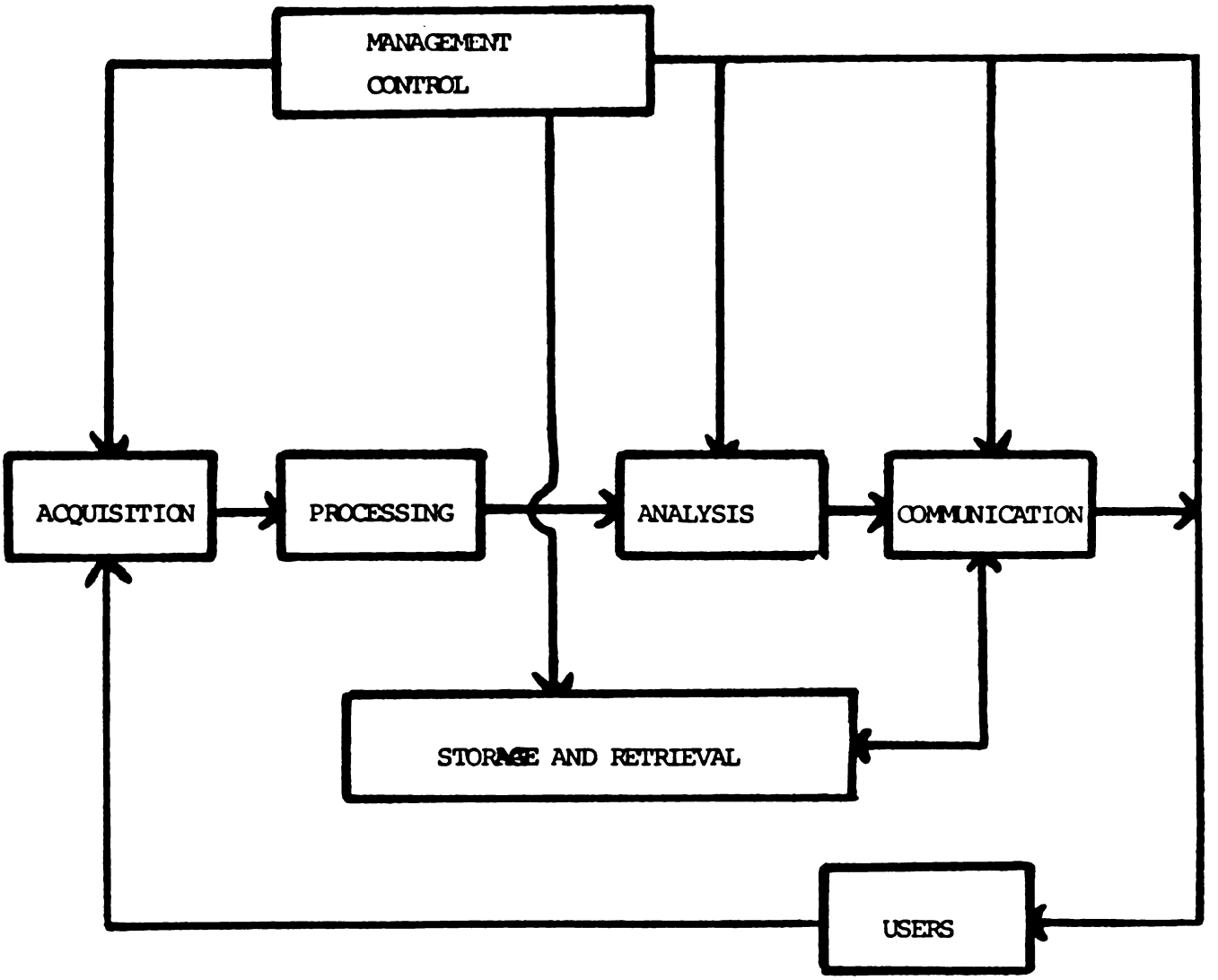


Figure 6. - Organisational Control of the System.

system for Guyana, given an information structure such as that in figure 5.

Table 1. - Staff Requirements.

Units		Personnel
Management	-	2
Staffing & Training	-	3
Finance	-	3
Acquisition & Recording	-	5
Processing	-	5
Services	-	5
Total	-	23

Each unit or division in the organisational structure requires highly competent and trained staff for managing its operations. The personnel requirements per unit would vary depending on its activities, but basically, a 1:4 ratio is most appropriate - i.e., one divisional head supervising four persons. As time goes on, the complexity of the operations would increase. This would necessitate increases in both the quantum and quality of the system's personnel if it is to efficiently achieve its objectives and survive. Management must be very selective of its

personnel in order to sustain and increase the level of efficiency of the system. It would be wiser in the absence of the required technical staff that personnel selected be functional in several areas.

The system's mission and operations determine the equipment and the facilities needed. These range from buildings to filing cabinets and computers. The type of facilities should always be selected for needs, applicability and economy. While these determine selection, there are certain minimum requirements that should be met to implement and operate the system at some minimum level.

The required equipment and facilities are directly related to the life cycle of the system. Information sources and volume increase every day. Over time, the small simple systems would become uneconomical and inefficient to handle the increasing volume of information for users needs and purposes. The (input-output) operations become more complex especially when manual operations give way to computer and electronic processing facilities. Such requirements would then become inevitable and basic for the system's operations.

(b). The activities of the system and achievement of overall objectives depend depend on its financial resources. Financing an information system is often a burdensome activity for many governments and institutions. While it can be argued that the importance of the system

will certainly permit funding it, financial pressures in the parent organisation will adversely affect its performance and survival. This is especially so when the system becomes the easiest target for any budget cuts. Many systems are implimented, often stagnate and decay due to this reason. It is very important both in the design stage and at the operational level to estimate the required finances and identify the sources of such finance, both in the short and long terms.

There are three main areas of funding the system - initial costs, operating and maintainance costs and future requirements. Table 2. shows a summary of budgeting for the system.

When financial resources are very limited, expenditure should always be kept to the minimum. The initial and operating costs are the more important considerations in the design stage. After implimentation, as the system develops, budgeting for the systems future requirements becomes increasingly important as this would affect the future survival of the syteim.

4. 2. - Systems Development

It is often impossible for information to flow directly from producer to the user. There are many factors responsible for this. Information flows across several disciplines, barriers, distance, language and boundaries before it is actually used. Though the direct communication between the producer and user is desirable and effective, the direct channel is generally impractical. In addition, the flow process becomes more complex due to the increse volume of information

ITEM	INITIAL COSTS	OPERATING COSTS	FUTURE NEEDS
Facilities	Buildings, Offices, etc,.	Renovations from time to time.	Extensions
Equipment & Materials	Purchases - cabinets, files, paper, computer, etc,.	Repairs and re-placements as needed	New and Improved equipment
Salaries & Wages	Consultants, etc.,	Professional, non-Non-professional, clerical, etc,.	Promotions, increments and additions.
Collection	Purchases of basic documents, books, journals	Document collection, subscriptions	New collectons
Miscellaeous	Start-up costs - travel, etc,.	Services, training	Research, expansion of services, etc,.

Table 2. - Planning the Budget.

and the increased number of potential users. And very often, users do not require the information in the form or content in which it has been produced. As such, it becomes the primary function of the information system to acquire the information and reproduce in the form and content needed by the user and at the time he needs it. This process is often a highly complexed one and depends on the development of the system. Between the input or acquired information, there are several basic processes through which the information flows (fig. 6).

4.2.1. - Acquisition

Information flow is a continuous process over time in the form of both inputs and output. It is important that the system acquire all the required information for its needs and objectives. The sources of such information flow must be arrested for the system's users. This policy of acquisition is determined by the system's mission and user needs.The selection policy should be stringent or else the system would be acquiring unwanted information at uneconomical cost. What must be established is a criteria for selection of relevant information for the system's needs. These criteria would serve also as a source of control for relevant information acquisition. Some important guidelines for selective acquisition of information are established by answering the following questions :-

1. Who are the producers and potential users of the information ?
2. What do the users do with the information ?
3. Which are the sources of the required information ?
4. How often can the information be acquired from these sources ?

For agricultural planning purposes, the components of our system have established the relevant information the system needs. Yet, that itself is not precise for selection purposes, but merely gives a picture of the area to be covered for information collection. Detailed selection and classification is the responsibility of a particular unit.

Information flows mainly in unorganized and semi-organized forms. Most of this however is unorganized for user needs. The acquired data has to be organized into a package for effective and efficient utilization. The methods of data collection need to be emphasised here. In unorganized information systems, information is usually obtained in an ad hoc manner. An organized system requires that the methods of collection be uniform and systematic. Uniformity does not mean that the same procedures be applied to all data collected. Different types of data require different approaches for collection. Some information may be obtained from sample surveys, some will have to be extracted from documents and so on.

All the information needs of the system must be categorised and methods of collection for each group worked out.

Once the sources of the information have been identified, a scheme must be drawn up identifying the type of information and the time when such information is available or to be collected. For example, production figures should be collected weekly/monthly or by crop. Some information will be sent into the system. These are often periodic and are in the form of reports, journals and other published documents. The schema would thus be important so as to outline the methodology for information acquisition by the sytem.

4.2.2. Documentation

As information is acquired, it has to be organized in some manner for use. Different types of information are acquired in different forms. The methods of collection vary and it becomes essential that the large bundle of information acquired be organized in some scheme based on certain characteristics. The process of storing the acquired information in an organized manner is referred to as documentation.

Two main considerations underlie this process-consistency and accuracy. These are the essential guidelines of this process. All documentation methods must be done in a consistent and accurate manner for they facilitate easy storage and retrieval.

The important aspects of documentation are classification and indexing. In essence, these aim at designing a scheme such that any item or piece of information can be placed or fitted into a group by virtue of its role within the scheme. Classification allows the acquired information to be logically arranged into a concenient form. Indexing, on the other hand serves as a locator of wanted documents and information. It guides the user as to where a particular document is located.

In the acquisition process, it is extremely important for the following elements of information to be acquired with respect to any document or piece of information:

a). Bibliographic details such as Title of document, Journal's title, volume, issue number, pages, publisher, date, document category: book, memo, letter, report, etc.

b). Names of author(s) or producer(s)

c). Subject

As information is acquired, they are placed under certain subject headings. The placement of the particular information however, dependes on the classification scheme that is designed. For example, ther can be subject headnigs such as rice, sugar, bananas, etc. Any piece of information that is acquired on any of the subject headings will be placed into its respective category. A format of this is shown below:

SUBJECT - RICE

1. Acreage - a) Harvested - years.
   b) Sown.
   c) Distribution
      i) District.
      ii) Region.
      iii) District.

2. Price - a) Domestic
      i) Consumer
      ii) Wholesale.
   b) Export.
   c) Import.

3. Production
   a) Annual
      i) District.
      ii) Region.
      iii) Village.
   b) Cost.

Or the classification scheme can be designed such that cost of production be one subject area, exports be one, imports, etc,. Whatever scheme is used, it must be consistent and accurate. The scheme must also be economical, both in terms of cost and time.

An accession number index tells the user where the information is located - in the library, on which shelf or

in which file. In an open system, it is not essential for the user to state his requirements since he can interact with the files themselves. This is not so ina a closed system such as those of government where the user has little access to the files. The operators of the system must clarify, define or translate the users requirements in terms of the index file to retrieve the wanted information. There is thus need to be greater precision in the closed system in indexing stored information. In addition, where users can be categorized in terms of their specific needs, the index plays a curcial role.

It is important that these functions be performed by skilled and qualified people. Suice the basic objective of classification and indexing is for convenient storage and retrieval purposes, these functions must be performed by qualified individuals or by those very familiar with the system's retrieval requirements and procedures.

4.2.3. Processing and analysis

Information processing and analysis is an organized system for transferring to the user timely, authoritative and evaluative information in a convenient form. Often, the acquired data is of little use to the user.

Some users would need raw data; some would require semi-processed and analysed data, while others still require highly processed information. The degree to shich the data is processed and analysed depends upon the particular use of it. Also, processing and analysis transform information into a very concenient form for economical storage and retrieval. Some prequisite conditions must be fulfilled

however before these processes are possible.

Editing is an important aspect of data processing. It permits the information or data to be carefully scrutinized to detect any error or omission and allows correction before the next stage of tabulation is proceeded with. Editing gives accuracy and reliability to the data obtained and ensures uniformity and completeness and wich facilitates easy coding and tabulation.

Coding transforms data into a machine readable format. It is the reduction of information from long sentence and words into smaller indices that are more convenient processing purposes.

There are many ways of processing information. The type used depends on the available data, facilities and the use to which the data is put. Very often decision-making purposes, information has to be processed and re-processed before they are used by planners and decision-makers. The complex relationship in the agricultural sector would necessitate use of machines for processing purposes. A further advantage is that computes give greater dimensions and usage for any particular piece of data.

Through various programs, the computer is instructed to perform its task. These programs are written in various languages and it is important to understand these languages before the system can attempt to use such processing facilities.

Data analysis and processing operations are very intertwined. Processing facilitates easy analysis of a large bulk of data. The key activities in analysis is to interpret, synthesize and evaluate the information for assimilation by

users. This function is highly specialised and requires such personnel as statisticians and econometricians if there is to be effective information analysis. A highly specailised unit is required for synthesizing information in a specially defined area or any particular field.

The unit must provide new and evaluative information for decision-makers. It must be mission-oriented and for it to be very effective, it must-work closely with planners, decision-makers and also those engaged in research.

4.2.4. Storage and Retrieval

The key to easy storage and retrieval of information is efficient documentation - coding, indexing and classification. Once the documentation procedures have been logically perfomed, easy retrieval is possible. Also, when the same persons engage in documentation and retrieval, there are less problems of retrieving any given stored information. This is permitted easily in a closed information system.

Information can be stored in a raw form or in a highly processed form. Whenever a particular piece of information is used for a variety of purposes, it is often more economical that it be stored in a raw or semi-organized form.

Information storage is related to the data base. The data base can be considered as the set of primary information acquired and available to any user or group. Establishing a data base is the primary objective of the system

after its implimentation, and it then becomes crucial for the functioning of the system. The data base also indicates the weaknesses and gaps in the stored information.

The data base is often designed in a hierarchical structure, divided into a series of files. These files are usually related to the characteristics of the classification scheme. A piece of data is assigned into one or more portions into this structure. Some of the files may be used very often and these should be readily accessible. Once the data has been stored, whether in files, folders or magnetic tapes, their positions must be located before they can be retrieved. If there has been consistency and accuracy in the classification scheme, accession problems become few.

As the data base grows, the storage capacity of the system must increase. In the manual labour-intensive system, it means more files, more clerks and cabinets. In the automated system, there will be need for larger files and computer tapes.

An important aspect of the data storage system is the continual updating of the data base, and this depends very much on the acquisition unit. Updating can be divided into two parts - updating of the record file and updating of the service files. Updating of the records is the main form of operation of the system. It is mainly concerned with updating records already known or information on new subjects.

For retrieval purposes, there are two modes for identifying the stored data - explicitly labelling and positionally tagging them. Labelling allows the data to be identified and is commonly used in narrative types of data. Automated systems use the position tag for storing a piece of information. Each piece of datum is placed in a position on a magnetic tape or punched card which minimizes wastage of space.

Retrieval of the stored information depends essentially on the index file. The crux of the retrieval operation is to match an inquiry whose index terms corresponds to the index term of the document or required information. Searching can also be done by computer where the storage tape file is consulted for a particular piece of information. Retrieving the required information with a query can be represented by a matrix as shown in table 3. below.

DOCUMENTS

	1	2	3	4	5	6	7	8	9
A	X					X			X
B	X		X						X
C						X			
D		X			X				X
E				X			X	X	
F			X			X		X	
G		X							X

Table 3. - Matrix for Retrieval

The numerals 1 through 9 represents index documents while A through G represents vocabulary terms that are indexed. Term A can be found in documents 1, 6 and 9. Document 9 contains terms A, B, D and G. The matrix shows the indexed location of particular pieces of data or information.

The objective of retrieval is to get the maximum number of elements out of a file for a query while keeping the number of irrelevant records to a minimum. This depends on the efficiency of the earlier stages of the information flow in the system. The operating efficiency of the retrieval system can be ascertained by certain criteria - relevance, precision and recall. The cost factor must also be taken into account when evaluating the retrieval system, because storing information is one thing, retrieving such information can be very costly both to the user and the system as a whole.

4.3. - Services

The fundamental parameter of the system is services. What are the kinds of services will the system provide ? The main factors affecting these are :-

1. The goals of the system and its users.
2. The size of the community.
3. Character and resources of the "parent" organisation.
4. Priority of services to be offered.
5. The implications of information use - productivity.

Having outlined the goals of the system earlier , it would be important to identify the users of the system, since the services the system offers are related to information usage. The main groups of users are :-

1. Important officials - Ministers, Permanent Secretaries, etc,.
2. Planners, decision-makers, etc,.
3. Other users directly related to the system.
4. Others.

Identifying the main groups of users usually influence priorities in dissemination policy and the appropriate methods for disseminating the information. This is especially so when the system is "very" closed and under various economic and political pressures, and there is a deliberate policy to keep information under "cover". This policy however, poses a danger to the very existence of the system in the longer run. This situatio exists with many information systems in the developing countries and the tendency is for many of them to outlive their usefulness in a very short time. There is need to be reminded that the system exists to perform services and these are related to user needs. The user then must be integrated into the system as an active participant, whose needs direct the design of the system while the information base reponds to his requirements.

Services can be grouped into four main areas :-

(a) Inquiry.

(b) Documentation.

(c) Dissemination.

(d) Special activities.

(A). Inquiries - These are requests for information and may be both general and specific. Each request should be analytically processed since some tend to be clear and well defined while others are ambiguous and poorly articulated.

(B). Documentation - The system generates information also through its own publications. One important aspect of publications is for the system to publish periodically selective information that are regularly required, such as for example, A Quarterly Digest of Agricultural Statistics. This can be an assignment by the parent organisation. The system can also be called upon to assist in the preparation and production of certain output documents. The tasks include writing, editing, duplicating and publishing, andmuch of this involves manipulative information. A special publications unit would be needed to disseminate such information. The various publications the unit can publish are :-

1. Brochures - describing and promoting activities, announcements, etc,.

2. Newslettes - information and news.
3. Current bulletins - information for current awareness.
4. Periodicals - journals of statistics, research, etc,.
5. Reprints and photocopies.

The periodical publication is perhaps the most important, especially for those individuals and institutions directly involved in the sector's activities. This is a very important service. There can also be discriptive and informative abstracts. These help to keep individuals abreast of current developments and it is an extremely important service especially to those engaged in research.

(B). Dissemination - There can be selective dissemination of information to various users. In fact, most information systems practice selective dissemination of information to various extent. In a closed system,selective dissemination is of greater importance. For example, "high-powered" officials usually need certain types of information very regular, such as production figures, or market prices of a particular crop or commodity every week. Other officials related to the system will need need certain types of data less regularly. The periodical can fulfill this need. And then there can be selective dissemination of publications.

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(D). Special activities - Part pf the service must be related to surveillance and research in order to understand present and future requirements of actual and potential users. The user is the most important element an the cycle, and face-to-face contact produces the most effective user relations. Such activities help the system to adjust continually to the needs of the user.

4.4. Systems Maintainance

Sustainance and survival requires that the system be maintained on a continuous basis. Maintaining information systems is often a very costly activity. Over time, the system has acquired more information than it can presently handle. There is need for more physical facilities - files, cabinets and so on. Then there is the need for more skilled and qualified personnel. There is also the need to increase the methods of dissemination of information - more documents and reports, regular newsletters, etc,. These represents various areas of maintaining the system. Costs saving and cost avoiding instances should be important guidelines, and anticipation and regular planning for the future should be priorities in day-to-day management of the system.

An efficient information system usually keeps operating costs to a minimum and avoid unnecessary costs from time to time. This depends on management perform-

ance. The system must perform like any other enterprise. Costs and benefits must be evaluated at each level of operation. Efficiency and effectiveness will justify a given level of maintainance.

Two other aspects of maintainance need mentioning are adjusting to the environment and improving the data base. The latter has already been streesed upon. The ability of the system to give to its immediate users current information when they need it is an important area for data management.Adjusting to its environment is also a must for the system.Many systems are unable to adjust over time, resulting in stagnation and decay in a short time. To extend its life cycle, the system must be competitive with other systems in the environment.

SUMMARY AND CONCLUSIONS

The attempt in this paper has been to lay a framework for an information system for planning and decsion-making in the agricultural sector. The framework did not deal specifically with agricultural planning per se, but with an agricultural information system for the sector. The objectives and components of the system were identified and the system's operational aspects were discussed. Perhaps two important points were not clarified. These are whether the system should be centralised or decentralised, and whether the system be open or closed.

Centralisation of the system depends on its design at the operational level. With reference to Guyana, a centralised system would not be possible at the operational level. There will have to be a number of information centres which are units of the system. A prerequisite for the efficient functioning of the system would be a well designed communication network and mutual co-operation between the agencies involved. These would avoid the present duplication activities of information acquisition and storage, and would also give some measure of consistency in the planning process.

Open or closed system depend also on the design and the socio-economic cum political environment. In the developing countries especially, information means having some degree of "power" and it is an important weapon in the political and economic systems. This accounts

for much of information being kept as "classified", and a closed system inevitably develops. The danger however, is that such systems would be hardly competitive and effective in the longer run. It is also the main reason why the planning mechanism is somewhat fragmented and sluggish, since the existing information systems hardly serves its purpose in addition to being very reliable.

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