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FOR THE AGRICULTURAL SECTOR IN BARBADOS"

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"TOWARDS A MANAGEMENT INFORMATION SYSTEM
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Jorge Ishizawa

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PREFACE

Since 1984 IICA has been providing support to national planning and statistical systems to its member countries in the Caribbean through its Multinational Planning Project for the Caribbean.

In developing this activity it became clear that cheaper hardware made almost imperative that any internationally funded project would provide a microcomputer to its counterpart agency, as part of the technical cooperation package.

Soon it became apparent that, no matter how many microcomputers had been introduced in the ministries and related agencies, the information flow did not improve, and decision makers had not had better information upon which to base their decisions.

On the other hand, people who were supposed to work with this new tool that, as Ishizawa suggests in his report, could signify the "democratization" of computer power, did not actually go beyond word processing and sometimes, spread-sheet calculations.

In analysing the problem two things were noticed, one that microcomputers were delivered without any specific purpose, or with very general objectives for their use, and second, there was no real investment in the development of the human and organizational component, what Ingle has termed the "orgware" dimension of microcomputer systems.

With these considerations in mind, and with the purpose of cooperating with Barbados in the development of Information systems based on microcomputers, it was decided to perform a systems analysis in order to provide the framework for such a development.

What follows are the main considerations and conclusions arrived at by the Consultant. It is a starting point only and does not provide all the answers that people are eager to get, it was never intended to do so. It does provide with something far more important given the state of the affairs. It sketches a framework for analysis of MIS and of microcomputers as they relate to individuals and to organizations. It also presents some thoughts that represent a challenge to any technician worried with these matters. Finally, it provides guidelines for the specific development of information systems that, if followed should allow for the development of better Management Information Systems. From here we should be able then to identify specific technical cooperation projects geared to MIS that aim at a common goal and respond to a specific plan, regardless of the technical or financial agency involved, aiming at common goals.

Although the document is signed by the Consultant its contents actually are the result of the interaction of Dr. Ishizawa and all the people at the Ministry and parastatal organizations who

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collaborated closely and the IICA personnel of the Multinational Planning Project for the Caribbean who acted as direct counterparts to the Consultant.

Gonzalo Estefanell
Head, Multinational Planning
Project for the Caribbean



TOWARDS A MANAGEMENT INFORMATION SYSTEM FOR THE AGRICULTURAL SECTOR OF BARBADOS

INTRODUCTION

The purpose of this report is to present the conclusions and recommendations of the study carried out by the Consultant on the situation of the information system in the Agricultural Sector of Barbados on behalf of the Multinational Planning Project for the Caribbean of the Interamerican Institute for Cooperation on Agriculture (IICA). The period for the mission was 9 May 1987 through 12 June 1987.

The primary purpose of the study was to carry out a systems analysis of the existing information system in the Agricultural Sector in order to define:

- users' problems and needs
- scope of the present information system
- existing resources
- guidelines for the installation of a viable information system, and
- a list of immediate actions towards building it.

This analysis is intended as a necessary first step of the implementation of a management information system that effectively supports decision making in the Agricultural Sector. The complete analysis, design and implementation cycle for the information system would also include:

- a general systems design,
- a systems evaluation and justification,
- a detailed systems design and, as a final step,
- a systems implementation.

Such are the tenets of a formal systems design program.

This approach was deemed necessary because microcomputers are becoming an increasingly common adjunct of every new development project in Barbados. This situation is bound to be more frequent in the future as management requirements of timely and reliable information grow in a context of increasing complexity. Microcomputers are already in place in some agencies in the Ministry and elsewhere in the agricultural sector. But no internal policy as to their acquisition and utilisation exists at present. In a very real sense, at present we do not know what to



do with microcomputers. Witness to this statement, none of them is being utilised optimally in my view.

It is my impression that we still have to acknowledge two facts that are changing our workplaces: computer power in the form of microcomputers is here to stay; and, it may be inexpensive. We can use it or not. It is a matter of cost-effectiveness. But if we decide on their use, then we should not expect automatic benefit to ensue from that decision. To exploit that power effectively, we have to think through all the implications of its use. For instance, use of microcomputers will surely imply changes in our individual and group modes of operation. This poses the question of our willingness to change and of how we go about changing and learning to change.

Besides our present ignorance, there is a growing mythical aura about microcomputers and computers in general, that makes all the more urgent an objective appraisal of the possible organisational consequences in terms of advantages and hidden costs in scarce resources implied by their adoption.

The present exercise is postulated on the belief that the development of an information system can be planned. To plan it we adopt the systematic approach outlined above. The end result of that planning effort should be a blueprint for a viable information system for the agricultural sector of Barbados. With the present exploration we intend to get an overall view of the present situation of the information system, place it in the context of its possible evolution and suggest constructive guidelines that may shorten the period of haphazard growth and contribute to a gradual integrated development of a viable information system by providing a comprehensive framework.

In spite of the fact that it is the increasing presence of microcomputers that works as the background motivating force of the study, the present analysis emphasises the organisational impact of an improved information management, regardless of the eventual utilisation of computers in the implementation of the information system. The reason for this emphasis lies in the now well established fact that the management of information involves three components:

- hardware, the physical equipment including computers and peripherals;
- software, the procedures and techniques for managing data to transform them into information, and
- the so-called "orgware", the organisational setup, the human side of the information system whose modification entails training, changing policies on personnel development and modifications in procedures and routines.

It is estimated (1) that, in monetary terms, the orgware aspect of the information system takes up more resources than both the



hardware and software aspects combined. Taking a closer look into the specific resources that are involved (local or imported) we can make this estimation more precise. Thus:

- hardware means imports, and will do so for the foreseeable future. Given the present trends, it will become progressively cheaper, and more powerful in terms of processing speed and general capabilities, mainly taxing on our capacity to put it to intelligent use;

- software includes generic programs and specific applications. Versatile generic programs already exist that provide basic capabilities for stand-alone systems (wordprocessing, spreadsheet analysis and database management). Specific applications have been developed for areas like accounting, statistical analysis, and engineering. The imported component in software is presently very important, but must and may be reduced as local experience for adaptation and innovation in specific applications grows.

- orgware depends almost exclusively on the availability of highly qualified manpower with knowledge of internal conditions and after a thorough appraisal of the information needs. In a first stage of development of an information system, it may be brought from outside the Ministry or even from abroad, but exclusively for the purpose of systematically building up internal expertise.

It must be pointed out that adequate orgware is what probably distinguishes most a functioning information system. This has always been so, but has recently been obscured by the myths that surround computer utilisation. Besides, the traditional O & M (organisations and methods) approach has yet to recognise the fact that computers, and especially microcomputers, profoundly alters the way complex organisations can and must be managed. Training becomes then the overriding issue for system development. But training takes different forms according to the tasks that people have to accomplish and the overall stage of system development. Training planning must take into account that there exist stages in microcomputer utilisation in organisations and that what must be known varies with the role the trainee is playing in the organisation and the stage the latter is in.

In the evolution of microcomputer utilisation in organisations, there is an initial period of use as a sort of glorified, but not quite perfect, typewriter. Later, technical use is made of its spreadsheet capabilities, for convenient storage, updating and reporting accounting information with graphics added by the most daring users. Up to this point the microcomputer has only gone through the period of introduction, replacing functions already fulfilled by some other method, being manual or mechanical. Training at this stage cannot profitably go beyond the problem solving stage of replacing manual methods by the same procedures



using the microcomputer.

It is only when specific applications are developed that cannot be done otherwise: keeping inventory information daily updated, doing accounting work keeping information on transactions and balance continuously updated, etc. that the full power of the computer begins to be fairly appreciated. But to go further than this, to harness that power and put it to satisfying the organisation's needs, sooner or later, one comes to realise that it is one thing to solve immediate problems, and quite another to develop a computerised system that boosts individual and organisational productivity. To make full use of the microcomputer, we may find that we have to change our operating procedures. At this stage, training takes on a quite different meaning. We have to be able to understand how the capabilities provided by the technology affect the way we work, and how to take advantage of its synergic effect to function more effectively in the pursuit of the organisation's goals. It is important to point out that this has nothing to do with training in programming computers for specific applications, that is in learning computer languages like Basic or Pascal. It is a matter of wisdom, of understanding, not a matter of knowledge. Once again, it involves mainly orgware, and software in a much lesser extent.

One final point to be taken into account is that microcomputers tend to show the occult signs of the distribution of power throughout the organisation in the initial stages of computerisation. Microcomputer systems locked up in the manager's or the administrative officer's room are common liabilities in the struggle to keep control of a technology which is much feared for the disruption that may cause in the internal, informal organisational ladder. With the increasing quest for computer literacy in the workplace, it may well happen that a redistribution of organisational power take place. All in all, microcomputers point to a democratisation of the workplace via the democratisation of the access to their use. But to make this a reality, caution must be exercised in the allocation of such scarce resources, especially in the initial stages of development.

It must be remembered that "information is power". The centralised control of information flow may be the ideal of the top manager and the system administrator, but the days of a central processing unit and all its peripherals in one single air-conditioned room seem gone forever. The central access to all information flow does not need to preclude either the decentralised access to all information flows that pertain the needs of the various units or the overall control of the information flows for central management purposes.



I. A CONCEPTUAL FRAMEWORK FOR THE ANALYSIS OF MANAGEMENT INFORMATION SYSTEMS

A. Data, Information and Knowledge

The method of analysis of the existing information system at the agricultural sector level is postulated on the belief that data do not constitute by themselves information. Information is, for the purpose of the present work, that which informs, that which imparts form, that which gives meaning to incoming bits of representations of external reality. Meaning refers to the relationship of the data conforming these representations with its conceptual environment. In the present case that conceptual environment is provided by the uses of data and information in decision making.

A decision maker transforms data into information by bringing the appropriate data to bear on a managerial problem. This process generates information that leads to a decision. The implementation of a decision produces action which eventually generates new data that may be used to bear on new problems. These problems, in turn, could originate in the changed environmental conditions that such action may bring about. In the representation of the decision making process in Fig. 1, this process goes on in two levels: that of strategic decisions and that of tactical decisions. This distinction has to do with the time reach of the consequences, of the impacts derived from each kind of decision.

However, in order for information to become a true instrument for social learning it is necessary to devise a system that help managers to learn, and to learn to learn. In brief, information must somehow be transformed into knowledge. This is the ultimate challenge for an information system supporting decision making.

Knowledge is produced, as Bullers and Reid (2) have pointed out, when the results of several information generating episodes are generalised to solve a certain class of problems. Knowledge, in this context, consists of:

- Problem description and facts, which constitutes the so-called declarative knowledge.
- Relationships and rules for manipulating facts, which are labeled procedural knowledge.
- Processes, strategies and structures for coordinating problem solving, also called control knowledge.

Thus, the process of relating data to a specific issue or problem generates information in the form of descriptions, relationships, rules and processes. Subsequent use and generalisation of already established descriptions, relationships, rules and

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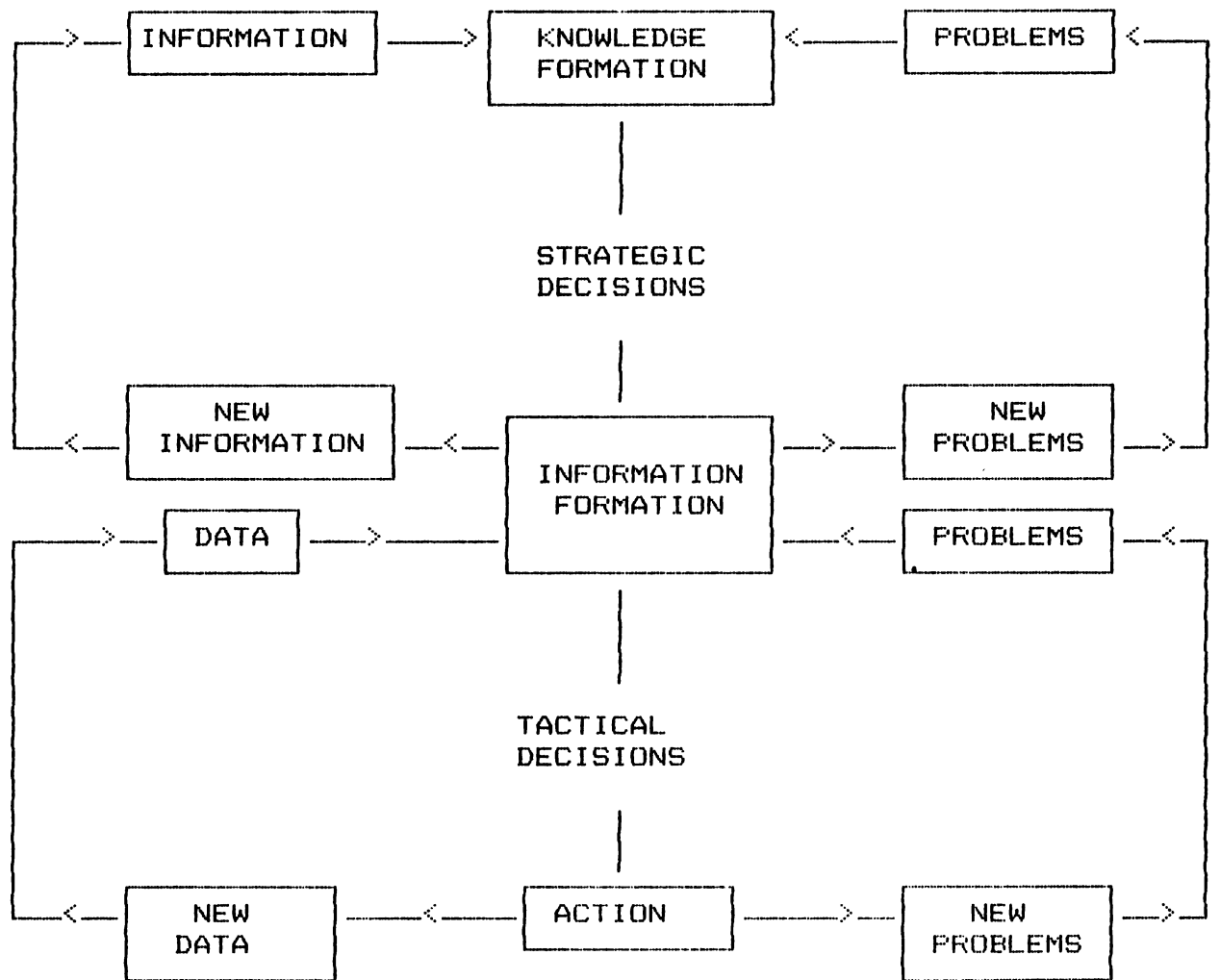


Fig. 1 DATA, INFORMATION AND KNOWLEDGE IN DECISION MAKING

Adapted from Bullers and Reid



processes to synthesize previously generated information produces knowledge.

In this context, expertise consists of knowledge about a particular area, understanding of that area's problems, and skill at solving them. It consists of declarative, but mainly procedural and control knowledge. Decision makers may need to draw on experts whenever taking a decision requires knowledge on the problem or area so critical and specialised that they do not possess. The general knowledge that decision makers should have at hand mainly consists of declarative knowledge. This can be systematically collected and processed to reside in the databases from which statistical information could be retrieved.

B. A Method for the Analysis of Information Systems

Management information systems are tools for systematic knowledge acquisition, and thus, in order to analyse the management support information system in the agricultural sector of St. Lucia, we have to inquire into the kind of knowledge that is available to managers. It is necessary to:

First, classify the managerial decision activities according to decision types. Decision types are associated with the modes of decision making, that is, whether the information system will support structured or unstructured decision-making processes. Structured decisions are routine, repetitive decisions for which a problem can be anticipated and an appropriate response programmed. A typical managerial situation when structured decisions must be taken is in setting up production levels at a sugar factory. Unstructured decisions cannot be formulated in advance since they deal with problems that are unique or complex. One such problem would appear when deciding on a new organisational setup for the statistical information subsystem. Between the two extremes there extends a whole spectrum of decision types. It is important to realise that structure arises from the repetition of decisions that can be assimilated (by analogy or other procedure) to a certain class.

Second, determine in which way the different stages in the decision-making process the existing information system is presently supporting. These stages are:

1. Intelligence - Problem recognition and interpretation, which often results from monitoring both the organisation's external and internal environment.
2. Design - Generation of alternative solutions to the problem.
3. Choice - Evaluation of alternative solutions and

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selection of a course of action.

4. Implementation - Installation of the selected solution.

The relation of the stages of the process with the degree of structure of decisions is clear. Structured decisions emphasise the elements of choice and implementation, while unstructured decisions involve all four stages, the critical one being intelligence, that is, problem formulation.

Third, determine the way in which the different levels of managerial activities are being supported by the information system. In general, three levels are involved:

1. Strategic planning - Determination of organisational objectives, identification of resources required for objective achievement, and development of policies to manage these resources.
2. Management control - Effective selection and use of resources to accomplish organisational objectives.
3. Operational control - Efficient implementation of the tasks required for objective achievement.

Here again, the relation of management level and decision type is straightforward. While structured decisions are associated mainly with operational control, unstructured decisions are met more frequently in the higher management levels.

In short, the analysis seeks to determine the decision type, stage, and activity level that the existing system is supporting. A proposal can then be devised to outline the type of information system that is required to support managerial decision making and how to go about transforming the existing system into the desired one. The proposal must also include the stages of development of such a system and the resources required for the implementation of each stage.

Among the options that are available the following are mainly related to the activity level that the information system supports:

- a) Electronic data processing (EDP) systems provide such diverse operational control functions as accounting and filing diverse documents.
- b) Management information systems (MIS) support information storage, retrieval and processing for routine, repetitive decision making and planning purposes, such as programming, budgeting and project and program monitoring.
- c) Decision support systems (DSS) and expert systems (ES) provide flexible, user directed modeling capabilities for



project planning and ad-hoc decision making.

The information system for the agricultural sector should then be conceived as a system that progressively provides a wider support in terms of decision types, stages of problem solving and activity levels.

In a first stage in the design process emphasis should be placed upon aspects of database technology. Databases will contain two types of information that must be distinguished insofar as their production processes differ. On one hand, there is the statistical information which is produced in accordance to well-known, accepted procedures of regular, systematic data collection and processing. Its reporting process is also regular conforming a number of standard formats, that can be readily produced from the database. It constitutes general, background information on matters that profit from a historical point of view. On the other hand, there is the management information where reports are produced as a response to ad-hoc queries leading to detailed information using the available data stored in the databases and/or conducting special surveys.

C. Levels of Decision Making and Information Flows

There are three types of potential end users of the agricultural sector information system:

- operational and general support units;
- middle management (project managers, operational managers);
- top decision makers and their close advisors

They closely correspond to the activity levels of the previous section. Thus, the operational and general support units are involved in operational control activities and require systems for their day-to-day operation that organise the incoming flow of information to support supervisory control.

For middle management the flow of control information is directly related to keeping track of ongoing activities on a regular basis (programme and project monitoring).

Top decision makers and advisors require that information be supplied on the most diverse issues and problems as they are required for decision making at the strategic planning and monitoring level on an ad-hoc basis.

The context in which each of these types of end users of information systems carry out their respective activities configure three different modes of interaction between levels:



- Routine reporting characterised by a periodic flow of information on operations originating in the operational and general support units and used mainly by middle and top management for monitoring purposes.

- Management reporting characterised by reporting-by-exception, that is, reporting on deviations from program and their probable causes, for management to take corrective action.

- Ad-hoc information retrieval in a group decision making context, characterised by a frequent access to a more or less flexibly structured mass of detailed information.

Each of the three modes implies a different resource combination and diverse strategies for supporting system implementation:

- Routine reporting rests on computer techniques with batch-type processing in the electronic data processing (EDP) tradition. Systems are programmed once for all foreseeable purposes using techniques that optimise in some prescribed fashion the use of resources. Presently, this approach may profit from the application of database technology.

- Reporting-by-exception which is presently the modern approach to management information systems (MIS), rests mainly on database technology with information retrieval carried out through the use of English-like instructions entered on a computer terminal.

- Information systems supporting decision making are only recently receiving attention through the availability of the so-called decision support systems (DSS) which combine database technology with techniques for flexible modeling. In this direction also, the industrial countries are assisting to an intensive development of applications of artificial intelligence techniques to the problems top managers face in the context of unstructured decision making through the use of the so-called expert system (ES) technology.

D. Microcomputer Implementations of Management Information Systems

So far the experience of introducing microcomputers in diverse types of organisations in the developing countries has made clear that we are witnessing a different phenomenon from the one brought about by the large computers (mainframes) in the sixties or even by that minor one of minicomputers in the seventies. Then the difference was one of increasing availability of computer power due mainly to reduced cost. It can be said that the difference was a quantitative, marginal one.



Microcomputers opened a whole new set of possibilities of applying powerful problem solving capabilities at the individual, not the organisational level. This goes beyond widespread availability and makes for an essential qualitative difference. They promise boosting overall productivity through the increase of individual productivity, not directly at the corporate level, for instance, through the introduction of an integrated computerised system.

In the context of the industrial countries, computerised systems have a long tradition in the solution of managerial problems, from accounting systems in the EDP approach through the development of management information systems to, more recently, decision support systems and expert systems. Microcomputers can perfectly complement the power that a fully functioning MIS, DSS or ES provides to corporate decision making. They contribute to improved decision making providing decentralised analytical power for ad-hoc problem solving. That such promise be realised is another question.

What is important in the present discussion is the fact that as far as corporate system development is concerned, mainframes and minicomputers are the appropriate vehicles while microcomputers are adequate for ad-hoc individual problem solving and system development at the divisional level.

Seen from the so-called developing countries, and particularly the small ones, "computers" have come to mean mainframes and minicomputers, conceived as powerful calculators. Once a mark of distinction for the knowledgeable, GIGO (garbage in, garbage out), the fact that computers do not do more than they are programmed to do, is now commonsense. We have come to accept that computers are the epitome of high technology, a technology we cannot afford to do without. The advent of microcomputers, from this point of view, is a welcomed one. Now we have increased computer power, once unaffordable, packed in ever smaller and cheaper boxes that promise to deliver us from underdevelopment.

The insidious part of the so-called "microcomputer revolution", however, seen from a "developing" country, (that is, one without a tradition of widespread computer utilisation) is the fact that we are unconsciously extrapolating all that was valid for "computers", as we knew them, to microcomputers.

And yet, microcomputers have introduced a very important dimension to computer use in organisations. They have in fact dissociated the short-term and the longer-term aspects of organisational problem solving. In the era of mainframes and minicomputers, the short-term aspect was almost non-existent. All computer systems were installed after a more or less extended period during which profound systems analysis and programming took place. Use of package software for statistical analysis (SPSS, SAS) or modeling (IFPS), for instance, required a period of training. Microcomputers, in turn, are extensively and



primarily used for one-time, restricted analytic tasks. There is no need to be reminded that electronic spreadsheets belong firmly to the microcomputer era.

In spite of the increasing confluence (in hardware and software terms) of macro-, mini- and microcomputers, this short-term aspect of immediate problem solving is presently obscuring the need for a serious systems analysis whenever an organisation identifies the need for a computer system to help improve its decision making. Typical examples of this situation are the use of electronic spreadsheets for the development of information systems, that is, for updating and periodic reporting on organisational resources and expenditures or for statistical reporting. In the latter case, spreadsheets permit sheet-by-sheet storage of tables that can be consulted as one would do with bulletins. This, viewed in a longer-term perspective, undoubtedly constitutes an inadequate use of software whose strength and excellence resides in the so-called 'what-if' type of analysis.

It is not the intention to belittle the usefulness of such devices. They are set up and maintained with relatively little effort by the users themselves without recourse to computer expertise. This in itself is valuable in terms of familiarisation and training. But it should not obscure the fact that electronic spreadsheets are suitable for relatively small one-shot tasks. Even slightly larger systems that attempt to mimic consulting an electronic dossier where different pages appear in different windows on screen, suppose 'awkward development and manipulation and difficult maintainability, not to mention the extreme difficulty of carrying out ad-hoc information retrieval of specific items. A more flexible approach would require using database technology but this implies more time and expertise for analysis, design and implementation, and bears upon an organisation's capacity to adopt a more systematic way of information management.

The rational approach to the correct use of microcomputers is two-pronged. Short-term problem solving should be dealt with whatever software is more adequate to have the problem solved in the least time. Longer-term problem solving, involving repetitive tasks requires the development of a system, for which the techniques of systems analysis associated with mainframes and minicomputers will prove helpful, particularly since power and availability make microcomputers ideal vehicles for progressive techniques such as prototyping.

One of the most promising aspects of microcomputers is the fact that short-term problem solving can be incorporated as a first approach to system development that permits the user hands-on experience leading to a second turn in a cooperative undertaking that encourages user involvement and may prove the only adequate approach to long-term system development.

II. DECISION MAKING IN THE AGRICULTURAL SECTOR OF BARBADOS

According to the extent that decision processes are structured, three types of decisions have been identified in the agricultural sector of Barbados. They are:

- the operational decisions that pertain the daily functioning of the different units (private and public) that make part of the agricultural sector. These decisions result from highly structured processes and conform to established administrative procedures. As such they include decisions on both technical and administrative matters. They can be found in all the different divisions of the Ministry, including the Minister's office and the units implementing specific projects.
- the managerial decisions that must be taken when deviations from program are detected. In general, the decision processes from which such decisions originate possess some degree of structure. They are semi-structured. Typical are the decisions taken by project managers, but they may also occur in the context of the Ministry's functioning, from the divisional heads upwards, as well as in the case of the commodity monitoring committees.
- the strategic decisions that have bearing on matters of the style of development for the sector. These are generated in typically unstructured processes involving a high degree of uncertainty and overall lack of relevant information. To gain knowledge pertinent to the decisions involved, much of the effort has to be devoted to gathering information for problem formulation and the consequent generation of alternative solutions.

For the preliminary analysis of decision making in the agricultural sector of Barbados, this three-level framework has been found to apply in the analysis of the information flows that support decision making.

From the interviews with decision makers, a feeling of absence of key information to support policy making in the sector was identified. There exist a number of issues on which such information would be welcomed. Among them:

- Competitiveness of local produce in overseas markets for which information on productivity by location and crop, and on differences of seasonal productivity is necessary.
- Availability of local resources especially land to take advantage of occasional export opportunities.

Such issues constitute instances of questions that continually crop up posing the problem of the informational support of unstructured decisions at the highest level. Such information

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should, in general, proceed from the statistical information subsystem. It is not usually the case and points to the need for an enlargement of the scope of the current statistical subsystem.

It is also felt that ready access to more reliable and timely information is required. The parastatals, BADC and BMC, were mentioned as main providers of information. Compatibility of information from the various sources still remains an important unresolved issue. The second aspect in turn highlights the issue of the opportunity with which the higher decision levels are provided with information. A need for speeding up data collection and information processing is certainly involved.

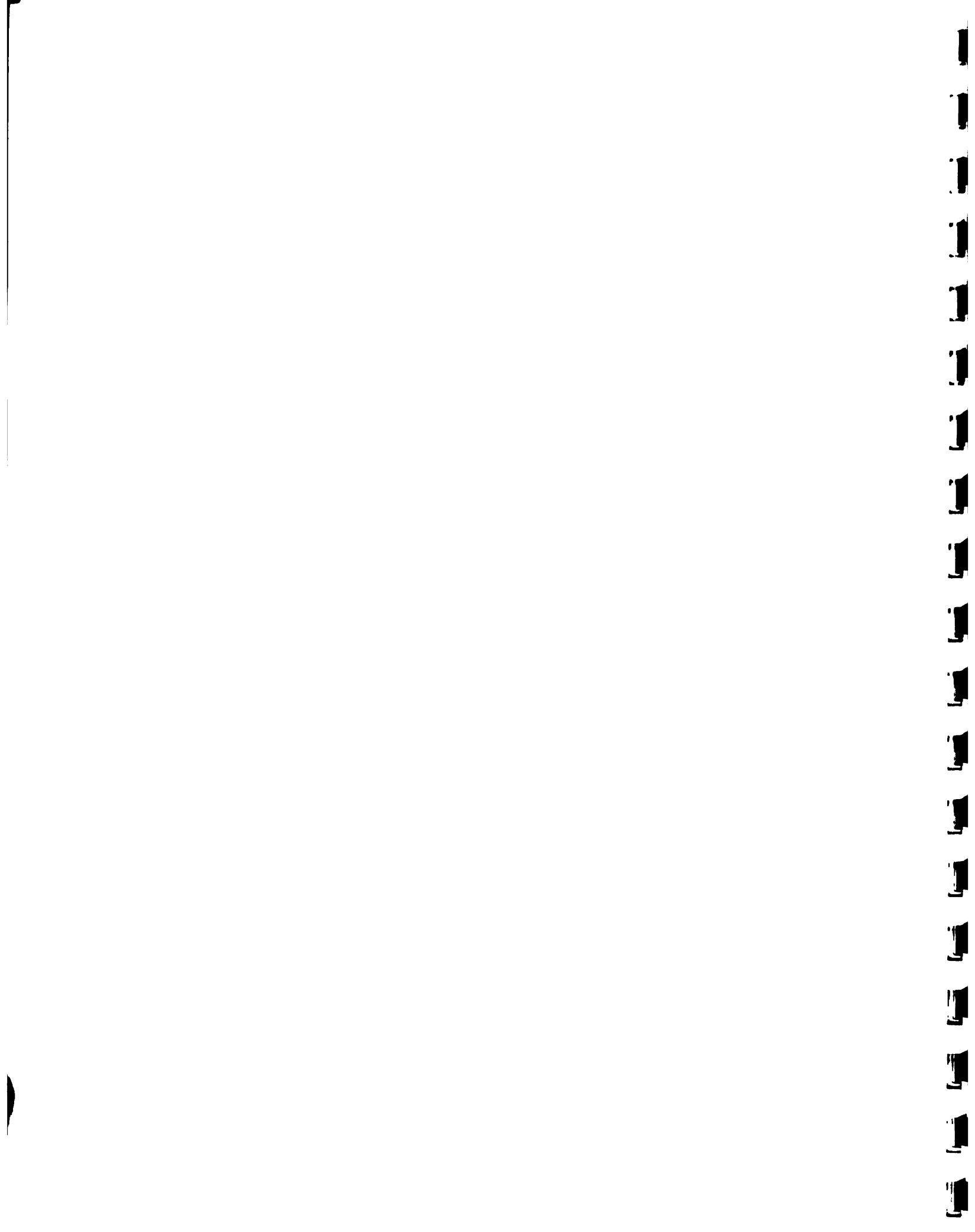
The need for systematic information and knowledge in general to support policy analysis at the various levels of decision making is also felt. This appeared in connection with the top advisors' duties. Among the areas that are only partially covered are:

- general economic information and market projections;
- selected information on crops and livestock on an ad-hoc basis;
- production parameters;
- information on current research areas (local and overseas)
- planning information: existing resources, land use.

Present sources of information are the Agricultural Planning Unit, the BSIL and the BMC for sugar cane statistics, BADC on overall commercial crop information, costs of undertaking certain new activities, production costs of selected crops. Since no integrated information is in place serious problems of compatibility may sometimes arise rendering the whole analytical exercise basically unreliable. In no other circumstance is this more clearly seen than when formulating a development plan or in taking strategic decisions, in general.

Let us take the case of the crop diversification drive, aimed at limiting sugar production. This is a good example of a strategic decision and the requirement of new information that stems from it. That new information ranges from intelligence information on markets overseas to local production possibilities (availability of resources and production costs) for prospective crops. In general, the adoption of decisions of strategic import render inadequate the existing information resources. Issues of compatibility arise when existing information from diverse sources is brought together to support a new analytical task. It is probably due to its restricted scope as seen from a new, wider context (the import substitution, export development, crop diversification drive) that it comes now to be considered inadequate by public decision makers.

On the management of projects and special programs (funded by



European Development Fund, World Bank, IADB) no special need for an integrated information system was expressed. The present system is felt to work satisfactorily in reporting progress and administrative and technical difficulties that need intervention from higher decision levels.

From the point of view of the stages of decision making, implementation is felt to be adequately supported, while intelligence, design and to a lesser extent choice lack proper support.



III. THE EXISTING MANAGEMENT SUPPORT INFORMATION SYSTEM IN THE AGRICULTURAL SECTOR OF BARBADOS

Keeping in mind the different decision types, stages of decision making and activity levels that the information system has to support, a preliminary analysis of the existing system was carried out to:

- identify basic procedures in information collection, handling and processing in place at the divisional level; and
- identify existing resources in terms of computer facilities, both hardware and software, and orgware.

The range of interest in the analysis extended beyond the computerisation, present or expected, of on-going divisional activities. The focal point has been the orgware side of the management support information system already in place. In the following, a cursory review of each unit visited in the agricultural sector is presented.

MINISTRY OF AGRICULTURE, FORESTRY AND FOOD

a) Agricultural Planning Unit

This Unit is in charge of the statistical information subsystem in the agricultural sector. Computerisation of the statistical reporting has been achieved with IICA's technical assistance. This has been achieved using Multiplan in a dual floppy-disk Wang microcomputer, in the form of information modules made up with individual sheets corresponding to the reports' tables. These sheets can be called up as soon as update data are available. A number of these information modules are now available:

- Fisheries statistics. Reported as Daily Recorded Fish Landings by Species.
- Boat Registration. This information is used for the expansion of fish landing sample results.
- Agricultural External Trade. These tables are generated from the Statistical Services basic print-outs. Data are entered and aggregated in Multiplan sheets.

Particular applications have been also generated to support specific information processing needs. Among these we have:

- MAFF's Technical Assistance Project Control also developed in Multiplan.
- Pay Travel Control. Developed in Multiplan for use of the



Accounting Office.

Most of these applications have been developed with a rented Wang PC microcomputer provided through IICA funding. At present the following system is operating in the Unit:

Hardware:

- Wang APC (IBM PC XT Compatible) with:
 - 8086 Processor at 8 MHz
 - 512 Kbytes
 - 1 1.2 Mbytes floppy disk drive
 - Graphics card interface
 - 1 20 Mbytes Hard Disk
 - IBM emulation
- Dot matrix printer (small carriage)
- Letter quality printer
- Monochrome monitor

Software:

- MSDOS Operating system
- MS Basic
- Utilities
- Multiplan
- dBase III Plus (Database manager)
- Business Graphics
- Wang Word Processor
- MSTAT (Michigan State University Statistical Package)
- The Survey System (Statistical Analysis Package)

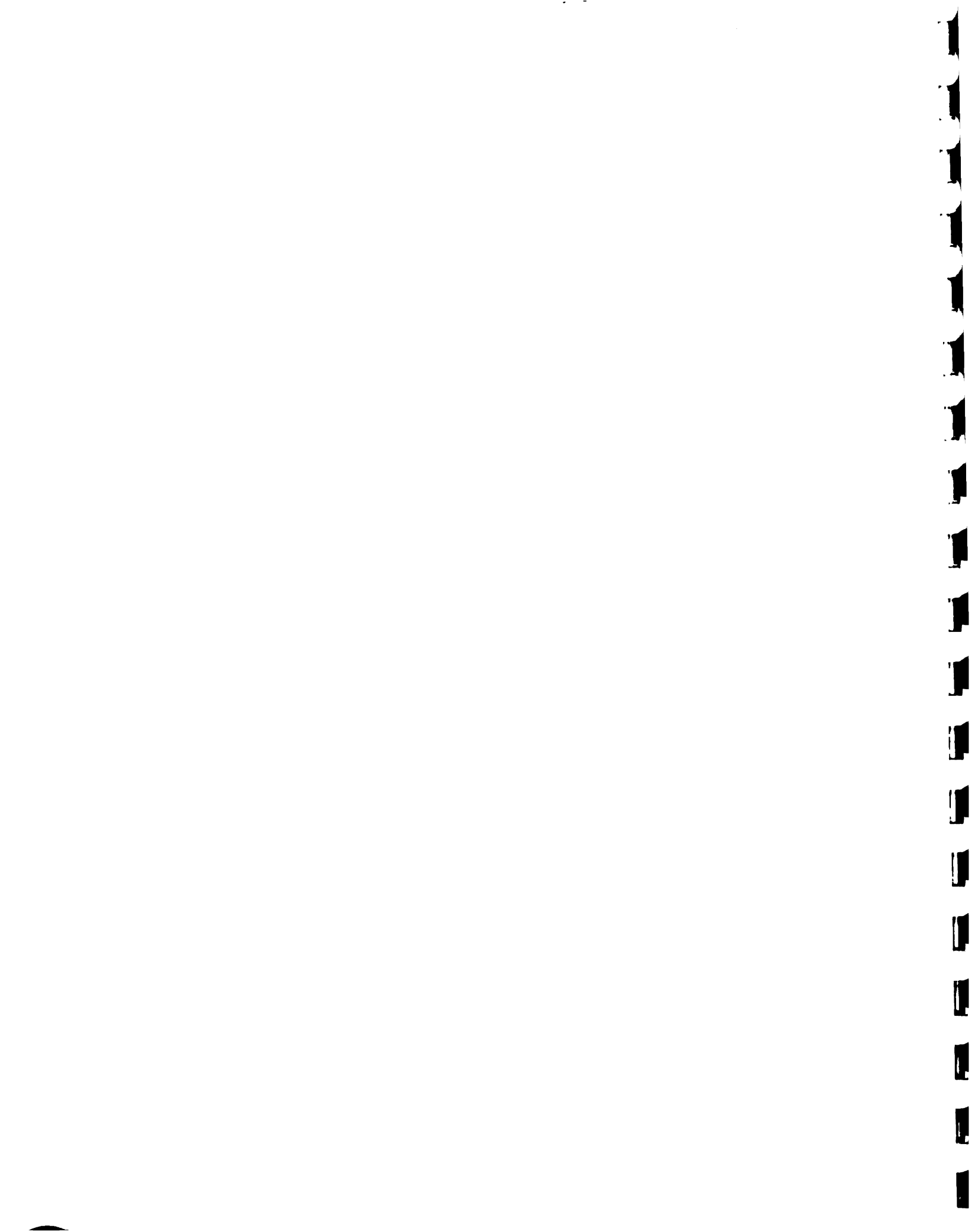
The applications are currently installed in the new microcomputer which is also used for wordprocessing and statistical analysis by researchers from the Research and Extension Unit. The latter utilise The Survey System and ad-hoc application programs developed in Basic for more specialised statistical analysis.

The need for more flexible data retrieval and manipulation points to the future development of database systems using dBaseIII Plus or ISIS, whichever is more suitable for both the applications already developed and the new applications.

Training has been restricted to wordprocessing for the support staff and to the use of the statistical analysis packages for the researchers. Statistical staff is not presently making use of the microcomputer in their own work.

As to statistical information processing is concerned, lack of personnel for data collection and input is reported.

The need for a new Agricultural Census is felt to be overriding, since the latest Agricultural Census was carried out in 1971. Not all of the Census results are available, and the preliminary report was published in 1980. The new Census was programmed to



be carried out in 1987 but funding was not approved. The total cost is estimated in the range of US\$ 250,000.

Statistical information is kept current by the staff organised along product groups. Thus, for instance, livestock statistics are processed by one officer who keeps records manually to update poultry statistics for use of the Poultry Monitoring Committee. The data is collected from three hatcheries, three large growers and four processing plants. Pig industry statistics are also processed for the needs of the Pig Industry Monitoring Committee. Some of this information is duplicated by BMC's BASIS system, but the need is felt of more timely information.

In the case of the dairy industry, information is kept on fifty producers for use of the Livestock Division and the Dairy Development Committee. It is used to manage the Revolving Fund.

This Unit is also in charge of the planning function at the Ministry. This function is currently implemented as an advisory role to the highest decision levels, since no formal planning exercise as such is carried out, with an specific institutional set up. This makes the expression of some needs felt as informational, to point to the absence of an organisational support for planning duties. An example of this is the manifested need for information to monitor the Five-Year Development Plan. For this a system for monitoring the Annual Plan (which is not formulated as such) and the development projects would be necessary. A more modest need was expressed in the form of project monitoring systems that provide a means of following projects in the pipeline, reminding managers of impending intervention to keep those going.

Overall the time is ripe for undertaking the design of an integrated information system for planning purposes that start with a classification of information distinguishing between the statistical information and that for use in project monitoring, intelligence on exogenous factors. From this it will be possible to determine and develop the appropriate sources of information (BADC, for instance) and integrate with the required adjustments the system elements that are already in place working well but on an ad-hoc, limited basis.

The possibility of accessing databases abroad in the various areas of research that would be of interest to Barbados can be explored in the context of the development of systems for intelligence collection.

b) Agricultural Division

- Research

No pressing need for internal information system development was detected. Needs are related to keeping track of information on



research results, internal and abroad. . Access to that information would be helpful.

A bibliographic system for the management of documental information is felt as an important need.

- Extension and Development

No need for management information was detected at the level of the Deputy Chief Agricultural Officer for Extension and Development. Units under their supervision were visited and some resources and needs were identified.

-- Animal Nutrition Unit

This Unit received the first microcomputer to be used at the Ministry. This equipment was donated by the OAS in 1984. The hardware configuration is the following:

IBM PC XT with 640 Kb main memory
2 360 Kb floppy disk drives
10 Mb hard disk
Monochrome monitor
IBM Graphics Printer, small carriage
Brother M1509 wide carriage printer

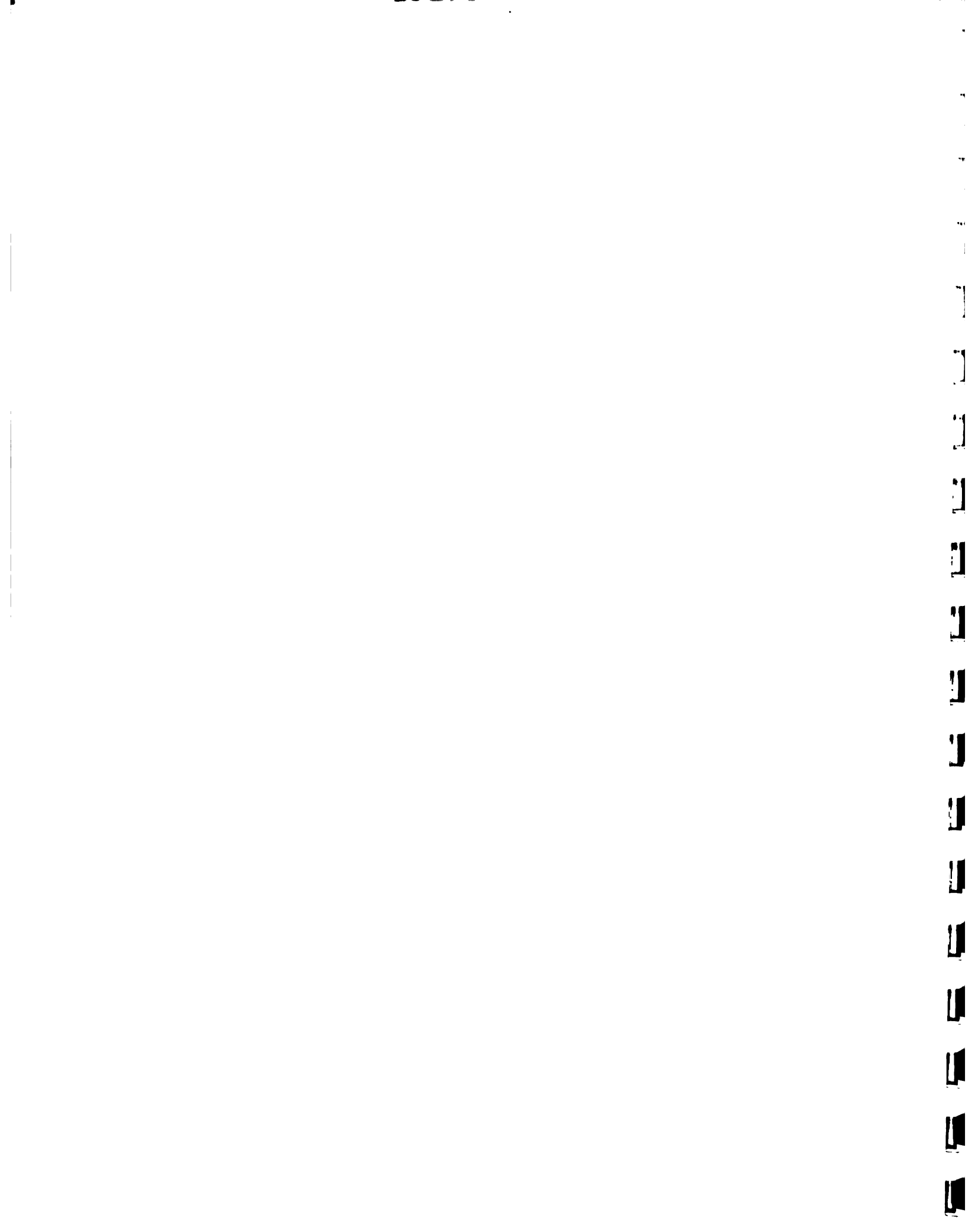
while the software includes:

Standard software (Disk Operating System)
Microstat (statistical package)
Printing utilities (Print-Q, Printmaster)
BRILL package for feed formulation
Missouri Sheep Improvement Program for genetic breeding program
Dairy and goat milk cost/profitability program.
In-house development of programs for laboratory and feed evaluations.
COBOL Compiler
Tutorial Programs for BASIC, Wordstar, dBaseIII and Lotus 1-2-3.

This system is used for running the specialised packages for livestock research and management while technical cooperation personnel was at the Unit. No general training program for microcomputer use was ever undertaken. It has been an interested user on contract on OAS funds that is now undertaking an informal system administrator and trainer-programmer role. Only a small minority of the research staff is reporting using the computer for statistical analysis of experimental data.

-- Central Livestock Station

This Station is currently carrying out extension and development activities. It manages three experimental stations: the Central Livestock Station, Greenland in St. Andrew and The Home.



This Unit is responsible for the Livestock Programme. Due to streamlining of operations over the last year, each station has specialised so that no duplication in operation occurs. CLS retains cattle, goats, rabbits, and poultry. The Greenland project specialises in calf rearing, and sheep, while the Home Station manages pig production.

No basic research is being done, due to lack of specially trained personnel.

Information is published yearly in the Annual Report. CLS sits in on the commodity monitoring committees, and the head of the CLS is a close advisor to the top decision making levels.

Data on insemination service is manually collected and processed. Monthly reports are produced. Some statistical analysis of experimental data is done at the Animal Nutrition Unit's IBM PC using a special programme. Since the facilities of the ANU are located close by, little inconvenience is foreseen as to getting some computer time. Computer facilities at ANU are felt to be quite sufficient for the needs of CLS.

- Soil Conservation Unit

The main function of this Unit is to advise the CAO on the utilisation of lands in the conservation area so as to prevent and mitigate the effects of soil erosion. It is currently implementing the Scotland District Project in Haggats.

The SDP has recently acquired the following computer facilities:

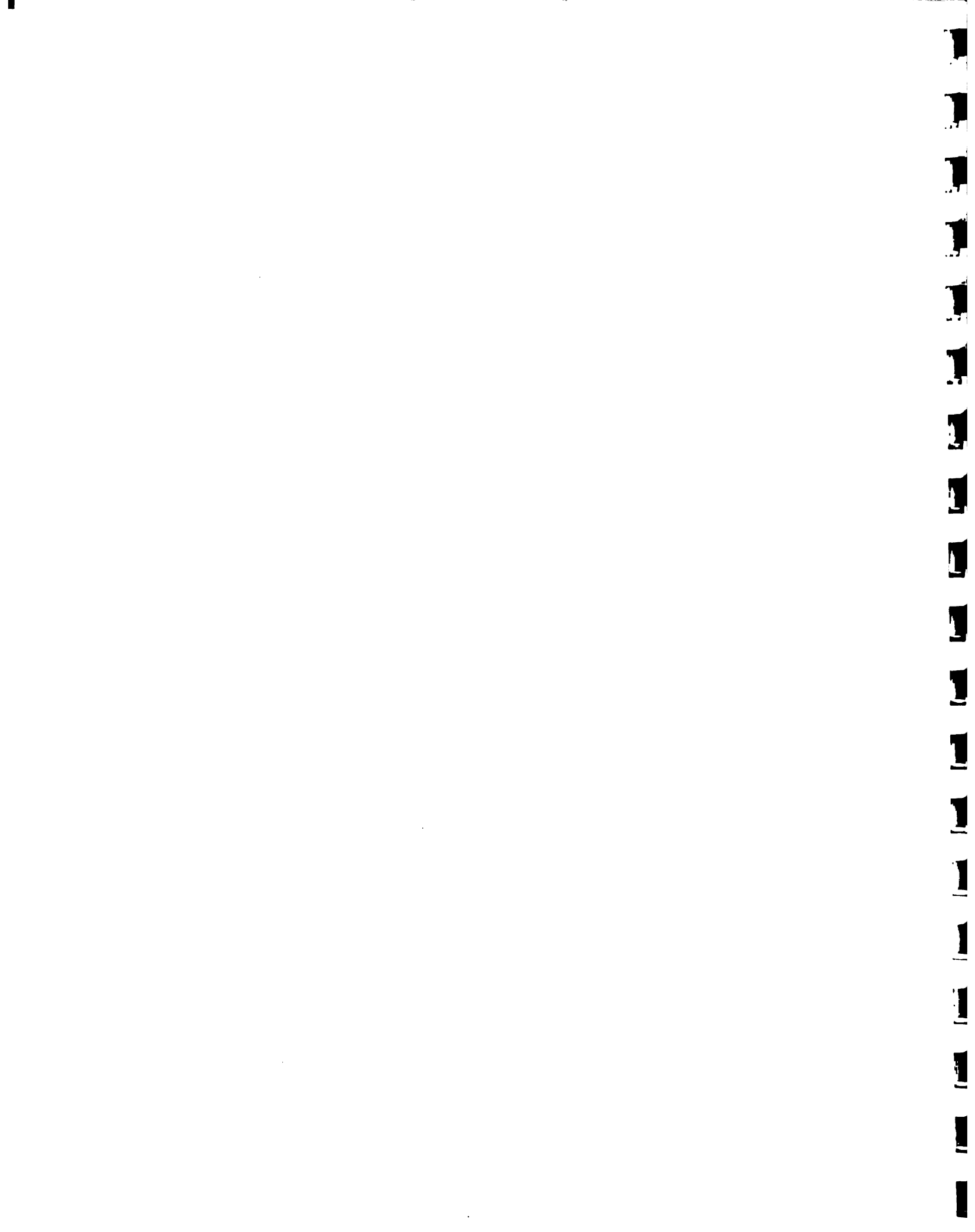
- IBM PC AT with 512 Kb main memory
- 1 1.2 Mb floppy disk drive
- 20 Mb hard disk
- Monochrome monitor
- IBM Proprinter XL 4202 wide carriage printer

Software includes:

- PC DOS ver 3.2
- Basic ver 3.0
- Multimate (word processing package)
- dBase III Plus (database management)
- Lotus 1-2-3
- Sharp Systems' Payroll package.

Thus far, all applications have been developed in Lotus 1-2-3 and include:

- Rainfall data for 9 areas
- Statistical analysis for sugar cane fertilisation experiments



- Soil analysis.

Other applications in the agronomic aspects of the project are expected to be undertaken in the near future.

Present use of the computer system is very restricted. Need for basic training at various levels is very sharp. An informal training program is being provided by the National Data Processing Unit. DPU has also offered technical help when required.

All in all, however, in-depth training will be necessary before proper use of the computer is accomplished. This is a fact that did not appear in our visit as being faced with the required understanding. Sharp Systems offered training for two accounting officers and one typist in the operation of the payroll package but no proficiency in the operation of this straightforward application was evident.

c) Fisheries Division

This Division has prepared a proposal for its computerization in October, 1986. At present all internal record keeping is done manually and the fisheries statistics are generated in the APU with data provided by this Division.

The proposal identifies the following needs for developing computerised applications of the following information modules:

- Fishing vessels record keeping
- Fishermen licence records
- Marine research project data processing
- General Office duties such as accounting;
- Library cataloguing, indexing and management.

The proposal asks for the acquisition of the equivalent of an IBM PC XT with a 20 Mb hard-disk, database manager, statistical package and standard software (spreadsheet and wordprocessing).

d) Government Laboratory

This Laboratory carries out analysis of substances for public and private institutions. It includes: agricultural, food, chemical microbiological and toxicological analysis. Biochemical analysis is done for all Public Offices. All tabulation and display is carried out manually.

It has the following computer facilities:

Hardware:

1 Apple MacIntosh with 128 Kb main memory



1 floppy disk drive 400 Kb
Keyboard and mouse
Imagewriter printer

Software:

MBasic
MacWrite
Multiplan

Currently the system is mainly used for wordprocessing. No staff is in operation of the computer, the existing resources are scarce.

The need is felt for scientific data management with graphic capabilities. The existing computer system is ill equipped to support this application mainly due to lack of adequate software. Here the issue of hardware compatibility with other units at the Ministry arises, if hardware, software (particularly packages and specific applications) or data are to be shared or communicated. If the IBM PC standard is adopted, then this system will be absolutely eccentric, and will only be justifiable if exclusive software is being used for exclusive tasks, which may well be the case here. The existing equipment though has been found lacking for these specific applications and it is no wonder that it is being used as an imperfect typewriter.

e) Registry

There is need for a computerised file routing system. Registry is a central clearinghouse that keeps manual record of file movement around the various divisions and departments. For this a standard coding system is in place. This application does not appear to be particularly difficult to implement with an adequate database manager for textual information.

f) Accounting

Two specific applications have been made using spreadsheet packages. One in the Planning Unit's computer is used for Pay Travel Control in Multiplan. The other application being developed in the Animal Nutrition Unit's computer with Lotus 1-2-3. Since this area has typically been subject of development of multiple applications, in its several functions:

- maintaining bookkeeping and accounting records;
- budget administration;
- keeping inventory records;
- preparing payroll; and



- purchase of required goods and services,

the real need here would be to outline a program of integrated, phased subsystem development, marked by evaluation, adoption and adaptation of existing packages to priority applications within the overall computerisation program.

PARASTATAL AGENCIES

g) Agricultural Development Corporation

This Corporation is one of the parastatals in the agricultural sector charged with the functions of:

- stimulating, facilitating and undertaking the development of agriculture and carrying out, operating and participating in such agricultural projects that are approved by the Cabinet; and

- develop and manage, on a commercial basis, the plantations and other agricultural lands that may be vested in it, implementing the government's agricultural policy so as to stimulate and encourage the private sector.

To carry out its activities the need for a programming and budgeting system for the BADC plantations was expressed. Similarly a monitoring system for the plantations' operations with a weekly report of activities is expected to contribute to better management. These can be integrated in a management information system that also includes a production costs subsystem. The latter would provide useful information that the National Statistical Service now requires for improving the quality of its current production estimates. IICA's technical assistance has been requested to develop such computerised management information system.

Requests for information are particularly numerous, not only from the top management of the Ministry but also from BMC, which requires information, for instance, on the type of products to promote, as well as actual production costs of different crops.

At present BADC does not have computer facilities of its own. Accounting data is processed outside. It has drawn up plans for the acquisition of a computer configuration to support its accounting system and the management information system it plans to develop. The computerisation plan (now for approval by the Computer Committee) consists of an IBM PC AT running on XENIX, a multiuser and multitasking operating system, with two terminals plus one IBM PC XT standing alone for payroll, wordprocessing and spreadsheet analysis. The larger system is intended for the management information system.



h) Barbados Marketing Corporation

- Agricultural Marketing Services (AMS)

The other parastatal of the agricultural sector of Barbados is charged with the following functions:

- stimulate, facilitate and improve production marketing and processing in Barbados, particularly to the benefit of the producers;
- secure the most favourable arrangements for the purchase, handling, transportation, storage, imports shipping, marketing and sale of produce;
- make recommendations on any matter related directly or indirectly to the production and marketing of produce.

The AMS is in charge of the following publications that originates in the BASIS System:

- BASIS Report (the latest issue was February 87 as of 15 May 1987). This report contains information on:
 - Acreages planted in plantations
 - Rainfall for the last three months
 - Average wholesale prices of selected crops
 - Next month's price forecast for selected crops.
 - Harvest projections
 - Average wholesale prices for the same month on the last three years
 - Average wholesale prices for the three next months on the last two years

The circulation of the BASIS report is estimated in 675 and is not restricted, i. e., it also reaches small farmers.

- The Poultry Voice (latest issue is January 87) issued monthly based on BMC-BASIS Poultry Statistics. These statistics are issued weekly with estimates on placements and estimates of national production, sales, stocks and imports.

Circulation of this bulletin reaches 355

- Pig Industry Newsletter, also part of the BASIS system, is issued monthly. It reports information on processing and imports. Its elaboration is not coordinated with the Agricultural Planning Unit which participates in the Pig Industry Monitoring Committee.

BMC has access to external trade information such as international prices from Holland on European markets, from the Toronto market and the CARICOM countries. But this is no



privileged access since such information is also directly obtained by the exporters and the Ministry's Export Promotion Commission.

Among the needs that were expressed in relation to the agricultural sector information system, are the following:

- Survey of small producers. At present all information on acreage come from surveys conducted on plantations by two officers. In spite of the circulation of the BASIS Report which is also distributed among small farmers, feedback information on small producers is thought important.

Data processing for the BASIS System is done manually. There exists a Burroughs B20 Microcomputer with a 5 1/4" floppy disk drive and a hard disk plus printing facilities in the Accounting Department, but it is being administered in the old mainframe tradition with restricted access to the AMS personnel. Some statistical information is being processed with the microcomputer at the APU.

PRIVATE ORGANISATIONS IN THE AGRICULTURAL SECTOR

It was felt that meetings with the representatives of the most important private agricultural organisations were necessary to incorporate their needs and resources in the analysis of the management information system for the agricultural sector.

A. Barbados Sugar Industry Limited

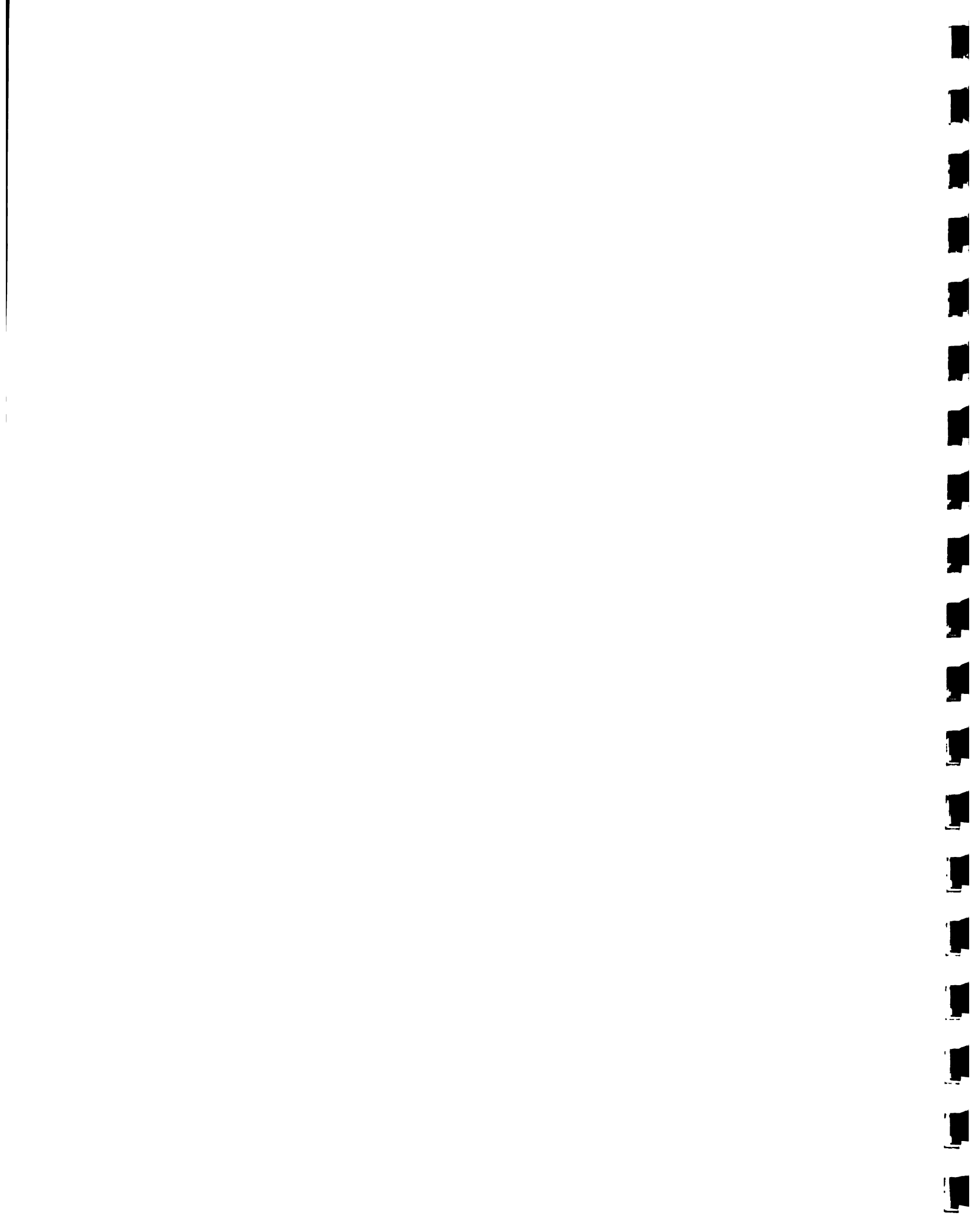
Aside from facilitating information to the Central Statistical Services for the elaboration of sugar statistics, BSIL publishes the Sugar Review with a circulation of 200.

No computerisation of information processing operations has been carried out. Accounting services are provided by a local private firm to most of the large plantations.

Global information for the sugar industry is derived from a large sample of such plantations (about 60) classified in 16 types. This classification is based on ecological considerations serves to compensate among members of the associations as to profit distribution.

A limited use is being made of microcomputers at the factory to process data. Hardware and software are restricted to a Commodore 64 and its utilities and application packages. No pressing need is felt for an expanded system.

BSIL services to farmers include milling in 6 factories, and advice on different aspects of sugar cane management from agronomic to broad technological matters.



At present development of a computerised system to be managed in-house is being considered to provide accounting services while keeping the present accounting service in its audit function.

The information that is felt it is needed most from the government services are research & development results. This is being presently accomplished.

B. Barbados Agricultural Society

A list of producers by parish and by product is kept personally by the General Manager. With this they are capable of keeping information on acreage planted. However the BAS would like to provide advisory service to all farmer on market oportunities. Do "forward planting" in short.

Since 1982 they have colabored with the BMC in the BASIS project. In their monthly Bulletin "One Voice" the BAS would like to provide information from BASIS to their membership, but information is usually two or three months late. This is considered to be too late.

On BASIS, it is felt that the pig industry information is good. The same opinion is held about the poultry figures even though mortality estimates are not always precise. Information on vegetables is considered definitely not reliable.

Also needed is data collection and information processing on dairy products.

OTHER PUBLIC INSTITUTIONS

It was felt important that a short survey be carried out in other public institutions in order to find indications as to:

- the way they were implemented in terms of hardware, software, experience and training in the use of microcomputers for eventual cooperative efforts; and
- the possible role of the Agricultural Public Sector in the context of the overall development effort of a public management information system.

1. Barbados Statistical Services

The following statistical information is being produced that is of interest for the agricultural sector:

- Production estimates based on surveys conducted by two officers. Additional data is collected from the



Agricultural Society (BAS) and the Sugar Industry (BSIL).

- External trade statistics: imports, exports and reexports from customs documents. Hardcopy print-outs distributed to selected public offices and on request. One of these is received by the APU for processing overseas trade statistics. The latest issued (as of 15 May 1987) is for February 87.

The CSS publishes the following bulletins:

- Monthly Digest of Statistics of which the latest is the issue corresponding to December 86
- Labour Force Statistics (quarterly)
- Monthly Bulletin
- Economic Report (latest 1986, published in April 87) contains the national accounts.

No household surveys have been conducted since 78/79. The previous one was 1961. Updated information on income and on consumption of agricultural products is not available in consequence.

Data processing is done manually. External trade statistics are entered in the Data Processing Division of the Ministry of Public Affairs. Transfer to 5 1/4" diskettes for downloading the data to the IBM PC XT microcomputer is presently being attempted with assistance from the DPD. This microcomputer is the only electronic processing tool of their own, and is being used sparingly for wordprocessing duties.

2. Data Processing Division

It has three units: Applications, Operations and Development (includes Applications Maintenance). Most of the work is implemented in the mainframe, an IBM 4300. There are the most diverse applications supporting the work of the public sector: Public Utilities, Electoral Office, Treasury, Statistical Services.

For the last two years they have been participating in the Computer Committee, chaired by the Ministry of Public Service. This is in charge of regulating the acquisition of microcomputers by the government, including those proceeding from extra-governmental funds. The criteria applied by the Committee include a confrontation of felt needs as expressed by the head of the Department with real needs as appraised by a DPD officer. They want to "protect users from themselves" in acquiring microcomputers, especially in view of what dealers offer and other consultants with packaged services (accounting, for instance) charge for their services.



Compatibility with the IBM PC standard also ranks high as a criterion for selection.

Concerning the Ministry of Agriculture they have authorised the purchase of the APU Wang Microcomputer, and the one in the Soil Conservation Project (IBM PC AT), where they are presently providing training in microcomputers (for 14 officers and staff) and general advice on the use of specialised software (Payroll).

Presently they have an IBM PC AT in place, both for training the trainers and for developing applications and design ideas that are carried over to the mainframe. They have trained officers to provide training in different software packages (Multimate, dBaseIII Plus, Lotus 1-2-3) but there is no formal program going on. Neither is there systematic software evaluation for use in the different Departments.

More microcomputers are not forthcoming to the DPD. It is felt that the provision of five microcomputers to the Training Division (which currently has no training program on microcomputers) would help start training in the public sector on a more continuous basis for which DPD could provide technical support. This is particularly necessary since private training organisations providing training in microcomputer use charge unaffordable fees for an inadequate end result.



IV. GUIDELINES FOR THE DEVELOPMENT OF A MANAGEMENT SUPPORT INFORMATION SYSTEM IN THE AGRICULTURAL SECTOR OF BARBADOS

A. Summary of Needs

Seen from an evolutionary point of view the construction of a management support information system making use of the microcomputer technology in the agricultural sector of Barbados is in an initial stage. No more than three units are in place and in no case a veritable system design and development has been conducted. In this respect the Agricultural Planning Unit has had the most experience, for reasons of its own mandate, in building computerised applications in support of its statistical work and because of its advisory role to the highest echelons of the Ministry.

Designing and implementing an integrated management information system is, in the opinion of the consultant, a viable though protracted undertaking. A system approach must necessarily be adopted to arrive at a system layout that may guide development as a top-down rough sketch to be implemented with a bottom-up approach.

The bottom-up approach is now feasible since, from the information processing point of view, all units at the Ministry have reached a point of individual organisational maturity. Some organisational arrangements have still to be made to avoid duplications or to centralise operations to attain the critical mass that permits a higher level of effectiveness. This may be the case when considering the statistical information processing at the Marketing Corporation and the Planning Unit, for instance.

Providing the units with powerful means of information processing may lend them the required flexibility to fulfill their roles more effectively and the capability for integration with other complementary units in operative groups armed with increased problem solving capacity.

For that to be effective a degree of awareness as to the implications of the eventual adoption of microcomputers in the development of the management information system is necessary. They are making possible to even conceive the idea of a cost-effective information system that efficiently supports decision making in the sector. To integrate them into the daily activities of the organisation will require a profound change not only at the institutional level. It will also affect individually the most valuable asset: the human beings that will make them be either useful tools or expensive reminders of human folly. This microcomputer awareness is the first overall and overriding need.

The second overall need, not less important than the first one, refers to the commitment to an interdisciplinary, integrated institutional approach to the development of the agricultural



sector. This is the organisational foundation without which no information system can work effectively, least of all support and improve the quality of decision making.

As to specific needs, it has been found that:

- most organisational units could readily profit from computerisation for carrying out their current activities.
- the next stage of computerisation at the core of the management information subsystem, the Planning Unit, involves the extensive and intensive use of database technology for an easier retrieval of information on an ad-hoc basis.
- there is need for reformulating inter-unit activities particularly associated with the production of statistics: an integrated statistical information subsystem should be set up specifically connected to planning needs.
- interinstitutional information subsystems in support of the commodity monitoring committees should be explored as a cooperative endeavour with the private sector.

It has been felt overall that a viable management information system in support of decision making in the agricultural level will emerge if these needs are progressively satisfied.

B. Summary of Resources

At present there are two IBM PC microcomputers (one XT and one AT) and a Wang APC microcomputer (equivalent in processing power to an IBM PC XT and compatible with the IBM PC standard) at the Ministry of Agriculture. The software needed for building the most urgent applications are already in place. A very small percentage of the staff has already had some acquaintance with the available microcomputers.

As far as resources for training is concerned, a thorough survey has not been carried out, but it is believed that this poses no serious restriction. Intensive training programs can be undertaken with the resources in place.

C. Summary of Restrictions

Given the context of well established procedures to be found at the Ministry, most of the applications that have been identified and merit high priority can proceed to the computerised system development phase. However, the number of them may pose serious pressure on the use of the available microcomputers.

In the initial stages of system development, the pooling of



microcomputer resources and the scheduling of its use should be contemplated. However, it is believed that this may not prove enough in a relatively short time. More hardware will be required.

D. The Proposal

It is postulated that a functioning management information system for the agricultural sector will be the result of the implementation of a medium-term development plan, with four main components:

- organisational development that does not necessarily involve a major change in the current organisation chart, but mainly upgrading procedures and communication links to integrate harmoniously the microcomputer technology;
- a training component which includes appropriate materials for every level of the organisational hierarchy: decision makers, managers and operational staff;
- an appropriate hardware acquisition and maintenance scheme;
- a software development program with a two-pronged approach: use of packaged software for the basic tasks (wordprocessing, spreadsheet analysis, statistical analysis, and straightforward database applications); and development of complex applications especially in support of particular decision making processes, when no similar application can be adapted from elsewhere.

Of these components that of training has been singled out as the most critical one and should be faced with the highest priority. The organisational component is also critical and should be considered with high priority and to be pursued in parallel with training.

It should be clear that training takes on a different meaning according to the role that the trainee has to play in the organisation. In this respect it is convenient to distinguish three prospective types of trainees:

- decision makers and managers in general
- technical officers
- support staff

with different training requirements. Thus, decision makers are most in need of in-depth, realistic knowledge of the capabilities, present and prospective, and inherent limitations of the microcomputer technology. For instance, will expert systems ever be built, reliable and flexible enough, as to really



support improved decision making in the agricultural sector with all its distinctive characteristics?. What can be expected of database technology for information management? In general, this information is not provided with an objective, disinterested regard to service, and the proposals for so-called integrated regional information systems are increasingly being pushed for adoption without consideration of basic organisational restrictions at the national level. Why these systems will never function properly if the units at the basic level do not undergo drastic upgrading is a question that should be clearly understood by decision makers. This can only be achieved if essential facts of information technology have been fully grasped.

Technical officers will profit for in-depth training in the use of packaged software for basic tasks (wordprocessing; spreadsheet analysis, database management, statistical analysis) and its application to specific problem solving in their specialised fields. At this level it is believed that training should emphasise the support that computers in general can provide to problem solving in the trainee's particular areas of application. Hands-on experience with specific projects identified and formulated from its daily work should form the gist of the training program.

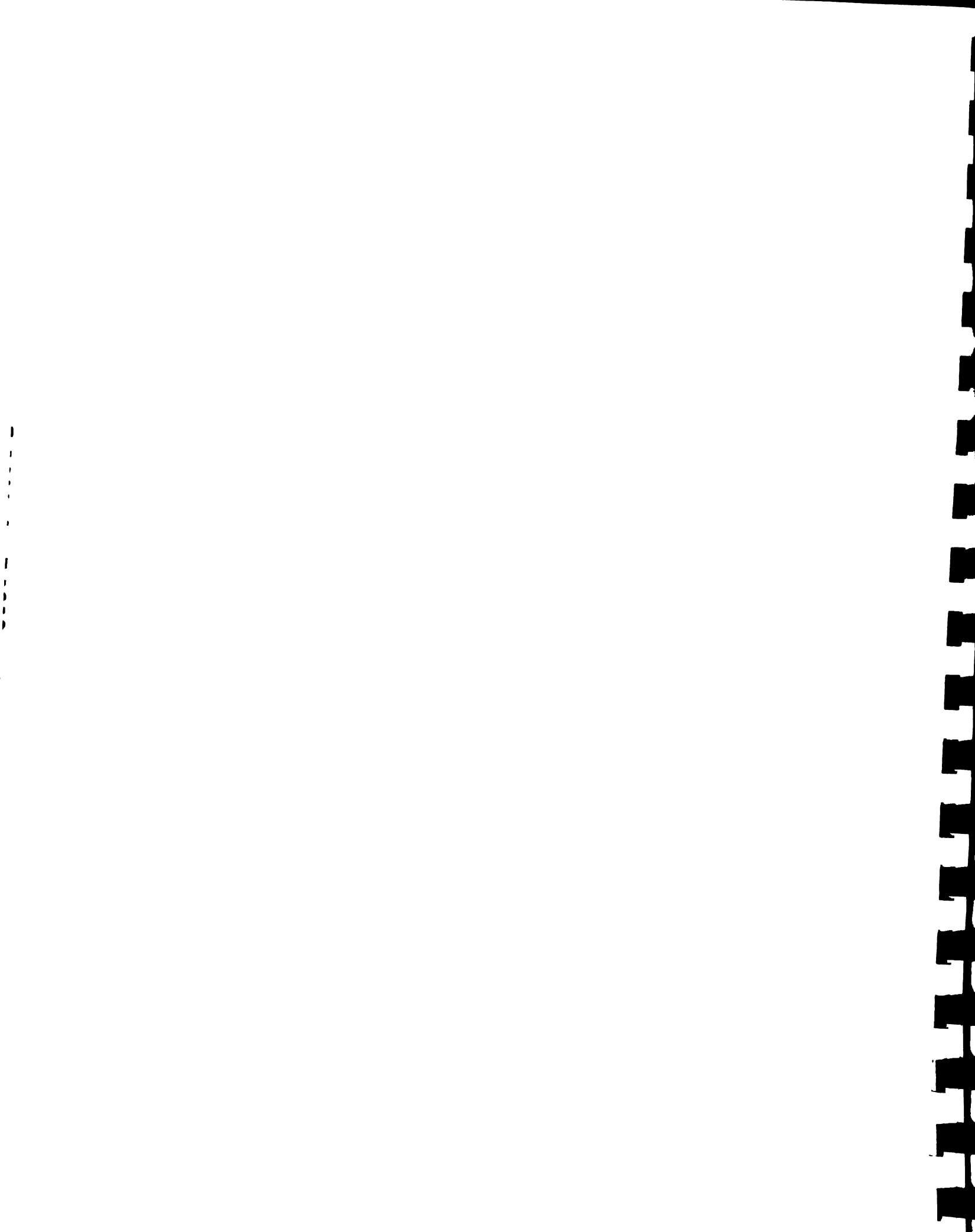
The training privately offered fits more the needs of support staff. And, in general, it provides this with information that does not have immediate relevance. This is particularly true of training packages that by definition must cater to the widest possible spectrum of trainees. Even this requires to be complemented with basic knowledge of maintenance practices of both hardware and software that is not usually provided. The other disadvantage is naturally the high cost of training provided on a commercial basis.

In general, software is not an issue to attend immediate development needs, save for one or two packages that are readily available. These include UNESCO's ISIS textual database management package and a package for statistical analysis of survey data (Creative Research System's The Survey System should be adequate for most needs).

As far as hardware is concerned, given the present restrictions as to availability, pooling of resources should be considered in the initial stages. It is believed that discipline in time scheduling by departments will help in the general stock taking that should pervade all initial efforts at systematic development.

For such scheduling it should be kept in mind that:

- scheduling does not mean putting all machines in one place. It only means that a centralised control of computer use is kept, so that the optimum use is made of scarce resources.



- as a rule, wordprocessing, spreadsheet analysis, data entry and basic database management can be done using a dual floppy-disk unit. Only more complex statistical analysis and database applications require a hard-disk unit.
- regular, programmed tasks take precedence over one-shot tasks which may be solved with other means.
- printing tasks should have low priority and be kept for off-hours. In no case should printers be used for multiple copies of the same document.
- system maintenance and general housekeeping tasks should be scheduled for off-hours.

The detailed system development plan should emerge as a result of the later stage of general system design, but some specific guidelines are here presented:

a) On hardware compatibility

The acquisition of microcomputers presents two different circumstances:

- the selection of the most adequate equipment for very specialised tasks, such as laboratory analysis of diverse kinds where both input and output is not done through standard equipment (keyboard and CRT). This case is typical of scientific computer equipment.
- the selection of equipment for the implementation of a computer system involving more than one unit. A typical case is the management information system.

In both cases, of course, the selection obeys to the goal that is being pursued and should conform to cost-effectiveness criteria. However in the second case the issue of the possibility of easy linkage between the various units appears. That linkage may involve:

- hardware compatibility, that is the possibility of interchanging pieces of equipment between different brands of microcomputers;
- software compatibility, the possibility of interchanging programs, applications and data between different brands. There are varying levels of compatibility that range from the interchange of data (compatibility at the operating system level) to use of complete packaged application programs.

Of the five microcomputers currently available at the agricultural public sector, three (the two IBM and the Wang microcomputers) are at least software compatible in all



foreseeable applications. The microcomputer at BMC (a Burroughs B20) may also present a level of compatibility at the operating system level permitting data exchange through diskettes. In our visit, however, it was not possible to get access to information allowing verification of compatibility with the IBM standard.

The microcomputer at the Government Laboratory, an Apple Macintosh, is definitely not compatible with the others at any level.

Since the government is adopting a policy of adopting the IBM standard for the acquisition of microcomputers for the public sector through the Computer Committee, no future problems are foreseen on this matter. Nevertheless, past purchases are indicative of the general manner in which the microcomputer technology is regarded. In general, more knowledge of what is available as contrasted with what is really needed to be able to discriminate real capabilities and limitations from dealers' claims seems indicated.

b) On the development of a management information system at the sector level

As already expressed in the summary of needs, the elements of a management information system at the agricultural sector are already in place as individual units functioning according to well established procedures and conforming the statistical information subsystem.

It is important to distinguish statistical information in the context of a management information system. Statistical information is produced in accordance to well-known, accepted procedures of regular, systematic data collection and processing. They constitute the background information available in a number of standard formats. On this background information, special reports can be produced as a product of ad-hoc detailed studies using other available information and/or surveys.

All these data collected, processed and stored in the files of a database management system, provide the informational support to unstructured decision making that requires prompt response to ad-hoc queries on the most diverse questions. The statistical part involves only that information that is reported in a constant, permanent fashion.

Thus posed, the question of a management information system at the sector level implies:

- the strengthening and enlargement of the basic statistical information subsystem; and
- its gradual integration into a functional whole.



In the case of the agricultural statistical subsystem in Barbados strengthening means primarily carrying out the Agricultural Census with the highest priority gearing its realisation to the need of a solid baseline for the statistical information subsystem as part of the management information system.

On the other hand the integration of the statistical subsystem requires working out a functional organisational arrangement between the Planning Unit, BMC and BADC in order to align their statistical activities to the needs of the sectoral management information system. Activities are being duplicated where a coordinated effort would be appropriate. For this exercise in integration a systems analysis will have to be undertaken as a first step to clearly define system goals and specific available inputs at each agency for the operation of the management information system in the agricultural sector.

The Planning Unit has been identified as the coordinator of the management information system at the Ministry of Agriculture. As such it is the organisational unit which is most in need of intensive systematic training. As database technology will surely be used to implement the management information system, the training program will have to emphasise this aspect of use of software for the technical officers at the Planning Unit.

c) On the central control of the management information system

The access by the top decision makers to information generated by and located in the decentralised agencies does not necessarily imply the physical centralisation of computer resources in a single location. What is required is software compatibility, communications links, and, most importantly, built-in flexibility and capacity at the information producing units, to respond adequately and with alacrity to ad-hoc queries. The delay time in answering a query would be the best measure of system maturity.

D. Stages of Development of the Management Information System

It is important to adopt an evolutionary view of the development of the management information system in the agricultural sector. Only then the constructive element of planning will help guide specific activities within the context of an overall view of system development.

In this view, we are presently at the initial stage of adopting microcomputer technology. As there prevades an overall state of ignorance as to the real implications of the decision to incorporate microcomputers in our information processing activities, it seems fairly clear that the first phase of development corresponds to a systematic, step-by-step approach to



reach computer awareness through a training program. As has been said, the contents of this program will be different according to the function the trainee performs in the agricultural public sector.

This training should be undertaken along with the identification of computerisation projects at the divisional level. Some examples can be mentioned:

- Registry can undertake computerisation of its filing system. This is a stand-alone application that performs only at this level and compatibility and communicability issues do not arise. Access to a hard-disk system with printer would be needed. The recommended software is ISIS, the textual database manager.
- The Accounting Office has initiated applications on this individual basis. A short systems analysis will permit better programming of its application development, and may permit identify the most adequate among the various systems that are being offered in Barbados.

The development of the statistical information subsystem of the agricultural sector management information system is a major undertaking that should be taken up as a project to be carried out in a medium-term effort. A detailed system analysis should be conducted to plan its orderly development in the larger context of a management information system. This does not preclude the development of more restricted subsystems at the agency level (BADC, for instance) for programming, budgeting and monitoring its activities. However, it is recommended that these efforts take into account the needs of the management information system, that is the informational needs of the top decision makers.



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