

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF INFORMATION STUDIES FOR AFRICA

INFORMATION RETRIEVAL BY USING E-MAIL FACILITIES: A CASE STUDY
WITH HOME-GROWN AGRICULTURAL DATABASES IN UGANDA.

A Thesis
submitted in partial fulfilment of the requirements
for the degree of
Master of Science in Information Science.

by

JANE FRANCES KANYUNYUZI-ASABA

May, 1996

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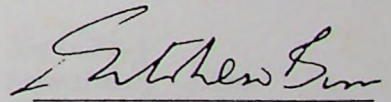
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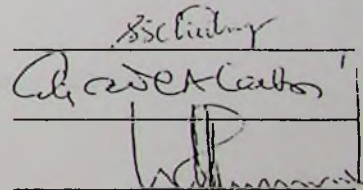
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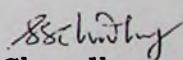
DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

Jane Frances Kanyunyuzi-Asaba

May, 1996

The thesis has been submitted for examination with my approval as a University advisor.


G.G. Chowdhury (Dr)

May 1996

DEDICATION

*To my children Simon and Paul whom I missed
so much during the two years of my studies at SISA
and in memory of my dear mother, Celina Abwooli
who inculcated in me the value of education.*

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Jane Frances Kanyunyuzi-Asaba.

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ABSTRACT

This study is aimed at designing an improved Information retrieval system (IRS) for the agricultural research sector in Uganda. The improved IRS is based on E-mail. For this reason, a survey was conducted to ascertain the information retrieval facilities available in the libraries of the National Agricultural Research Organization (NARO), Uganda as well as the information needs of the users. The survey was necessary as a basis for developing an improved IRS.

The Agricultural sector is the engine of growth of the Ugandan economy. It employs nearly 90% of the country's population and contributes to over 64% to the government revenue, over 50% of the GDP and over 90% of the total exports. The agricultural research sector, under NARO, has to meet the challenge of modernizing agriculture through development of improved technologies that can be taken to the farmers.

Findings of this study show that the existing information facilities / libraries are not adequate for the needs of the research scientists in NARO, let alone other users in the agricultural sector. The majority of information users indicated that the current information facilities could not meet their requirements. In most cases the information needed is not available in the libraries at their institutes and they have to search for it from NADIC, other libraries or use alternative sources of information such as the invisible college. On the other hand it was established that there were modest information resources at NADIC which could be shared by all research scientists in NARO. For this reason, an Information retrieval system (IRS) that is based on E-mail has been proposed. It will enable the users at remote research institutes to access the

information resources that are available at a central facility located at the National Agricultural Documentation and Information Centre (NADIC).

The prototype information retrieval system (IRS) comprises of two major components: NADISRV, a bibliographic information server which will facilitate the users at remote institutes to search home-grown databases at NADIC without having to travel from their stations; and an E-mail assisted Selective Dissemination of Information Service. By using the databases that are available at NADIC, the E-mail assisted SDI service, will periodically update all registered users about current information in their fields of interest. These services require as a prerequisite the availability of active and fast growing databases. For this reason, the centralized home-grown databases that are already existing at NADIC, namely AGRIN, CARIN, AGRINF, and ULIST will be used. In addition, two other prototype databases have been established using Micro CDS/ISIS software. The first one is AGREXP, a database of profiles of experts in the broad agricultural field, and the second, is AGRORG, a database of institutions that are closely or remotely related to agriculture.

The third component of the Information retrieval System (IRS) is, the NADIC SEARCH INTERFACE, a user friendly interface which has been developed using the ISIS Pascal interface. This interface will allow both the Information Centre/Library staff and the on-site users to interact with the system in a friendly way, thus making it easy for the users to conduct searches for themselves.

Finally, strategies for implementing and managing the proposed prototype information retrieval system, and recommendations for further improvements, are suggested.

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LIST OF ABBREVIATIONS/ACRONYMS

AGRICOLA	-	Agriculture On-line - A database of the National Agricultural Library (USA).
AGRINDEX	-	The hard copy form of the AGRIS database (Refer to AGRIS below).
AGRIS	-	The International Information System for the Agricultural Sciences and Technology (FAO).
ARIC	-	Agricultural Research Information Centre (proposed name for NADIC).
APC	-	Association of Progressive Computing, USA
BBS	-	Bulletin Board Systems
BITNET	-	Because its time to network, cooperative, World.
CABECA	-	Capacity Building for Electronic Communication in Africa,
CARIS	-	Current Agricultural Research Information System (FAO).
CAS	-	Current Awareness Service.
CDS/ISIS	-	Computerized Information Service, Integrated Scientific Information System.
CD-ROM	-	Compact Disc Read Only Memory.
CEPIS	-	Pan American Health Organization, Lima, Peru.
CGNET	-	An electronic mail network of the Consultative group on International Agricultural Research.
DARPA	-	Defence Advanced Research Projects Agency (USA).
DBMS	-	Database Management System (DBMS).

EARN	-	European Academic and Research Network, cooperative, Europe.
ECASRV	-	A bibliographic Information Server of the Pan African Development Information System.
ELCI	-	Environmental Liaison Centre International, Nairobi, Kenya.
ESANET	-	East and Southern African Network (Involves five Universities of East Africa and Southern Africa).
ENDA	-	Electronic Network in Dakar, Senegal. (Fidonet)
ERNET	-	Education and Research Network, India.
ESANET	-	East and Southern African Network.
ESNET	-	Network of the Department of Energy (USA).
FAO	-	Food and Agricultural Organization of the United Nations.
FTP	-	File Transfer Protocol. This refers to the ability to copy files from one's PC (or terminal) to a computer at a remote site or vice versa.
GDP	-	Gross Domestic Product.
IACR's	-	International Agricultural Research Centres.
ICRAF	-	International Centre for Research in Agroforestry.
IDRC	-	International Development Research Centre, Ottawa, Canada.
INFORM	-	A research Management Information System.
IRS	-	Information Retrieval System.
ISDN	-	Integrated Services Data Network.
ISNAR	-	International Service for National Agricultural Research (The Hague, Netherlands).
ITU	-	International Telecommunications Union.

IP	-	Internet Providers (Commercial Internet Services in Uganda).
IRS	-	Information Retrieval System.
JANET	-	Joint Academic Network (UK).
LAN	-	Local Area Network.
LEO	-	Low Earth Orbiting Satellite (store and forward technology).
HealthNet	-	Electronic mail Network of the Medical Faculties in the East and Southern African Region.
MANGO	-	Zimbabwean-based Fidonet network (host).
MISANET	-	An E-mail Bulletin Board Based in Windhoek, Namibia (Fidonet).
MIS	-	Management Information System.
MOA	-	Ministry of Agriculture, Animal Industry and Fisheries, Uganda
MS-DOS	-	Microsoft disk operating system : an operating system for micro-computers.
NARS	-	National Agricultural Research Centres (Institutes).
NASA	-	National Aeronautics and Space Administration (USA).
NGOnet-Africa	-	Non-governmental Organizations Network based at the Environment Liaison Centre, Nairobi.
NSF	-	National Science Foundation (USA).
NSFNET	-	National Science Foundation Network (USA).
NSINET	-	National Aeronautics Space Administration (NASA) Network (USA).
PADIS	-	Pan African Development Information System (Addis Ababa, Ethiopia).

PADISNET	-	Pan African Development Information System Network.
R&D	-	Research and Development.
SABINET	-	South African Development Network.
SADC	-	Southern African Development Coordination Committee.
SDI	-	Selective dissemination of information.
SISA	-	School of Information Studies for Africa (Addis Ababa, Ethiopia).
SLIP/PPP	-	Serial Line Internet Protocol, Point to Point Protocol.
S&T	-	Science and Technology.
UNCST	-	Uganda National Council for Science and Technology
UNESCO IIP	-	United Nations Education Scientific and Cultural Organization, Inter-governmental Informatics Program.
UNINET	-	A South African Network.
UPTC	-	Uganda Posts and Telecommunications Corporation.
UUCP	-	Unix to Unix Copy Program.
VSAT	-	Very Small Apperture Technology (for transmitting digitized information).
WAIS	-	Wide Area Information Server.
WWW	-	World Wide Web.

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

The importance of information as an invaluable resource in national economic development is well known even in developing countries like Uganda. Information has come to be accepted and recognized as a critical resource of all human activity. It permeates all stages of the research and development process, finding important applications in the areas of interpreting the mandate and legal status of the research and development (R&D), policy and decision making, formulation and implementation of R&D programs and projects, dissemination of R&D results and the actual management of R&D institutes themselves (FAMESA 1992).

Pina (1987) states that the improvement of food availability in the developing world by the research efforts of the International Agricultural Research Centres (IARC's) depends not only on applicability of the research in the developing world conditions but also on the ability of the IARC's, and the national agricultural research system, to get improved technologies into the farmers' fields and on consumers' plates. He emphasizes that information services have an important role to play in making technologies that can improve food production available to the national systems. More importantly, Pina notes that this role must be fully integrated with other centre activities related to this effort. He suggests that information workers have an obligation to support national researchers with timely and updated research findings. On the same issue, Kabele

(1987) notes that in the field of agriculture in particular, information plays a dynamic role towards increasing the production of various commodities.

Neelameghan (1994) states that in any area of socio-economic development, timely provision and use of relevant and reliable data and information is a prerequisite for gainful decision making, problem solving, planning and management. Information also helps to minimize the duplication of efforts and wastage of resources thus enhancing productivity. Such a provision, in turn, requires the development of an appropriate information infrastructure be it institutional, national or global.

This chapter gives a statement of the problem of this study which is lack of adequate and current scientific information for agricultural research scientists in Uganda, a country which relies on agriculture as the mainstay of its people and an engine for the growth of its economy. This lack of information is attributed at least in part, to poor information retrieval practices.

The chapter also discusses the possible solutions to specific problems identified in agricultural research libraries. The need for conducting a survey of the information resources available in the libraries of the National Agricultural Research Organization (NARO) in Uganda, the information retrieval practices used, and the needs of the research scientists is discussed. The objectives of the study and its justification are given. Also discussed are: the scope and limitations of the study; the research methodology used for the survey; and the significance of the study. Finally, details of the organization of the thesis are furnished.

1.1 STATEMENT OF THE PROBLEM

1.1.1 Agricultural Research in Uganda

Agriculture is the main economic activity of the people of Uganda. It contributes more than 50% to the GDP and over 90% to the total exports. Uganda has a wide range of soils, rainfall and altitudes which enable it to produce a diversity of crops and livestock. As such, Uganda has largely remained self-sufficient in food and has exported both cash and food crops despite the internal disturbances that prevailed in the country for some time in the past (Uganda. Working Group 9A 1991:1). However, with new demands on the economy and an increasing population, the development of Uganda cannot be sustained by relying on natural endowment alone, to sustain agriculture. There is therefore need to modernize agriculture so as to cope with the changing demands of the society. Development of agriculture requires the application of appropriate and tested technologies that have to come out of agricultural research.

Uganda has a long research tradition starting with the early pre-colonial period at the beginning of this century, when reputable and outstanding research stations such as Kawanda, Namulonge, Serere and Entebbe were established. From these stations flowed a series of improved plant and animal materials that made Uganda one of the foremost East African countries in food and export production in the 50's, 60's and early 70's. Makerere University commenced training in agriculture in the 1920's, and started research in agriculture in 1957. In addition, Uganda served as a station for the East-African Community Research in areas such as; trypanosomiasis and tsetse control, viruses, sorghum, millet, sugarcane and cotton improvement. After the break up of the

East-African community in 1977, agricultural research was neglected as the government of the day was not ready to spend much money on it. With minimum funding in addition to damages and looting of the research institutes which ensued from the civil strife that followed, there was a remarkable decline in research as well as the scientists morale (Uganda. Working Group 9A 1991:1). This decline was equally registered in research libraries in terms of their collections, manpower to run them and even the interest of the library users.

Realizing the value of research and its contribution to national development, in 1980 the Uganda government initiated the restructuring of agricultural research in order to rationalize the system so as to meet the national objectives. This work was later, in 1987, continued by a national task force assisted by the International Service for National Agricultural Research (ISNAR) and supported by the World Bank. As a result, a national agricultural research strategy and plan was developed in which provision of agricultural information to scientists is given priority. Consequently, government has implemented reforms in the research sector which are intended to enable it generate technologies that can facilitate agricultural development. Today the agricultural research sector is organized under an umbrella body known as the National Agricultural Research Organization (NARO). It comprises 8 research institutes, 5 research stations and several varietal trial centres (Uganda. Working Group 9A 1991:1).

The agricultural research strategy puts emphasis on improvement of the agricultural research services, hence improving the flow of technologies to farmers in order to underpin and improve their contribution to the growth and productivity of the

agricultural sector. The strategy also states the challenges of research as being able to produce innovations that are [Uganda. Working Group 9A 1991:2]:

- Attractive and therefore easy to disseminate to farmers;
- sustainable in terms of profitability i.e. without special subsidies;
- realistic in input requirements; and
- supportive in efforts to enhance environmental quality.

Realization of the above requires as pre-requisites [Working Group 9A 1991:2]:

- sufficient understanding of the agricultural sector to correctly focus the research efforts to farmers needs;
- a knowledge of the range of possible innovations available locally and externally; and
- the ability to successfully conduct research, on and off station, and transmit the results to the extension workers and farmers.

The above requirements confirm that provision of timely, relevant and accurate information is a major factor in the fulfilment of the research strategy and attainment of the research goals. On one hand, scientists need relevant and timely information in order to be able to conduct meaningful research and on the other hand the findings from research must be disseminated to pertinent users, namely farmers.

Agricultural research and agricultural information are major contributors to agricultural development. Correspondingly, the agricultural research scientist supported by an

agricultural information worker are the key players in developing the country's food, and other agricultural resources.

In the case of the situation in Uganda, the re-organized agricultural research institutes inherited library/information facilities that had for many years remained virtually unchanged for most of the institutes, with the exception of the new ones, such as The National Agricultural Documentation and Information Centre (NADIC) and the library at NARO secretariat (NAROSEC). Apart from a few publications that these libraries get as donations, they are unable to provide information to meet the changed mandates of their parent institutions. As a result, the research scientists lack adequate and timely information to be able to do their work well.

1.1.2 Specific problems

The state of the agricultural information services, specifically that of the agricultural research libraries has been observed to be inadequate and in some cases very poor. Some recent studies (Woodward 1990; Uganda. Agricultural Task Force Group 4 1987) attest to this inadequacy. In addition, findings of the most recent study indicate that [IGADD, Strengthening library 1995]:

- Research scientists who are the major users of the information services at NADIC and at the research institutes' libraries mainly need current scientific information. Scientists require this information for planning and conducting research, in order to build on what is already known and to avoid duplication of research and wastage of resources.

- The major constraints facing agricultural research libraries is lack of adequate funds due to very small budgets that are allocated to libraries. Consequently, libraries suffer from lack of basic library tools, modern information technologies and insufficient collection development. The services offered by these libraries are minimal.
- Major services such as interlibrary loans and current awareness are offered by a few libraries. Literature searches are offered only by NADIC from its collection of home-grown (national) and CD-ROM databases.

In addition to the above problems, a study by the Agricultural Task Force Group 4 (1987) had cited the following problems;

1. Inadequacy in the number of qualified library personnel to run the libraries;
2. General lack of support for strengthening library and information services as an essential component of the institutional support to national agricultural research; and
3. Lack of coordination among research libraries.

Although agricultural research activities have been going on in Uganda for many years, sharing of research findings among scientists especially those at remote locations, has not been commensurate with the level of research activities. Similarly, dissemination of the research findings to users has also been inadequate. Information generated through research unfortunately remains in the scientists' drawers or files and therefore unpublished and unknown even among the his/her peer group.

To overcome these problems, the National Agricultural Documentation and Information Centre (NADIC) has, since its inception in 1989 endeavoured to reorganize the agricultural information resources through the following means:

- Re-arranging of the national collections
- Setting up databases and reactivating of current information services
- Conducting bibliographic searches; and
- Offering document supply services to a limited extent. (Refer to Chapter 5, Table(s) 5.13 and 5.14 for more details on the databases at NADIC).

Currently, scientists cite most current information from a few current journals in their libraries and from the databases at NADIC. Researchers and other users send their information requests to NADIC, a search for the requested information is done manually and the search results are mailed/sent back to requester using ordinary (snail!) mail. Despite the efforts made by NADIC, these services do not reach the majority of users of the research libraries. Even those who get the information, receive it late in most cases.

1.1.3 Possible solutions

In an effort to address the problems identified above, the research sector is currently facing a tremendous challenge of re-building and re-equipping the research libraries. The goal is to give adequate information to the scientists and eventually to enhance cooperation between the research institutes/scientists by establishing research information network. This network is also intended to break the isolation of researchers

from national, regional and international knowledge sources. To effect these changes, several actions have been undertaken by NARO since its establishment in 1992. The first action was to absorb NADIC into its organs and to give NADIC the mandate to provide support for agricultural research by the efficient and timely supply of relevant information to scientists and other users according to their needs. (Refer to Chapter 2, Section 2.1.3.1 for details about NARO).

The determination by NARO to develop its information services is expressly put in its information policy which is discussed in Chapter 2, Section 2.1.3.1.3. Given the situation that tight budgets have, and will for sometime to come, continue to be constraints in research libraries, the possible solution for alleviating the problem of lack of adequate information would be through judicious sharing of the available information resources. To achieve this, a well organized agricultural information retrieval system is imperative. Such a system should facilitate the research scientists in selecting the required information from the stores which may be databases, libraries, etc, with ease. Furthermore, the information system should have a mechanism of channelling information to particular people who would optimally use it in their work (Guha 1983). These should be the goals of any information retrieval system.

The use of information technologies (IT), mainly computers as a means of facilitating information storage and retrieval, is necessary to achieve efficiency. Vickery (1987) states that the design of information retrieval systems is becoming increasingly dependent of physical mechanisms and in particular on computers and telecommunications. He notes that this is an important area of information management.

The use of IT in information management in NARO is not new. This can be seen in the discussion on IT facilities in NARO in Chapter 5, Section 5.1.2.1. What is required is to ensure that IT use is coordinated and used appropriately.

Some of the possible ways of correcting the problem of lack of access to adequate and current information could be by:

- Setting up a central facility (node) at NADIC to coordinate the sharing of information resources among NARO libraries;
- Stepping up the indexing of publications such as research reports, workshop papers, etc. into home-grown databases at NADIC;
- Establishing an information retrieval service that can provide retrospective search services, current awareness services (CAS) and selective dissemination of information (SDI), for both on-site and remote users;
- Improving retrieval of information so that on-site users can interact with the system individually. This could be done by establishing a user friendly search interface; and
- Utilizing Electronic mail (E-mail) to deliver information to users at remote institutions.

The view of improving access to bibliographic databases concurs with the contributions made by African research scientists at a workshop on databases held at the Pan African Development Information System (PADIS) of the United Nations Economic Commission for Africa, Addis Ababa, in October 1994 (AAAS-SSAP and UNECA-

PADIS 1995). These scientists recognized the need to provide better access to bibliographic data available in databases as a major goal of every information centre.

Moreover, the advent of electronic communication has further facilitated access to databases. Access of databases through E-mail has been implemented in many parts of the world and more efforts continue to be directed to improving this technology (Refer to Chapter 3, Section 3.3.2 for more details).

It is against this background that this study was formulated as a way of investigating the state of the current information resources, the facilities in the agricultural research libraries and the users needs. A broad investigation was necessary in order to formulate a concrete information retrieval system for all users.

1.2 JUSTIFICATION OF THE STUDY

Utilization of the available information resources in the agricultural research sector requires the use of appropriate retrieval methods that can bridge the gap between the available resources and the users. Hence a study to propose the use of improved information retrieval practices is a worth while effort. The need for such an effort is justified by the following facts:

1. The Ugandan economy depends on agriculture for its growth and agriculture is the mainstay of the majority of Ugandans. Development of agriculture is therefore an absolute necessity;
2. Information is the key for the development of agriculture;

3. There is a high demand for agricultural information, particularly among the agricultural research scientists (Refer to Section 1.1.1 above);
4. In Uganda, the research institutions are geographically dispersed and therefore are remote from the central information facilities at NADIC. As such, research scientists have to travel long distances to access

libraries/information resources at NADIC or other sister institutes;

The location of the various institutes are shown in Figure 2.1, Map of Uganda showing the location of the agricultural research Institutes in the Agro-ecological zones given in Chapter 2)

Below is a description of the location of the institutes:

- Serere Agricultural and Animal Production Research Institute (SAARI) is in the eastern region, located 350 km from the capital, Kampala;
- The Livestock research Institute (LIRI), is at Tororo in the east, located 207 km from Kampala;
- The Fisheries Research Institute (FIRI), is at Jinja, in the mid-east, 80 km from Kampala;
- The Forestry Research Institute (FORI), is currently located just outside the capital but will soon move to a distant location in the central region;
- Namulonge Agricultural and Animal Production Research Institute (NAARI), is 30 km from the capital, Kampala;
- Both Kawanda Agricultural Research Institute (KARI) and the National Agricultural Documentation and Information Centre (NADIC) are located on the same site, 13 km out of the capital; and

features and/ or with automated functions that the user can interact with, thus minimizing or even eliminating the need for a human intermediary;

10. Recent developments in telematics, have resulted in the development of improved information retrieval services. Thus information is no longer localized.

E-mail is a cheap and more effective way of sharing resources;

11. Recently an E-mail facility was installed at the NADIC to facilitate communication within and outside Uganda. In addition, E-mail facilities are being installed at NARO institutes . There are plans to install these facilities in all research institutions / stations under NARO. This will be a way of implementing the NARO information policy which is discussed later in Chapter 2, Section 2.1.3. Since electronic connectivity is already being implemented by NARO and is now being used for ordinary communication, then sharing of information resources through E-mail will definitely maximize the utilization of this technology.

1.3 OBJECTIVES

1.3.1 General Objective

The general objective of this study is to investigate the existing system of information retrieval and dissemination at the National Agricultural Documentation and Information Centre (NADIC) and at other research libraries with a view to developing a prototype information retrieval system that would be capable of rendering faster and more effective information services to all users, particularly to the agricultural research scientists at remote research institutes by using E-mail.

1.3.2 Specific Objectives

- 1.3.2.1 To conduct a survey of the existing information system in order to establish the state of the information facilities at NADIC and at the research institute libraries.
- 1.3.2.2 To identify the information needs of research scientists and the adequacy of the present information services in meeting these needs.
- 1.3.2.3 To identify the state of the databases at NADIC and their adequacy in meeting the users needs.
- 1.3.2.4 To propose improved information services for optimum utilization of the resources at NADIC and other NARO libraries.
- 1.3.2.5 To propose, design and develop a complete (prototype) improved information retrieval system that is capable of providing information to both remote and on-site users and a system that users will find easy to interact with;
- 1.3.2.6 To explore the possibility of using electronic mail as a way of bridging the gap between the information resources such as the databases at NADIC and the users (research scientists) at remote agricultural research institutes in Uganda.

1.4 SCOPE AND LIMITATIONS OF THE STUDY

The scope of this study has been to develop a system which will facilitate information retrieval by agricultural research scientists in Uganda. These scientists work in different geographical areas of the country and have problems of accessing information at the

central library at NADIC. It was observed that the information retrieval system required should facilitate both on-site (or local) and remote users, therefore an interface was developed to facilitate the on-site users. In order to facilitate the remote users in accessing the databases at NADIC, the existing information retrieval facilities as well as the information technology (IT) environment were surveyed and a bibliographic server (bibserve), ECASRV, was chosen as an interface to the FrontDoor electronic mail software (Fidonet technology).

By modifying the SDI program that comes with the CDS/MISIS Software, a fully automated E-mail based SDI program has been developed. Two prototype databases have also been developed.

Although the proposed system is primarily meant for the research scientists in NARO, other users who are affiliated to the research institutes could benefit from this system.

1.5 METHODOLOGY

1.5.1 Sample design

The population studied was composed of the following:

1. The information facilities / information management survey covered a total of eight librarians at eight NARO institutes. In other words, the questionnaire on information facilities / management was administered to the entire population under investigation. The librarians at the research Institutions already mentioned i.e. NADIC, NAROSEC, KARI, NAARI, SAARI, LIRI, FIRI and FORI, were the respondents.

2. The users' needs survey covered a total population of 238 library users, most (89%) of whom were research scientists, based at 7 agricultural research institutes (six are old and one is new), at NAROSEC, and at NADIC.

1.5.2 Questionnaire survey

Two sets of questionnaires were administered during the study for the purpose of soliciting information in various areas as will be detailed later. These questionnaires were adopted from questionnaire modules furnished in two courses studied at SISA namely; INST 527- Information Users' needs and INST 503 - Research Methodology. Initially, pilot testing of the questionnaires was done using two small groups of users namely: users from the information profession and subject experts at one of the agricultural research institutes.

1.5.2.1 Users questionnaire

The objective of the users survey was to collect information and data on the users' information needs and therefore be able to find out whether these needs were being satisfied. The goal was to obtain information that would be used to plan information services that are capable of meeting these needs. The questionnaire covered the following areas: use of library and documentation services in NARO libraries, information services provided by the libraries, publication of research findings, sources of information used and the users familiarity with information technologies.

The questionnaire used for obtaining data for the study is presented in Appendix 1(A).

Sample population

Sample of users was drawn using the method of stratified sampling by academic qualifications. This method was selected for the purpose of ensuring that essential categories of research scientists were included in the sample. In addition to this, earlier observations on the use of the library had indicated that the users' academic achievement influences their use of library facilities, reading habits and degree of exposure to information technologies. Therefore, in order to achieve greater representation, the population of research scientists at each institute was stratified on the basis of academic qualifications. Stratified sampling was used with systematic sampling of users from each strata.

The number of questionnaires to administered at each institute was based on the number of scientists at that institute. The latter information was obtained from the NARO Secretariat. By using systematic sampling within each strata, one questionnaire was administered to every fourth research scientists on the list of scientists at each research institute. However, in the case of the libraries at NADIC and NAROSEC which do not have a fixed number of users as such, the sample population for the study was obtained from records of regular library users which was obtained from the respective librarians. These records were in the form of: loans, requests for reference services, and database search services. In this case, administering of questionnaires to users in the sample population was done in a similar way (systematically) i.e. to every fourth user on the compiled list of regular users. A total of sixty (60) questionnaires were administered. Details on the distribution of the questionnaire to respondents are given in Table 1.1.

TABLE 1.1 DISTRIBUTION OF THE USERS' QUESTIONNAIRE

Degree/Diploma

NAME OF LIBRARY((ACRONYM)	LOCATIO N	No. OF QUESTIONNAI- RES ADMINISTERED	PhD	MSc/ MA	BSc/D ip
NAROSEC	REMOTE	6	2	2	2
NADIC	ON-SITE	11	5	3	3
KARI	ON-SITE	11	4	4	3
NAARI	REMOTE	9	2	4	3
SAARI	REMOTE	7	2	3	2
LIRI	REMOTE	5	2	2	1
FOSRI	REMOTE	2	1	1	—
FORI	REMOTE	5	1	2	2
FIRI	REMOTE	4	1	2	1

KEY: On- site - users at NADIC/KARI

Remote - users at institutions far from the NADIC/KARI

Responses

The response to the Users' questionnaire was 72%.

Limitations

The limitations encountered during the study are given below:

1. Inadequate resources; mainly funds and time. Due to these limitations, the number of days spent in travelling to remote institutions (to collect data) had to be reduced;
2. A good number of researchers were not available at their institutes at the time of the survey;
3. There were delays in responding to the questionnaires. This led to repeated follow-up in order to collect questionnaires;
4. The time frame and resources were not enough to use a systems analysis approach for studying the eight libraries. If this approach was to be adopted, a period of at least one year would be required to study the eight libraries. This period includes allowing time for changes that could possibly occur as the system evolves. Therefore, questionnaire method which is the most common method of studying libraries was used. The advantage of using the questionnaire is that it is flexible and can therefore be used to gather information on almost any topic from large and small numbers of people (Moore 1983);
5. Although on the whole, the response rate to the users questionnaire was good, (72%), a few researchers promised that they would fill in the questionnaires and return them but they did not honor their promise. Three of the respondents to the users questionnaire, sent their questionnaires long after the analysis had been done. It was therefore not possible to include their answers among the findings. However, answers to the unstructured questions were included in the analysis.

Twenty-eight percent of the sampled users did not respond to the users questionnaire;

6. It was not possible to implement a stratified sample on the basis of research programs due to unavailability of a good number of scientists belonging to some programs, at the time of the survey. Thus, the possible influence of research programs on the use of the library facilities could not be elicited. Instead stratification was done on the basis of academic qualifications as already explained in the methodology; and finally
7. In some cases the information being sought was not available.

1.5.2.2 Information Managers/librarians questionnaire

Sample size

In this case the entire population composed of eight librarians at the eight libraries was included in the sample. Thus the entire population responded to the questionnaire.

Objective

The questionnaires were meant to solicit information on information management and in particular, information retrieval in agricultural research libraries under NARO. Specifically, these questionnaires were intended to solicit information on four major areas, namely the available information resources; the information services provided; human resources; and information technologies in NARO libraries.

The questionnaire used for obtaining data on library facilities is presented in Appendix 1(B).

Responses:

All the eight (8) librarians, to whom the questionnaire was administered, responded to it, thus giving a 100% response rate.

Problems:

Despite the fact that the response was very good, some respondents did not provide all the information that was requested for. Thus many gaps remained in the questionnaires.

1.5.3 Interviews

The interview method was used to verify the information that had been gathered by the questionnaire and in particular to fill the gaps where questions had not been answered by respondents.

Population interviewed "

Selection of the population to be interviewed was based on fair representation of the institutions that are directly concerned with agricultural research. Seven people were interviewed from the agricultural research sector. Also interviewed were six groups of people, each group was from an institution that provides services in areas such as: Telecommunication, Electronic Communication and Computer Applications. The

purpose of these interviews was to elicit information on computing and telecommunications situation in Uganda. The lists of people interviewed are given below:-

From the research sector:

- The Head, National Agricultural Documentation and Information Centre (NADIC).
- Two research managers i.e Directors of Agricultural Research Institutes,
- Three researchers from the National Agricultural Research Institutes.
- One senior member of staff responsible for the Publications, Information Technology and Electronic Communication Unit, at NAROSEC.

The interview questions for the research sector group were based on the questionnaires since, in most cases the intention was to verify unanswered questions. The findings from these interviews have been presented in Chapter 4, 5 and 6 of this thesis.

From the Computing and Telecommunications sector:

- The Principal Executive Engineer/Quality Management and the Chief, Computer Operations, Uganda Post and Telecommunications Corporation (UPTC).
- The Head of Institute of Computer Science at Makerere University, Kampala, Uganda.
- The Network Manager, Mukla FidoNet Network, Makerere University.
- The chairman, Polytechnic of Information Technology, Kampala, Uganda.(A private Computer Training School)
- An Engineer, Celtel Uganda Limited, a business providing cellular phone services.

- Four different Internet providers (Details on this are provided in Chapter 4, Section 4.4.2 and appendix 6).

The guiding questions to the interviews that were conducted with the research group and the computing and telecommunications group are presented in Appendices 2(A) and 2(B), respectively.

Limitations

1. As was the case for the Questionnaire method, this method was limited by lack of adequate financial resources and time. Because of the time constraint and the continuously changing situation, particularly in the developments in electronic communication environment in Uganda, it was not possible to obtain current information through a single interview.
2. It was not always possible to get the people who were selected as interviewees. Because of this, interviews had to be re-scheduled several times and in a few cases, alternatives were sought to substitute the original choice.

1.5.4 Observation

The observation method was used during the visits to the agricultural research libraries. The purpose was to ascertain the status of libraries as well as the information services provided by these libraries. The findings obtained through this method are presented with other related findings in the different chapters of this thesis.

1.5.5 Document Analysis

Secondary sources of information, such as, manuals and reports of previous studies and institutional reports were consulted for information. The method of information analysis and consolidation was used to obtain information from these documents. The information so obtained has been presented in various chapters of this thesis.

1.5.6 Data Analysis and Prototype development

1.5.6.1 Data Analysis

The data collected in the study was analyzed using the network facilities at the School of Information Studies for Africa (SISA). The software used for data analysis include; WordPerfect 5.1 (c) Copyright 1982, 1989; Harvard Graphics for DOS, version 2.12 from Software Publishing Corp. (1988).

1.5.6.2 Prototype databases and system development

The application program used for the prototype databases and system development is Micro-CDS/ISIS, version 3.07 (c) UNESCO 1993. This application software was chosen because it is already being used at NADIC and has been recommended for use in other NARO libraries. In addition, the FrontDoor software, an E-mail program which is the most commonly used communication package under the Fidonet technology, was adopted. The Frontdoor Noncommercial version copyright (1986-1991), from Advanced Engineering sarl, is already being used in the NARO E-mail system.

1.5.6.3 User Interface

Since the databases at NADIC run on CDS/ISIS, it was found necessary to use the ISIS PASCAL programming language in developing the 'NADIC SEARCH Interface'. This interface is part of the proposed prototype information retrieval system.

1.5.6.4 SDI Program

The SDI program that was developed by UNESCO for use with the CDS/ISIS information retrieval software, was adopted and used for the Selective Dissemination of Information (SDI) service that has been proposed for research scientists in NARO Institutes. This service is part of the proposed prototype information retrieval system.

1.5.6.5 Bibserve

The ECASRV Bibserve module developed by the Pan African Development Information System (PADIS) was adopted (as NADISRV) for the proposed E-mail database search service. This program which interfaces CDS/ISIS with the FrontDoor E-mail software was developed using the CDS/ISIS PASCAL programming language. It has been used by courtesy of PADIS and the developer of the program Ato Nega Alemeyeho who is based at SISA.

1.6 SIGNIFICANCE OF THE STUDY

- It is anticipated that the results of this study may be used by information specialists at NADIC in consultation with the overall management of NARO, to initiate the development of an improved information retrieval system that is capable of meeting the users needs. The system could also be extended to the entire agricultural sector.
- The study may serve as a spring board for further studies in related fields thus saving the time of other researchers.
- Other information systems in the country may borrow the results of the study and design similar information retrieval systems to support their information activities.
- If the proposed system is implemented, it will form part of the total national agricultural information network which will enhance exchange of information for agricultural and subsequently, national development.
- The study will contribute to solving the problems of information work and service which aims at user satisfaction. If the proposed information retrieval system is implemented, users' needs will be satisfied to a considerable extent. For example, a selective dissemination of information service will be proposed for both remote and on-site users. A retrospective search service is also foreseen. These services can be implemented more efficiently and effectively from the databases at NADIC.
- The study will contribute to increased efficiency in implementing information services. For example, searching databases has advantages in that it saves the time of the users as well as that of the information workers who are in charge

of searching. This is in line with the five laws of information science derived from Ranganathan's five laws of library science (Lancaster, 1988).

1.7 ORGANIZATION OF THE THESIS

This thesis is composed of nine chapters. Chapter 1 deals with the statement of the problem, justification of the study, its objectives as well as its scope and limitations. This chapter discusses the methodology of the survey as well as the problems encountered during the study, application of the research results and organization of the thesis.

Chapter 2 gives the general background of agricultural research in Uganda. It highlights the scientific and technological developments in Uganda such as the science and technology policy, an overview of the agricultural sector in general, agricultural research policies and strategies, establishment of the National Agricultural Research Organization (NARO) and its mandate, and the research institutes under NARO and their functions. This chapter also includes the NARO information policy, the National Agricultural Documentation and Information Centre (NADIC) and the library facilities in NARO libraries.

Chapter 3 discusses developments in information technology with particular reference to Africa. The major issues raised in this chapter are the importance of information and the information technology revolution. Developments in telematics are discussed with an overview of the world wide situation, database search services by E-mail and developments in telematics in Africa. In the latter case, the CABECA project, being

implemented by The Pan African Development Information System (PADIS), is cited as an example of a successful electronic connectivity project that relies on poor telecommunications infrastructure.

Chapter 4 covers information technology in Uganda. The issues discussed include; developments in information technology and electronic communications in Uganda, the proposed IT policy for Uganda, the IT environment and in particular, development of computing and the use of computer applications in information management in Uganda. The role of the Uganda Posts and Telecommunications Corporation in data communication is discussed. Recent developments in electronic networks and electronic messaging services are highlighted. A specific example used is the Mukla Fidonet network and the impact that it has made during its four years of existence in Uganda. The Internet service providers in Uganda are briefly discussed.

Chapter 5 presents the findings of the survey of information facilities in NARO libraries. The findings cover the following major areas: information resources and information technologies available in the libraries; information services; and the information flows.

Chapter 6 presents the findings of the survey information needs of the research scientists in NARO institutes, while Chapter 7 attempts to give an interpretation of the research findings presented in Chapter 4, 5 and 6.

Chapter 8 presents the proposed improved information retrieval, system (IRS) namely, its objectives, the different modules of the system and their functions. The modules are: SDI module which includes user profiles and document profiles; the database search module which includes the NADIC SEARCH INTERFACE and NADISRV, a bibserve facility adopted from the Pan African Development Information System (PADIS). Guidelines on how to use the system are given together with examples of search outputs for the retrospective and SDI searches. The techniques of searching through the NADIC SEARCH INTERFACE are given together with the screen features of the interface. The techniques for searching through NADISRV for both retrospective and SDI searches are discussed. Finally, details of implementing the proposed system are given. Specific reference is made to; database requirements, Fidonet network requirements, hardware and software requirements as well as personnel and management issues.

Chapter 9 gives the conclusion of the study and the recommendations.

CHAPTER 2

AGRICULTURAL RESEARCH IN UGANDA

2.0 INTRODUCTION

Promotion of Science and Technology is not a recent activity in Uganda's development. It dates back to the beginning of this century when research institutes were first set up to assess the performance of introduced crops meant for export and to produce improved plant and animal products and technologies that were adopted within the country and outside, particularly in the East African region. (Nyiira 1994). The contribution of research to national development was recognized as early as that time.

This chapter discusses the status and contribution of agricultural research in Uganda. In order to set the discussion in its proper perspective, the contribution of science and technology (S&T) as well as S&T policies, to Uganda's development are given. A brief introduction to the agricultural sector in Uganda is also provided with reference to the major developments in the sector, such as the establishment of the National Agricultural Research Organization (NARO). Factors that are expected to influence agricultural research such as: the agricultural research policy and the agricultural research information policy are discussed. As an introduction to the information services in NARO, which is the theme of this study, the present status of the libraries within NARO is given.

2.1 SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENTS IN UGANDA

2.1.1 Science and Technology Policy

The relevance of Science and Technology (S&T) to economic development has been amply demonstrated throughout the world and is a matter of little dispute. A good scientific and technological base needs a sound information system to sustain it. Thus, the infrastructure that enables information access can be said to be a critical component of a thriving Science and Technology System and of society itself (AAAS-SSAP and UNECA-PADIS 1995). Africa's poverty and development problems could be eliminated

to a large extent through the use of science and technology as the driving force of economic and social progress (Godard 1994).

Uganda's ability to renew the economy largely depends on her resolve to apply science and technology (Nyiira 1994). In recognition of this fact, the Government of Uganda is putting much emphasis on the development of science and technology and has commissioned the National Council for Science and Technology to draw up a science and technology policy that would direct national development plans. A draft policy document has been submitted to the government for consideration. The major issues of the proposed science and technology policy such as its objectives and policy guidelines are given below. In this section, emphasis has been put on areas that are directly related to this study. The agricultural policy is discussed in Section 2.1.2 of this chapter while policy on technology and technology acquisition is discussed in Chapter 4, Section 4.1.1

Objectives of the Proposed S&T Policy

The Uganda National Council for Science and Technology (UNCST), gives the major objectives of the proposed science and technology policy as being able to promote science and technology by [Uganda, UNCST, Uganda Needs, 1991]:

- creating awareness among Ugandans about its value and role in social economic development;
- strengthening institutional capacity for implementing the science and technology policy;
- directing science and technology efforts along identified national goals;
- harnessing science, promoting and translating science and technology results into actual innovations and services;
- promoting an endogenous science and technology base through research and development;
- motivating creative output in science and technology;
- expanding and strengthening the technological base of the nation; and
- inculcating a science culture into the Ugandan society through theory and practice.

2.1.2 The Agricultural Sector

Agriculture is the mainstay of the Ugandan people being their source of food, employment and incomes. The agricultural industry will for the foreseeable future remain the engine of the growth of the Ugandan economy. Over 88% of the country's population live in the rural areas and they get their livelihood from agriculture. Most are small scale producers farming on an average two to three hectares of land. It is indicated that for the years 1993 and 1994, the value of the agricultural export accounted for 94% and 95% respectively of the total value of exports. Thus, Uganda depends mainly on the agricultural sector for its foreign exchange earnings (Uganda, MOA, Budget Statement, 1995 /1996).

Like other developing countries, Uganda's manufacturing and service industries are agro-based. These industries depend on the agricultural sector for provision of raw materials. Sixty-four percent of the government revenue comes from agriculture. This contributes directly to the development of social and physical infrastructure. The contribution of agriculture to the GDP in 1994/1995 was 51% and 49% respectively (Uganda, MOA, Budget Statement, 1995/96).

Approximately 80% of the working population are involved in agricultural activities. About 20-25% of the regular wage employees are also engaged in commercial agricultural enterprises such as coffee curing, cotton ginning, tea production and refining, cigarette manufacturing, grain milling, textiles and leather products manufacturing.

The above scenario makes it clear that the only way to develop Uganda is to modernize agriculture and increase productivity of resources like land, labour and capital and hence raise people's incomes. The agricultural sector has an obligation to conserve and develop agricultural resources so as to ensure supply of adequate nutritious food for the expanding population and for export. To achieve this, promotion of agricultural research is seen as the major means, the others being education and training of agricultural workers, proper planning of agricultural activities and provision of agricultural extension and information services to farmers. To this end, the agricultural

sector has implemented a number of improvements among which is a dynamic agricultural research system whose objectives are to come up with technologies that can contribute to agricultural development (Uganda. Working Group 9A 1991:1).

2.1.3 Agricultural Research Policies and Strategies

The national agricultural research strategy puts emphasis on improvement of the agricultural research services in order to improve the flow of technologies to farmers. This would in turn improve the farmers' contribution to the growth and productivity of the agricultural sector. The strategy identifies the challenges of research as being able to produce innovations that are [Uganda. Working Group 9A 1991:1]:

- Attractive and therefore easy to disseminate to farmers
- sustainable in terms of profitability i.e. without need for special subsidies
- realistic in input requirements; and
- supportive in efforts to enhance environmental quality.

Realization of the above strategies requires as pre-requisites [Uganda. Working Group 9A 1991:2]:

- sufficient understanding of the agricultural sector to correctly focus the research efforts to farmers' needs;
- a knowledge of the range of possible innovations available locally and externally; and
- the ability to successfully conduct research, on and off station, and transmit the results to the extension services and farmers (Uganda. Working Group 9A 1991:2).

The agricultural research policy emphasizes the following main issues [Uganda, UNCST, Uganda Needs 1991]:

- Improving the quality of foodstuffs through development of crop varieties and livestock breeds with desirable characteristics such as high yields, resistance to pests and diseases and to drought, etc., as well as development of efficient farming methods;

- Ensuring available and adequate food (including livestock and fish products) throughout the year by upgrading the traditional technologies and biotechnologies, utilizing and adopting new technologies and using techniques that can improve the production of both crop and livestock;
- Increasing the nation's forest products potential for a variety of industrial and domestic uses through: the development of improved woody forestry species; afforestation, agroforestry research and encouraging processing technologies for forestry products; and
- Encouraging forward integration through the use of agricultural products as inputs into other industries.

2.1.3.1 The National Agricultural Research Organization (NARO)

2.1.3.1.1 NARO: Establishment and Mandate

Established in 1992, NARO is the National Agricultural Research Organization of Uganda, representing the public sector national agricultural research system. The organization is composed of a Board, a secretariat and eight research institutes. These Institutes have already been enumerated in Chapter 1, Section 2.1. In addition, any institute which undertakes agriculture or agriculture- related research may join and become an associate institute of NARO (Uganda. NARO Handbook 1994).

NARO was formed through the re-organization of the old research system of the colonial era to meet the new requirements of independent Uganda. The old fragmented research system was transformed into a unified lean organization in an institutional framework that is envisaged to be more effective and responsive to the national development objectives of diversifying agricultural production for the supply of adequate food and raw materials and improving the quality of rural life (Uganda. NARO Handbook 1994). This transformation needs to be supported by a strong research information service.

The Secretariat for the organization is located at Entebbe while the institutes are located in different regions of the country to cater for the needs of the different agro-ecological zones. Figure(s) 2.1 and 2.2 below show the distribution of four major agro-ecological zones of Uganda, and the location of the research institutes in the agro-ecological zones, respectively while Figure 2.3 shows the organogram of NARO. NADIC and KARI are located at Kawanda in the tall-grassland zone IV; NAARI at Namulonge, 30 km north-west of Kampala, also in zone IV; SAARI at Serere in the short grasslands and semi-arid-rangelands covering zones II and III; LIRI at Tororo in zone III; FIRI at Jinja in zone IV; and FORI and FOSRI are both at Nakawa in zone IV. AETRI is yet to be established. NARO's mandate is to conduct research in all aspects of crop, livestock, fisheries and forestry.

Objective

NARO's objective is to undertake, promote and coordinate research in all aspects of crops, livestock, fisheries and forestry; integrate research, where needed to avoid wasteful overlapping and duplication of research; and to make the most efficient use of available research resources.

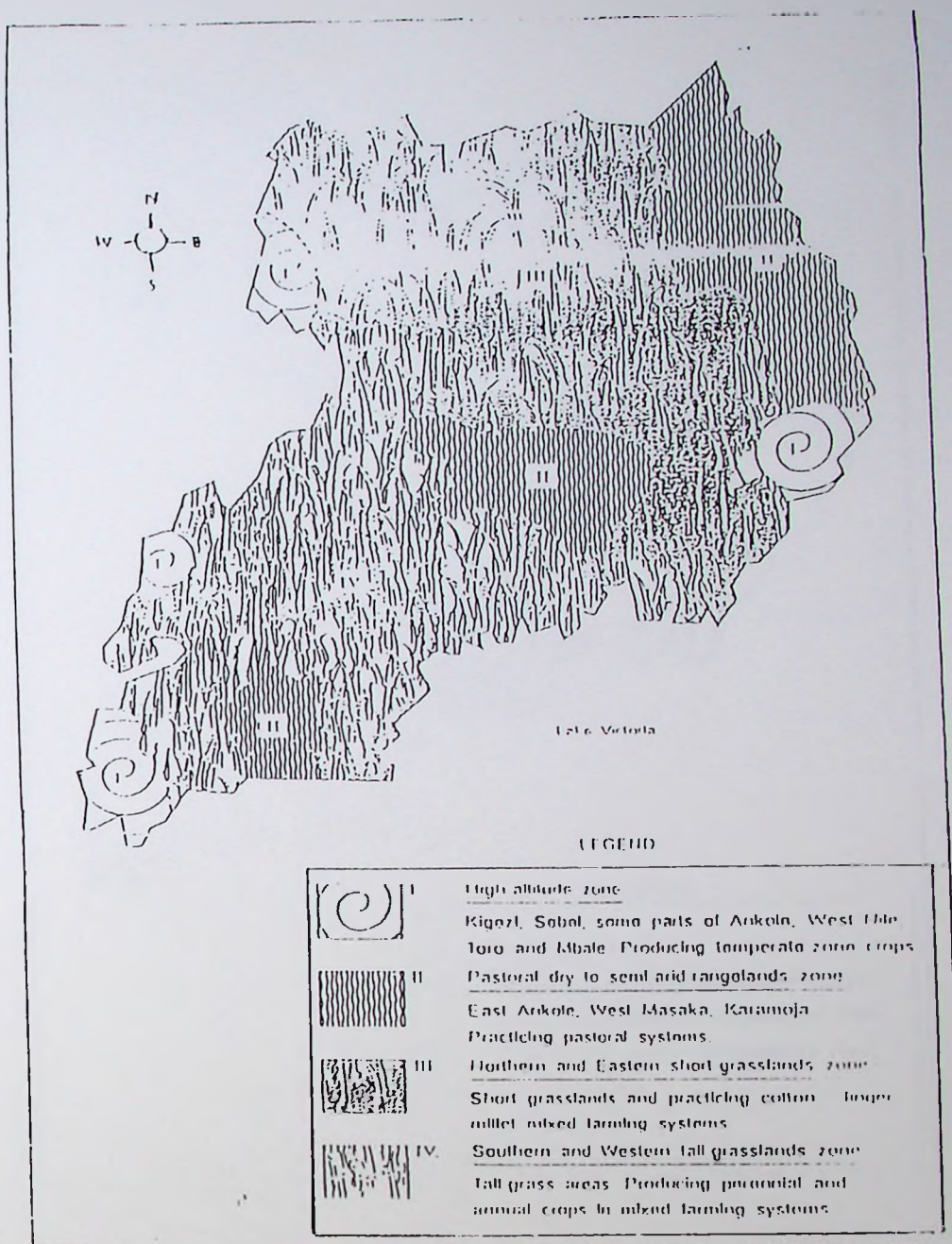


Figure 2.1: MAP OF UGANDA SHOWING THE DISTRIBUTION OF FOUR MAJOR AGRO-ECOLOGICAL ZONES OF UGANDA

Source: Uganda Working Group 9A - Agricultural Policy Committee. 1991. National Agricultural Strategy and Plan: Strategy, Organization and Management, Vol.1

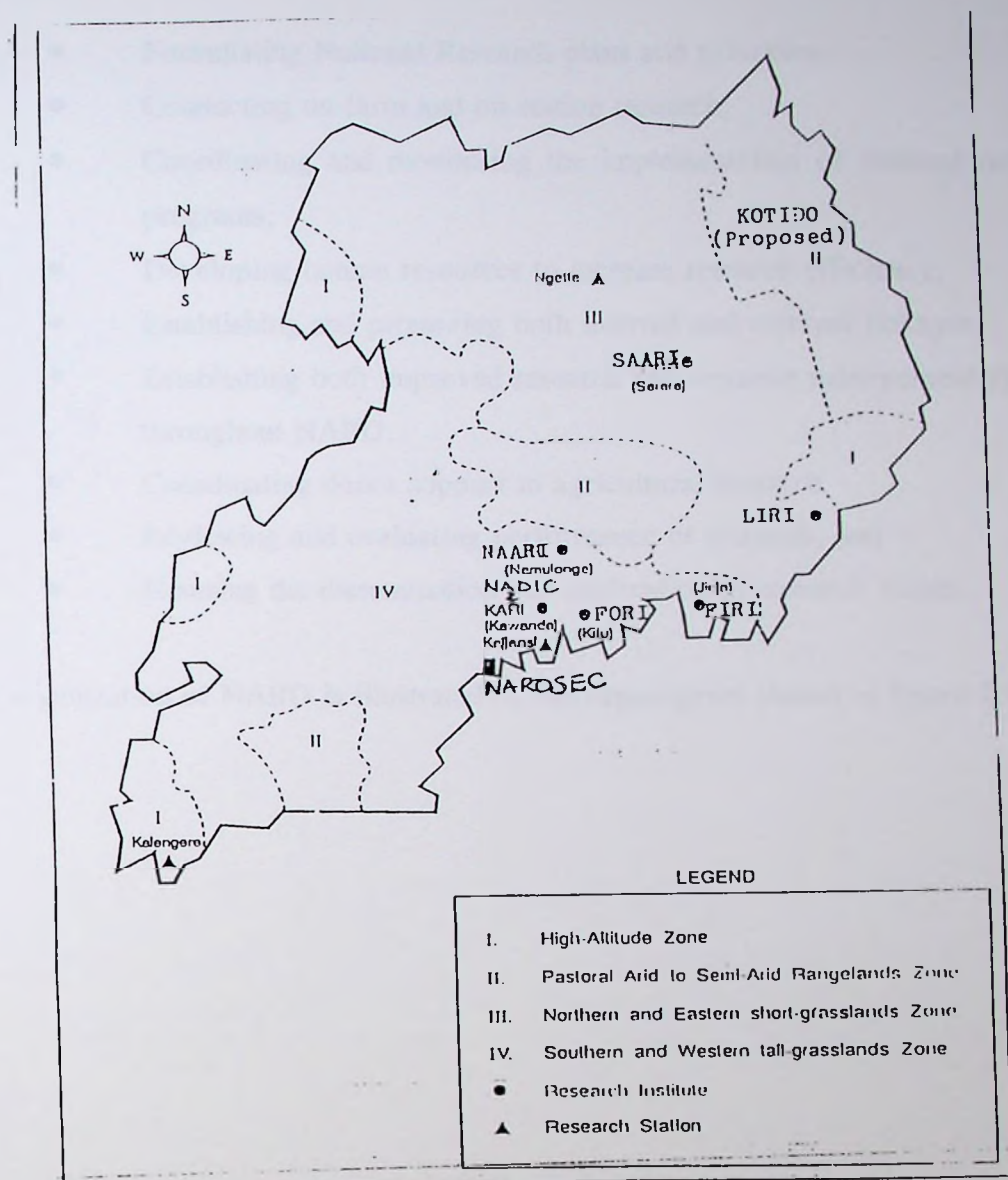


Figure 2.2: MAP OF UGANDA SHOWING THE LOCATION OF THE RESEARCH INSTITUTES IN THE AGRO-ECOLOGICAL ZONES

Source: Uganda Working Group 9A - Agricultural Policy Committee. 1991. National Agricultural Strategy and Plan: Strategy, Organization Management, vol. 1.

In order to fulfil its objectives NARO performs the following functions:

- Formulating National Research plans and priorities;
- Conducting on-farm and on-station research;
- Coordinating and monitoring the implementation of national research programs;
- Developing human resources to increase research efficiency;
- Establishing and promoting both internal and external linkages;
- Establishing both improved research and resource management systems throughout NARO;
- Coordinating donor support to agricultural research
- Reviewing and evaluating performance of research; and
- Ensuring the dissemination and application of research results.

The organization of NARO is illustrated by the organogram shown in figure 2.3.

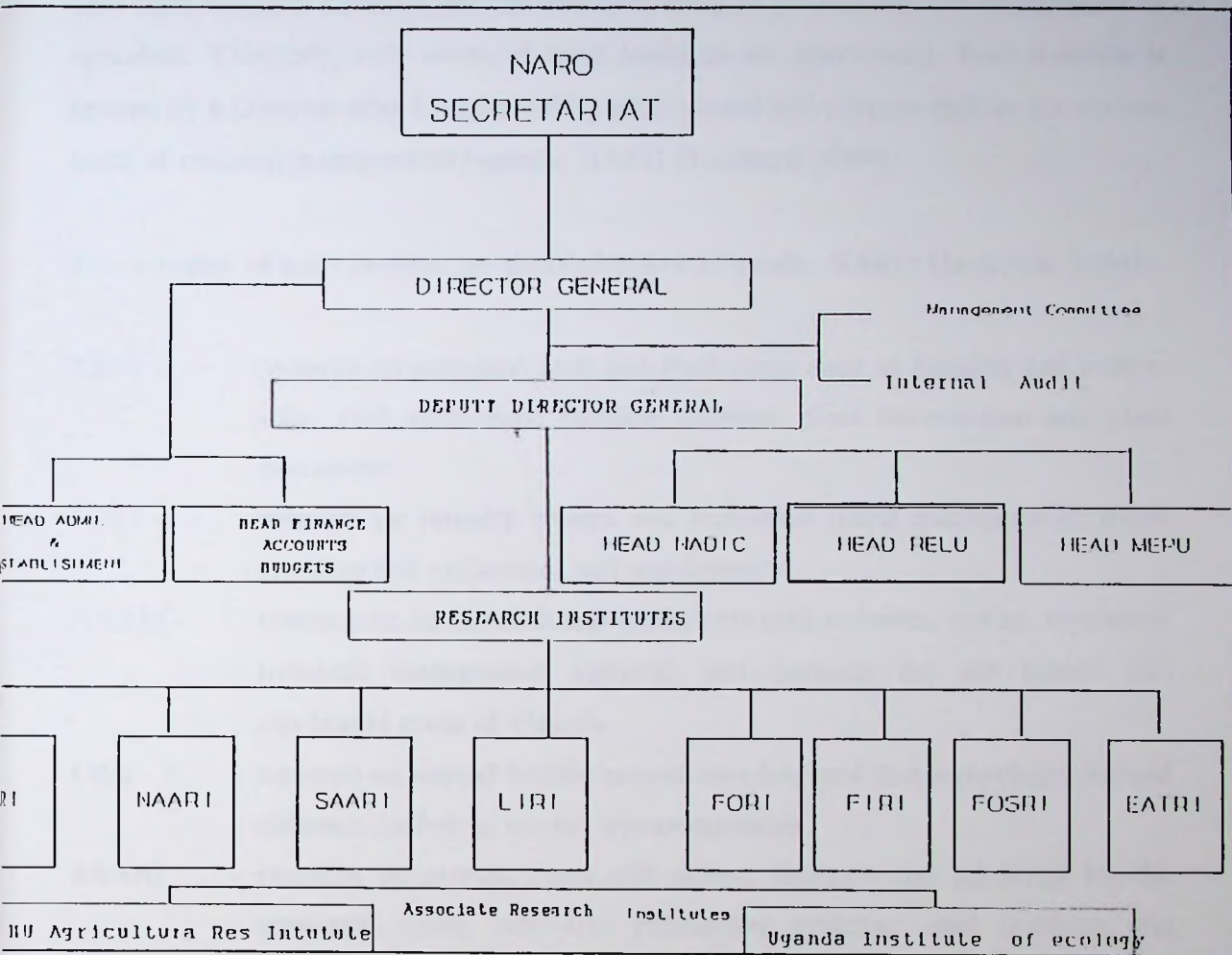


Figure 2.3: ORGANOGRAM OF THE NATIONAL AGRICULTURAL RESEARCH ORGANIZATION (NARO)

Source: Uganda. 1994. NARO Handbook.

2.1.3.1.2 Mandate of each research institute

The eight research institutes are the technical arms of NARO and are autonomous in operation. Currently, only seven of eight institutes are operational. Each institute is headed by a Director who is supported by professional and support staff in the various tasks of research management(Uganda. NARO Handbook 1994).

The mandate of each institute are detailed below [Uganda. NARO Handbook 1994]:

- KARI - research on perennial cash and food crops such as bananas and coffee; soils; crop protection; farming systems; plant introduction and plant quarantine.
- FORI - research on forestry natural and plantation forest management; forest products and utilization; and agroforestry.
- NAARI- research on annual cash and food crops such as beans, maize, soyabean; livestock management systems; and pastures for the humid and sub-humid areas of Uganda.
- LIRI - research on animal health, animal breeding and theriogenology; animal diseases, including human trypanosomiasis.
- SAARI - research on cereals, roots and tubers, legumes and oil seeds for the semi-arid areas; semi-arid production systems; seed research and production; pastures and range management; and crop and livestock management for the semi-arid areas.
- FOSRI - research on food preservation, processing, storage, marketing and dietetics.
- FIRI - research in fresh water fisheries, fishing and fish technology; aquaculture and fish production systems.
- AETRI - research on farm mechanization, crop processing and storage, soil and water engineering and technology. (Institute proposed but not yet functional)

Each Institute has one or more research stations affiliated to it, located in the same agro-ecological zone.

2.1.3.1.3 The NARO information policy

In recognition that information is a vital component of research and development and that it is in high demand by policy makers, managers, researchers and other stake holders in the development process, NARO has developed an integrated

information strategy as a starting point to formulating its information policy. This strategy has been presented to the NARO management for ratification. The key element of the information strategy is the establishment of a central unit which will be responsible for most of the coordination activities and provision of many common and specialized services. The strategy also proposes that the mandate of the National Agricultural Documentation Centre (NADIC) be broadened to include the domains considered in the strategy (Refer to the details below). In addition, a change of NADIC's name to Agricultural Research Information Centre (ARIC) is proposed. Though not yet approved, this strategy is a clear indication of NARO's interest in improving the provision of agricultural information to users. Below are the salient points of this strategy [Uganda.NARO/ISNAR, Information Strategy 1995]:

- (1) To strengthen institutional capacity through appropriate staffing and human resource development;
- (2) To acquire and maintain adequate physical facilities to perform information activities;
- (3) To ensure that NARO's use of information technology (IT) is planned, coordinated and fully integrated;
- (4) To facilitate faster and more efficient communication and access to information within NARO and beyond, both nationally and internationally;
- (5) To disseminate effectively NARO's research results to the research community as well as to the users, by strengthening capacities for production and publication of scientific information and agricultural extension materials;
- (6) To provide information services of primary relevance to users, for example, selective dissemination of information (SDI) to scientists and other interested parties;
- (7) To create compatibility in the processing of information in order to facilitate access to and exchange of information within NARO and at a broader level; and

- (8) To improve functional linkages at national and international levels. Currently, only (1), (2), (3) and (4) are being partially fulfilled. Awareness of functions (5), (6), (7) and (8) is just beginning to grow. This study will therefore seek to promote implementation of this strategy.

2.1.3.1.4 National Agricultural Documentation and Information Centre (NADIC).

Established in July 1989, the National Agricultural Documentation and Information Centre (NADIC) was setup under the Ministry of Agriculture, Animal Industry and Fisheries. This was in recognition of the need to support agricultural research, extension and other development activities with information. In 1994, NADIC was brought under the National Agricultural Research Organization (NARO) management. It is now one of the units of the NARO Secretariat.

NADIC's mandate is to collect, organize, process and disseminate information on Agriculture to all pertinent users but particularly to agricultural research scientists. NADIC is organized under four sections namely, the library and documentation centre; and two other proposed units namely, reprography and publications. The operational structure of NADIC is shown in Figure 2.4 and NADIC's activities are shown in Figure 2.5 below;

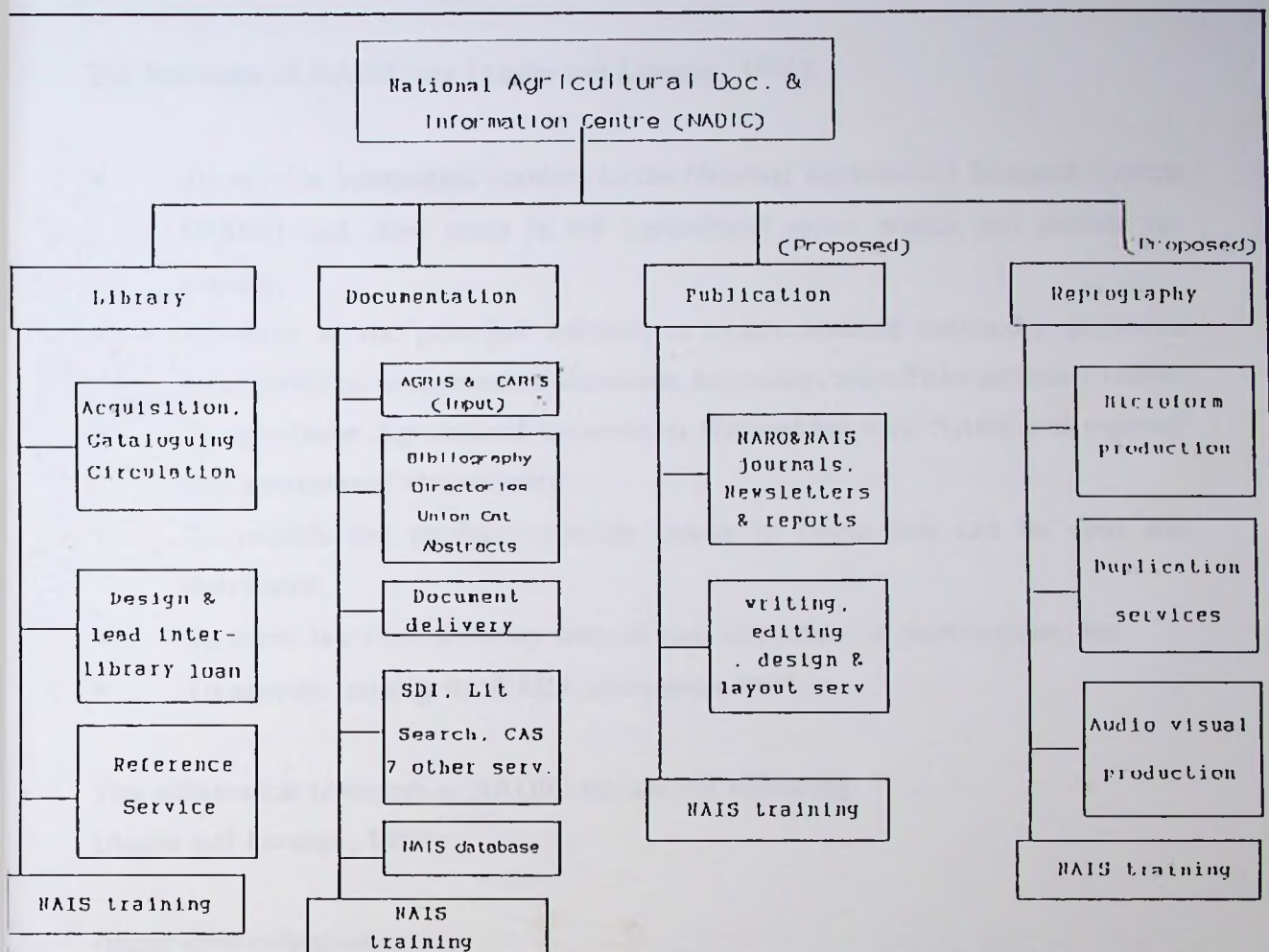


Figure 2.5: NADIC's Activities

Source: Uganda Agricultural Task Force Working Group 4, 1987.
Strengthening Agricultural Research in Uganda.

At the moment, only the library and the documentation sections are functioning. Publishing functions have started at NARO Secretariat with the biannual production of the Uganda Journal of Agricultural Sciences.

The functions of NADIC are [Asaba and Lwanga, 1991]:

- To provide information services to the National Agricultural Research System (NARS) and other users in the agricultural sector within and outside the country;
- To serve as the principal information centre housing nationally generated information on: computerized databases, hard copy, microfiche and other forms;
- To coordinate Agricultural Information Networking with NARS and regional and international Organization;
- To publish and produce research results in forms that can be used and distributed;
- To serve as a central library with all rare collections of publications; and
- To provide training for NARS information staff.

The information resources at NADIC include the following
[Asaba and Lwanga, 1991]:

Home-grown databases:

1. **AGRIN** for nationally generated publications (including grey literature);
2. **CARIN** for on-going and completed research projects;
3. **ULIST** for records of periodicals; and
4. **AGRINF** for records of Agricultural Institutions.

Details on these databases are furnished in Chapter 5, Table 5.14 and Chapter 8, Section 8.2.1.3

NADIC also has a collection of CD-ROM databases, namely,

- AGRIS;
- AGRIS Fisheries and Aquaculture, Prototype;
- CARIS on CD-ROM, prototype;

The above three databases are from the Food and Agricultural Organization of the United Nations (FAO)]

- CAB PEST CD - from the Centre for Agriculture and the Biosciences International (formally, Commonwealth Agricultural Bureaux International); and
- AGRICOLA prototype - from the National Agricultural Library of the United States of America.

AGRIS is also available on microfiche and AGRINDEX (hard copy version of AGRIS). Other Information resources available include a Union list of Serials of International Agricultural Research Centres (IARCS); and an Index of publications on Livestock microfilmed by The International Livestock Research Institute (ILRI), formerly, the International Livestock Centre for Africa (ILCA). Details on CD-ROM databases are furnished in Chapter 5, Table 5.13.

These databases are an avenue for the scientists to share information. Information from databases also promotes agricultural research and related activities by helping the researchers in planning and conducting their research.

NADIC participates in INFORM, a research Management Information System (MIS), for NARO. NADIC's role is to maintain certain aspects of the INFORM database such as adding subject codes (descriptors) which are required for searching the database.

NADIC also participates in AGRIS, the International Information System for the Agricultural Sciences and Technology; and CARIS, the Current Agricultural Research Information System. Both information Systems are run under the aegis of the Food and

Agricultural Organization (FAO) of the United Nations. It is also a deposit Library for FAO publications.

The documents collection at NADIC cover the following subjects: Crop Sciences, Animal Sciences, Forestry, Agroforestry, Fisheries and Aquaculture and ancillary subjects. The collections consist of books, primary and secondary (abstract journals) periodicals, various types of publications (from institutions, governments and international organizations), reference materials, maps, microfiche and CD-ROM databases.

As a focal point for NARS libraries, NADIC provides the following information services:

- Literature searches from local (home-grown) databases;
- Retrospective searches from CD-ROM databases;
- Selective Dissemination of Information (SDI) to limited number of users mostly on ad-hoc basis;
- Current Awareness Service (CAS) through contents of pages;
- Document Delivery services;
- Photocopying services; and
- Library reference and loan Services.

The future strategy for NADIC is to develop an agricultural information network of all institutions involved in agricultural research (under NARO).

The information services offered by NADIC such as contents pages and literature searches are beginning to contribute to the scientists state of awareness of what is taking place in his discipline both within and outside the country. Scientists are now beginning to make contacts with their peers elsewhere in the world. Research Scientists and other users send their information requests to NADIC, a search for this information is done manually and the search results are mailed/sent back to the requester. What remains to be done is to improve these services in terms of quality and content; and to ensure that users get relevant information on time. The latter entails improvement of

access to databases. This would greatly enhance usage of pertinent information in planning and conducting agricultural (research) activities.

2.1.3.1.5 Library Facilities in NARO Institutes

Six out of eight NARO research Institutes have libraries. The National Agricultural Documentation and Information Centre has its own library and is designated as the focal point to the Agricultural Information System. In addition to the six libraries at the research institutes, the library at NADIC and the NARO Secretariat library, make a total of eight libraries which were surveyed. The findings of this survey are presented in Chapter 5.

Each of the libraries has a collection of literature related to the mandate of the concerned Institute but often the literature covers peripheral areas of agriculture. For example, the library at KARI has literature on perennial crops such as bananas, coffee and horticultural crops, whereas the one at FIRI has literature on fisheries and aquaculture. Unfortunately, most of this literature is rather old and outdated and does not meet the requirements of the scientists. Details of the scientists' needs, as elucidated by the survey are presented in Chapter 6.

2.2 SUMMARY

In Uganda, promotion of agricultural research is a priority national development activity. The development of science and technology policy as well as research policies; and the establishment of NARO, testify to this statement. NARO relies on the development of information services to support its activities. This is shown by the proposed NARO Information Strategy. There is need to strengthen the role that NADIC is playing in order to support implementation of the information strategy (policy) and consequently lead to better information services.

CHAPTER 3

DEVELOPMENTS IN INFORMATION TECHNOLOGY WITH PARTICULAR REFERENCE TO AFRICA

3.0 INTRODUCTION

Information Technology (IT) refers to technologies that pertain to human communication processes and the information they handle. IT is the new science of collecting, storing, processing, and transmitting of information. IT refers more particularly today, to how computers store, process and transmit information through, for example, satellite, telephone lines, telex and cable (Woheren 1993).

Today developed countries are experiencing an information technology revolution or an information age where the only unique resource or input into socio-economic development is information. There is continuous research into the methods of handling information as well as the creation and improvement of tools that exist in the creation, generation, collection processing, organization and communication of information (Jensen 1995).

This chapter discusses the information technology revolution with particular reference to Africa. The chapter begins with a recap of the importance of information, this is followed by a discussion of the major landmarks in the information technology revolution. The world-wide developments in telematics are discussed. Particular reference is made to: networks such as the Internet and Fidonet; databases search services by E-mail on Fidonet and on the Internet; and the developments in telematics in Africa. In the latter case, examples of successful electronic networks are given and

special reference is made to the on going project on Capacity Building for Electronic Communication in Africa (CABECA).

3.1 THE IMPORTANCE OF INFORMATION

Information is a resource as important to the modern world as energy or skilled work force (Tarelo and Gaudette 1995).

Lack of information is being cited as the cause of poor health and education in poor and isolated areas of the world (Kenney, 1995). Kenney notes that it is in these areas that electronic information delivery mechanisms can compensate to a significant degree for the isolated condition for millions of people in the world.

Illustrating further the value of information, Kenney (1995) gives an account on how information delivered via telecommunication systems can be and is being used in various developing areas of the world for:

- Medical consultation to provide diagnostic and treatment support to relatively unsophisticated rural health workers or to isolated patients;
- Training to improve and maintain the skills of isolated health care workers;
- Basic health education to reach expectant mothers, young children, etc; and
- Disseminating information for education to isolated rural areas.

3.2 : THE INFORMATION TECHNOLOGY REVOLUTION

Throughout the world, information and communication technologies are generating a new industrial revolution which is as significant and far reaching as the past revolutions. Technological progress now enables us to process, store, retrieve and communicate information in whatever form it may take, unconstrained by distance, time and volume. This revolution adds huge new capacities to human intelligence and constitutes a resource which influences the way we work and live together (Bangemann et. al., quoted in Talero and Guadette, 1995). These changes are facilitated by the revolutionary advances in information technology. Fortunately, the information revolution also creates extraordinary new opportunities to attack vexing problems such as poverty, inequality and environmental degradation (Talero and Gaudette 1995).

Technologies that have influenced the developments of telematics include, among others, the following:

- The invention of satellites which have enabled point to point communication thus opening the door for communication with the rest of the world.
- Invention of the laser which has a capacity to emit intense, highly directed beams of light that have enormous data carrying capacities;
- Discovery of fibre optics which act as efficient conductors of photons which are more efficient than electrons at transmitting data. Both lasers and fibre optics are ideally suited for high speed digital transmission;

- Replacement of the twisted pair cable by the coaxial cable which is capable of carrying large volumes of data, up to 100 bits per second or 1,800 to 3,600 calls at once;
- Development of microwave systems which are more suited to carrying high volume data and long distance communication of both voice and data. Microwaves also reduced the need for cabling (Mayo 1985);
- Development of the micro-chip (1962) which paved the way to Large Scale Integration and later in the 1970's, Very Large Scale Integration techniques, thus enhancing the memory and storage capacities of computers and leading to miniaturization. The latter, opened up a wide range of new application areas;
- Development of software tools with modern computer-aided design techniques to facilitate the accomplishment of computer aided tasks with reasonable resources of manpower, equipment and time;
- The emergence of digital communications as a common vehicle for both voice and data, leading to integrated services digital networks (ISDN). This has evolved into a common technology for computers (informatics). An example is the 64 kilobyte per second channel which is now a universal information carrier (Pitke 1989);
- More recently, development of very powerful microprocessors and sophisticated digital signal processors which can encode and decode pictures thus making it possible to transmit images.

The above developments led to the emergence of telematics which is the marriage between computers and telecommunications. Telematics is the basis for electronic communication (Pitke 1989). Pitke (1989), Held (1991), and many others argue that

whereas in the 1960's and 1970's computers were generally expensive and not well suited to the needs of developing countries, the present state of technology for hardware, software, interconnection, packaging and telecommunications provides new opportunities for developing countries to apply these technologies for their own benefit to the fullest extent. These developments have resulted in improvements in telephony and computer storage capacities.

In light of the above developments, the most fundamental consideration for any developing country such as Uganda, is not how to acquire modern technologies indiscriminately but how to exploit advances in IT optimally for human and economic development. This view has been expressed in the policy proposal regarding informatics and information technologies for Uganda. This policy encourages the optimum utilization of emerging information technologies for data and information handling with a view to improving the quality, comprehensiveness and management of information systems and services in the country; and facilitating access to, and delivery and utilization of data and information (Neelameghan 1990). Details on the proposed national policy on information systems and services are discussed in Chapter 4, Section 4.1.1.

On the value of information technologies, Seetherama (1990) cites the views expressed by Neelameghan (1976) and Seracevic and Wood (1981) who noted that information technologies are an essential support to development. They plead for among other things, organizing mechanisms for effective information delivery to problem solvers and decision makers by employing information technologies and networks that are appropriate to their circumstances. Furthermore, Seetherama (1990), states that in a

given context, a decision is only as good as the adequacy of the information available to the decision maker and the capacity and efficacy with which he proceeds to handle and apply information. These views support the theme of the thesis which is to improve the users access to databases by using E-mail.

Woherem (1993) indicates that the ability to harness information and knowledge (which are valuable resources) to enhance and sustain the present competitive positions of companies and nations, underlies the success of using IT systems.

Finally, a number of authors, including: Tarelo and Gaudette, Woherem (1993) and Adam (1995) have expressed the view that developing countries will only be able to participate in the global information economy, if they implement changes in their economic policies particularly in their information and telecommunications policies. Fortunately, Uganda is one of the countries that is already effecting such reforms.

3.3 DEVELOPMENT OF TELEMETICS

3.3.1 : The evolution and current state of electronic networking : The world-wide situation

Modern data networks have evolved in developed countries during the last 30 years. This revolution in computing has radically changed the developed world. Computing and information technology now pervades almost every area of life (Sadowsky 1993). Information technology has produced new industries and markets, it has also revolutionized the way in which the industries and other businesses work. The diffusion

and adoption of information technologies (IT) has been driven in a large part by rapid cost and price performance decreases of microelectronics technology, optical fibre technology and packet switching techniques (Sadowsky, 1993).

Electronic networks are telecommunication systems that connect two or more computers and their peripheral devices. It was noted earlier, that these networks have evolved out of the developments in IT. Networks connect mainframes, minicomputers and microcomputers in either a local area, in which case they are referred to as local area networks (LANS) or in a much wider area to form wide area networks (WANS) (O'Leary and Williams 1989). Over the years several networks have developed in a number of countries for the purpose of sharing information within an organization or between different organizations or individuals in countries or continents that are far apart. Examples of such networks are; BITNET, cooperative, world; EARN, a similar network in Europe, JANET, the Joint Academic Network in Britain; and the **Internet** which is the "network of networks".

3.3.1.1 The Internet

The **Internet** emerged in 1973 when the U.S Defence Advanced Research Projects Agency (DARPA) initiated a research program to investigate techniques and technologies for interlinking packet networks of various kinds. This 'internetting' project developed communication protocols which are known as the TCP/IP Protocol Suite or the Transmission Control Protocol - Internet Protocol. The system of networks which emerged from the research was known as the "Internet".

Later, in 1986, the U.S. National Science Foundation (NSF) initiated the development of the NSFNET which, today, provides a major backbone communication service for the Internet. The National Aeronautics and Space Administration (NASA) and the U.S. Department of Energy contributed additional backbone facilities in the form of the NSINET and ESNET, respectively. In Europe, the major international backbones such as NORDUNET and others provide connectivity to over one hundred thousand computers on a large number of networks. Commercial network providers in the U.S. have also followed suit.

Since its inception, the Internet has grown very fast. It is now linking governments, schools, libraries, corporations, and individuals to each other and to various information resources. By August 1995 it had about 28,000 registered networks, about two million host computers, and 30 million users worldwide. The number of users is growing at a rate of 20-30% per quarter. About 149 countries have connections of some sort of an international computer network, of these, about 63 countries have direct connections to the Internet (BOSTID 1994:6).

Judging from its growth, the importance of the Internet cannot be doubted. On this issue, Djamen et al (1995) quote the Canadian Secretary of state who said that, " .. in the eighteenth century it was already recognized that information was the cornerstone of democracy. At the end of the twentieth century, information, as well as money, are the cornerstones of power. The haves and the have-nots of the next century will be defined by their degree of access to information ". Perhaps the benefits of using electronic networks could best be described by the preceding statement.

3.3.1.2 The Information Superhighway

The term "Information Superhighway" was coined by Al Gore, the American Vice president who has championed the campaign for building this "Global Information Infrastructure (GII)"

which is an interconnection of existing communication and information media, bringing television, telecommunications and computer technologies into a single medium. The emergence of digital communication, has facilitated this development.

The concept of "Information Superhighway" emerged in 1986 when the Internet which was until then exclusively used by American research scientists and computer scientists for E-mail, group discussions and research, changed to become the most effective medium of mass communication. Ideally, the GII is an incorporation of all existing networks into one global system. It will enable every human being on earth to interact with each other. Al Gore and the builders of the GII envisage it as an information system, equipped with the latest Information Technology which will facilitate individuals, even in the most remote areas of the world to be able to access libraries, databases, educational institutions, hospitals, government departments and private organizations virtually anywhere on the planet (Akhtar and Nostbakken 1995).

Akhtar and Nostbakken (1995) state that this network will be used to foster education, cultural exchange, entertainment and economic development through global technology transfer and investment. It is anticipated that this global interconnectivity will result in a new "communications era" (Akhtar and Nostbakken 1995).

3.3.1.3 Fidonet

Initially developed in 1983 by Tom Jennings (USA) only as a bulletin board system, Fidonet is a store and forward form of electronic communication that provides a means to bridge time and distance to facilitate interpersonal communication. The simplest and least expensive type of computer-based messaging service is the bulletin board (BB) System. In this system any member (of the system) can browse through the bulletin board reading items of interest. Fidonet compatible systems offer three main services: electronic mail (one to one communication), conference mail (many to many), and file transfers. Fidonet file transfers can handle both text and binary files. Since its official inception in 1984, Fidonet has grown to include over 15,000 systems on six continents. It has also gained fast acceptance as an attractive networking standard for educational, government and business networks. Its popularity is due to its low cost and ease of use. To use the Fido technology one requires a computer, a modem, and ordinary dialer (communication) software (BOSTID 1994, 8:2).

The advantages of Fido technology are:

- The Fidonet technology can be used to establish regional E-mail systems using small host computer based in a developing country. This technology is particularly suitable for Africa;
- Independent Fidonet systems establish gateways (such as Greenet in London) with larger, international electronic mail systems using high speed (and error correcting) modems. Then, at regular intervals, the independent system dials into the larger systems to swap incoming and outgoing messages;

- Fidonet technology keeps down the cost of international calls without requiring sophisticated computer equipment;
- Fidonet compatible systems, relative to other electronic mail systems are cheap and easy to install. They do not require powerful computer hardware;
- The Fidonet technology does not use packet switching and is thus attractive in countries which do not have highly developed computer and telecommunication facilities;

It is intended that the information retrieval system to be proposed in this study will be based on Fidonet technology , thus taking advantage of its qualities.

In addition, research has made several breakthroughs in the Fidonet Systems. It is now possible to conduct database searches using programs that interface some Fidonet software such as: Pegasus and Frontdoor with information retrieval software such as CDS/ISIS (Details on this are discussed in Section 3.3.2 of this chapter).

At the moment Fidonet has been tested and/or installed in 28 African countries, Uganda being one of them. (See Appendix 4 for more details). Fidonet has a number of hosts in Africa namely: PADISnet - Addis Ababa; ENDA - Dakar; WORKnet - Johannesburg; MANGO - Harare and ELCI - Nairobi. Fidonet also provides a gateway access to researcher's on various university computer networks that form part of the Internet, JANET and BITNET worldwide and UNINET in South Africa.

3.3.1.4 Electronic mail (E-mail)

The value of network connectivity for developing countries can be exemplified by a simple example of general network tools such as E-mail and file transfer which have potential to increase substantially the pay-off for external assistance. E-mail can provide a major improvement in the communication between people in developing countries and developed countries. It also makes possible referrals of questions to others who are connected in a very time and cost-effective manner. Through E-mail, librarians, who are stewards of very large quantities of information, have an opportunity to find the information they need from other sources (Sadowsky 1993).

The exchange of messages by electronic mail is only one function of the computer networks such as Internet and Bitnet. Networks offer other facilities such as listserves and Newsgroups which are discussion forums for different groups of professionals namely; professional organizations, Universities, database producers and software vendors. Bulletin boards and special network tools aim to guide the users towards the electronic information services world-wide. Kempf (1994) cites an example of the British Bulletin Board for Libraries (BUBL), as a possible starting point for a tour into the world of "electronic information space". Information specialists can use the available network resources for reference, training, publication or research purposes (Kempf 1994).

In developed countries, for many years, librarians and researchers have become used to having access to remote

facilities in some way or another. Literature searching on-line, electronic mail, data transfer or document ordering are only some of these applications. Recently, issues about computer networking have been receiving attention from professional groups. The fact that computer networks are interlinked, makes the networks more attractive for professionals. The exchange of messages by electronic mail is no longer linked to a special physical or regional network. Based on new improved telecommunications infrastructure, new services for data and information exchange are being developed. Printed forms are offered in electronic forms, unique electronic documents have become publicly available on research networks, and the geographical location of electronic archives is no longer an obstacle to their users (Kempf 1994).

Although the above scenario relates to developed countries, with the use of available low cost technologies such as Fidonet, a similar situation could be true for developing countries.

In 1993, the International Service for National Agricultural Research (ISNAR) noted that developments in telecommunications and computers are revolutionizing agricultural research. It was observed that new information technology has the potential to improve the quality of agricultural research, the efficiency of its management, and the relevance and timeliness of research results. Scientists and managers can now access more information than ever before. At the same time they can disseminate information to users more easily. At that time (1993) the impact of such new technologies on many national agricultural research systems (NARS) was slight (ISNAR 1993: 6). In relation to this concern, this study has been undertaken to investigate the potential of E-mail (an

IT), in increasing access to vital, database resources within the country (Uganda), for the agricultural research scientists.

3.3.2 Database Search Services by E-mail

Databases are collections of information or integrated data that has been cross referenced in order to allow easy retrieval (O'Leary and Williams 1989). Databases are becoming increasingly required due to the increasing needs for information particularly in a changing business environment (Backett 1987). Katama (1994) amply describes the role of databases by saying that databases are crucial for the final and sustained success of marketing information. She goes on to say that it is now imperative for the serious publisher of scholarly literature to initiate routine information searches to cut down on time spent on person to person inquiries with prospective authors of a suitable area of research. FAMESA (1992) observes that failure to search and use appropriate information for research and development project planning can lead to massive waste of resources. A good researcher must ensure that appropriate literature searches are carried out and pertinent literature studied before a project is started.

Unfortunately, in Africa, databases and/or the means by which they are accessed often represent a barrier rather than a path to progress. The question of how to get the needed information, how to keep up with changes, and how to cope with the costs of doing so continue to perturb the African scientist and information worker equally.

Accessibility is one of the primary database issues. Information, however well organized and indexed, does not realize its value until it is known and put to use

(AAAS 1995). The view of providing better access to bibliographic data in databases should therefore be the goal of every information centre. It is useless to get documents indexed in databases if these databases cannot be searched. Searching databases is a primary method by which references are located. Thus databases increase the demand for information (AAAS-SSAP and UNECA-PADIS 1995). It is therefore imperative to improve access to databases.

Each day the number of people that have accessibility to electronic mail is growing. However, this is not true with the services of on-line database accessing mainly because of the communications cost and the cost of the infrastructure needed (Makane 1995a). To fill this gap, a number of efforts to access databases by using E-mail (Fidonet technology which is a cheaper alternative), are going on in several parts of the world. Below are some examples of successful efforts in this area:

- In India, the National Centre for Science Information (NCSI) of the Indian Institute of Science (IISc) has developed an Inforserver using IISc's E-mail node. This node is part of the Educational and Research Network (ERNET). With this system, remote users are able to search and retrieve bibliographic information from NCSI's databases which run under the UNIX environment (Sreenivasa and Indira 1994);
- At the Pan American Health Organization (CEPIS) in Peru, a listserve has been developed under CDS/ISIS for e-mail search in DOS or UNIX. This Listserve is capable of conducting E-mail searches without the need to have large communications infrastructure to run the service. What is needed is an XT

computer with 640 K of main memory and 1 MB free disk space for the program. The listserve analyzes the electronic mail that have been received in pre-established electronic directory and translates the messages as files with electronic searches for CDS/ISIS databases. CEPIS has developed this program to run under PEGASUS MAIL software (Makane 1995a);

- The Library of Congress in Nairobi has a catalogue database that can be queried by E-mail. Makane (1995b) indicated that the database is established with dBaseIV software and is queried by E-mail using Fidonet technology.
- The most recent success was registered in February 1996 by PADIS, at the Economic Commission for Africa, Addis Ababa, Ethiopia, where a program has been developed to query and search CDS/ISIS data bases using Frontdoor (Fidonet) software.

However, access to information from databases through electronic networks requires as a prerequisite: the establishment and maintenance of databases. In Africa, several databases have been created for the purpose of providing information to different groups of users. Some of these databases can be accessed electronically. Below are some examples:

- The Southern African Development Coordination Committee (SADC) database in Gaborone is part of a SADC Early warning System which provides weather information to (at least) five out of its eleven member countries who are on-line. This information is helping member countries in planning their agricultural activities. SADC is also creating databases about countries in the region and it has plans to provide information (electronically) to the SADC member countries,

namely, Angola, Kenya, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zaire and Zimbabwe (William 1995);

- PADIS (Addis Ababa) offers public on-line access to its databases maintained on its HP 3000 computer.

In 1990, PADIS acquired the Fidonet system of electronic networking. Through this system, PADIS can offer services such as E-mail, conferencing, Bulletin board and most recently, databases searches by E-mail from any remote location;

- The CGNET member institutions composed of eighteen international agricultural research Institutes, among which are, the International Livestock Research Institute (ILRI), Addis Ababa, The International Centre for Research in Agroforestry (ICRAF), Nairobi, Kenya, are able to conduct database searches through the CGNET (E-mail) electronic network as well as communicate with their member institutions and share research information (Gordard 1994, Aina and Kgomotso 1994). The ICRAF country station in Uganda is benefiting from this network.

- Other network facilities:

In addition, there is MISANET, an E-mail System (Bulletin Board) based in Windhoek, Namibia. Journalists in the Southern African region are using MISANET to share local stories (plain text) with their colleagues elsewhere in the world (William 1995);

As can be seen from the preceding discussion, E-mail has a great potential for providing relatively cheap and efficient information support to several development activities, including scientific research. Therefore developing countries like Uganda have high chances of improving their information services and in particular information retrieval by using this method. The Fidonet technology is particularly appropriate because of its advantages of being relatively inexpensive and using poor quality and unreliable telephone lines which are predominant in most of Africa.

Database searches can also be conducted on the Internet by using E-mail. However, the costs of conducting a search on Internet from Uganda or for that matter, most parts of Africa through a direct Internet connection are very prohibitive. This makes it impractical for most users in Africa. Examples of the costs incurred in connecting to the Internet from Uganda are given in Appendix 7. Suffice to mention here that there is cost incurred while using E-mail to access the Internet are lower than the costs incurred when using other technologies such as Serial Line Internet Protocol/Point to Point Protocol (SLIP/PPP) or Full Internet connections.

Furthermore, use of (Internet) network functions demands some technical knowledge of the system. In view of this, interfaces have been developed to help the user. These interfaces integrate the different basic services in a value added information system. This is the case of Gopher, World Wide Web (WWW) or Wide Area Information Systems (WAIS). In addition, the user needs special client programs which make it possible to use the applications on the host computer (the information server). These include software for different platforms namely, MS-DOS, Mackintosh, Unix and

VMS. Some examples of search tools that have been developed to help users in searching on the Internet and their mode of operation are briefly discussed below:

- **Gopher** is the most widely used look up tool that helps the user to navigate through the Internet by selecting resources through menus. Gopher menus may point to text files, other directories, phone books or pictures, as well as open remote login (Telnet session) or a retrieval facility. The advantage of Gopher is that it collects information that is across many computers in different forms and presents it in one menu. The user then selects an item of her/his choice on the menu, then gopher automatically makes the connection to the concerned computer to retrieve the information;
- **Veronica** is a tool with an index search that helps to find interesting documents through hundreds of Gopher menu entries. It searches for key words or phrases in a menu title. It then gives the addresses of all the menus with those key words;
- **WAIS** is an acronym for Wide Area Information Servers. This tool is more powerful than gopher because it actually searches the full text of a document to look for specified keywords. WAIS accepts the keywords in English, processes them at user level and relays the processed information to the selected databases. WAIS then searches the index of the server that has been specified by the user and then informs the user which databases are likely to have the information being searched for. There are 250 WAIS libraries that have been set up to

provide free access to documents and other resources. WAIS servers can be good sources of Science-related topics;

- **World Wide Web or WWW** is a menu based service that helps one to access a variety of resources. The difference between WWW and Gopher lies in the hypertext organization of the web that allows cross references or associative links between related resources. Both Gopher and WWW have links to WAIS, the Wide Area Information Servers. In WWW, each document contains highlighted items for which additional information is available. If a user needs this additional information, s/he has to select the highlighted item, then the document will be displayed. With appropriate software such as **Mosaic**, the user can view not only text but pictures, sound files and video.

While the Internet is an important source of information, searching on it is not easy, it requires a lot of patience, particularly for users who are connected to Fidonet systems. Moreover, it is also important for Africans to give priority to development of databases and networks that are relevant to their situation rather than depending entirely on information from abroad. It is equally important to develop methods of accessing national or regional databases. Doug (1993) confirms that with the recent developments in micro computer technology and communication infrastructure, it is possible to envisage the provision of comprehensive and efficient system for dissemination of information. He notes that the current telecommunication technologies can immediately benefit Africa even before networking is spread over. Low cost solutions are indeed already available to give individuals access to electronic networking (Doug 1993).

3.3.3 : Development of Telematics in Africa

Although Africa which is well known for its "poor" telecommunications infrastructure is gaining international attention in electronic networking. The tremendous impact of electronic communications on the development of Africa is being acknowledged by those residing in it. Among the opportunities that electronic communication has offered to Africa are: the restructuring of traditional institutions', management of crises and alleviation of poverty (Adam 1995).

On the impact of electronic networking in Africa, Adam (1995) observes that it has far reaching effects. Connectivity enhances activities being done by individuals, stimulates interaction and enables access to knowledge and resources. Furthermore, Adam (1995) quotes Benzine and German (1995) who observe that electronic communication is a living college where people of diverse backgrounds and expertise share resources, knowledge and experiences. The influence of electronic networking in Africa is bi-directional. Networking breaks the isolation of researchers by making them both recipients and generators of global information. Thus by stimulating researchers, electronic communication can upgrade African education as well as other development activities that benefit directly from research. High band width tools such as video links can upgrade African Universities overnight (Rischarde 1995). Other opportunities that have been observed wherever connectivity is available include; access to vast and up-to-date information, maintaining contacts with researchers and imminent professors; and discovering opportunities.

In Africa, the communication infrastructure can vary from very good to abysmally small from one country to another (Jensen 1995). The International Telecommunications Union (ITU) indicates that Africa has the least teledensity in the world. The average telephones per 100 people in Africa was 1.6 in 1993, with an ever growing population, the teledensity has remained stagnant even though marginal increases in telephone lines have been achieved by some countries (Adam 1995).

However, the situation is not so grim. Jensen (1995) notes that some Sub-Saharan African countries, have over the past few years, been able to put into place advanced communication networks operated by skilled and resourceful managers. Uganda is one such country where the telecommunication infrastructure is rapidly being rehabilitated. In addition, the telecommunications sector is being deregulated and liberalized in order to make it more efficient (Owor and Wadunde 1995). The current state of the telecommunications sector is reviewed in the discussion on "Information Technology in Uganda", Chapter 4, Section 4.3 and 4.4 .

The advent of computer-based electronic networking in Africa is therefore providing an opportunity for resolving the problem of lack of information, that many scientists working in Africa, find themselves in (AAS-SSAP and AAAS 1992).

This view is supported by Sadowsky (1993) who advocates for electronic connections for developing countries arguing that electronic connections have a high pay-off in these countries because of lack of reliable alternative delivery mechanisms in the developing world.

Personal microcomputers are increasingly available in many parts of Africa and with the addition of a modem and an appropriate communication software, they can transfer information over poor quality telephone lines at minimum costs (See Table 3.1 below). There are alternatives to the telephone link, namely microwave links, satellite and packet radio links. Fortunately, telecommunications is improving in Africa and there is now an increase in the use of computer technology. Consequently, there is a valid reason for electronic networks in Africa (Aina and Kogmotso 1994). Electronic access has significant advantages in that the number of databases reachable becomes virtually unlimited. Many areas in Africa have already acquired E-mail or are planning to do so. There is much information that can be obtained by this technology alone. Yet, E-mail, valuable as it is, remains unexploited by African scientists and information workers.

TABLE 3.1 : COMPARISON OF THE COST OF E-MAIL AND FAX BETWEEN
ADDIS ABABA AND LONDON

Medium	Size of file	Time	Cost
FAX	4 pages	8 minutes	US\$ 14.00
	24 pages	48 minutes	US\$ 84.00
E-MAIL (2400 baud modem)	4 pages	1 minute	US\$ 1.60
	24 pages	3.7 minutes	US\$ 6.00
E-MAIL (9600 baud modem)	4 pages	20 seconds	US\$ 1.60
	24 pages	40 seconds	US\$ 1.60

Source: Lishan Adam, " Sustainable Academic Networks in Africa,"in Electronic Networking in Western Africa Universities, AAAS, 1994.

Adam (1995) reports that though it is spreading, computer connectivity is still very low in Africa. Many networking developments in the region are based on grassroots initiatives serving the academic and research community. The user base in most cases is relatively low. Adam (1995) cites six networking techniques in use in Africa, namely: **Fidonet, Healthnet, SLIP , UUCP, Cooperative TCP/IP and Commercial TCP/IP.**

Appendix 4 gives the connectivity situation in Africa showing the different networking techniques.

3.3.3.1 Examples of electronic networks in Africa

At present (1996), several electronic networks exist in Africa and others are being established. By April 1994, there were 18 non-commercial networks and 7 commercial networks operating on the African continent, most of them are using Fidonet technology. Some examples of non-commercial networks are given below;

- PADISNET a network of the Pan African Development Information System (PADIS). Initially setup in 1990 as a regional pilot project involving international and regional linkages (including linkages to other networks), the PADISNET project is currently one of the largest networking African projects, linking 37 African countries. PADISNET is based on Fido technology;
- HORNET is a free bulletin board operated by PADIS that serves as a source of news, reports and discussions on issues related to the Horn of Africa.
- Other networks include:

SABINET which is a subscription-based South African bibliographic network, UNINET (South African), MANGONET (Zimbabwean), ESANET (East and Southern African Network), and NGONET-Africa which is based at the Environmental Liaison Centre International (ELCI), Nairobi.

3.3.3.2 Capacity building for Electronic communication in Africa (CABECA)

So far one of the most outstanding efforts to promote computer-assisted networking throughout Africa is the three year IDRC-sponsored project known as CABECA. Executed by PADIS, CABECA arose out of a need to assist Africa in exploiting the tremendous advances in electronic communication that are being used elsewhere in the developed world. These advances are viewed as a resource for economic and social development and as a tool to promote regional cooperation (Adam 1995).

CABECA began in 1993 with the aim of introducing low-cost electronic connectivity (Fido-based) to some 24 African countries in the region. CABECA builds on the experience gained by several African countries over the last few years from a number of IDRC sponsored electronic networking projects namely, PADISNET, ESANET, NGONET, etc. IDRC has taken a lead in financing African Electronic networking initiatives. The aim is to demonstrate that the technology for developing electronic communications throughout Africa is readily available and could be implemented at a relatively low cost, taking into consideration the economic, social and political difficulties that the region faces. Thus the CABECA project takes into account the problems of the Africa region that have isolated it from international networking phenomenon, including:

- the world's lowest level of telecommunication development, resulting in a scarcity of lines even in urban areas;
- the worlds lowest level of spending on informatics, making computers and computing skills still relatively very rare;

- high telecommunication charges especially for international calls;
- tariff barriers to data communication; and
- Scarcity of Africa-based specialists to train others in the area.

The overall objective of CABECA is to provide technical assistance to bring about sustainable computer-based networking in Africa, at an affordable cost, accessible to a wide variety of users from both the private and the public sectors. The users include: business persons, researchers, planners, policy makers and development workers from NGO's and International organizations. The project is also building capacity for computer networking, by training a corps of system operators who should train others in their area and offer continuing support to users to ensure the sustainability of the national nodes with connections to international networks (Adam 1995).

The projects' aim is to offer inexpensive and easy access to local and international information services on systems run by local operators and sustained by revenue from users.

By mid 1995, CABECA had worked to initiate or strengthen electronic communication systems in more than twenty African countries, Uganda being one of the beneficiaries.

Under the CABECA project, countries are provided the following:

- Equipment for a Fido node
- Training of system operators and users
- Backstopping of the system

In some instances E-mail is the only facility available, whereas in other cases, BBS have been set up (Hafkin and Menou 1995).

3.3.4 Summary on the developments in IT

As the rest of the world embraces developments in IT, Africa cannot afford to be left behind. The fore-going discussion shows that electronic communication and in particular, E-mail, has great potential in enhancing development activities even in the absence of sophisticated telecommunications infrastructure. There is need to exploit this potential by all concerned sectors. In the case of Uganda where electronic communication has been introduced and is gaining popularity, the agricultural research sector could take the lead in this endeavour. Therefore, this study is an attempt to utilize the available networking facilities for improved information retrieval in the agricultural research sector in Uganda.

CHAPTER 4

INFORMATION TECHNOLOGY IN UGANDA

4.0 INTRODUCTION

Like in other countries in Africa, the diffusion of Information Technology (IT) in Uganda has been driven by external factors. Computer vendors', commercial pressure and widespread expatriate support have taken precedence over direct government control. Most computers came to Uganda as donations from abroad. According to Mulira (1995), two major forces have influenced the computer market: the economic and political crisis of the 1970 and 1980's which resulted in dependence on loans and grants as well as the influence of NGO's from industrialized countries who have made intensive use of microcomputers at the institutional and project level. In addition to enhancing the use of computers, NGO's also helped in spreading the skills that are needed to operate the computers.

This chapter discusses current developments in the status and use of information technology (IT) in Uganda. It begins with some background information on the historical developments that are associated with the diffusion of IT in Uganda and then discusses the proposed IT policy. The IT environment in Uganda is discussed with developments in computing and the use of computer applications, the role of the Uganda Posts and Telecommunications Corporation (UPTC) in regulating developments in the telecommunications industry. Recent developments in electronic communications are also highlighted. Most of the information

provided in Sections 4.1, 4.2 and 4.3 was obtained through interviews with different people in the IT sector. A list of those interviewed is provided in Appendix 3B. This information was supplemented by information from documentation obtained from the institutions.

4.1 DEVELOPMENTS IN INFORMATION TECHNOLOGY AND ELECTRONIC COMMUNICATION IN UGANDA

4.1.1 IT Policies in Uganda

After several years of instability, Uganda is currently trying to recover from the ravages of civil wars. The government has therefore found it necessary to have policies that can regulate and promote programs that are geared towards overall national socio-economic development. Under the government's recovery program launched in 1986, Uganda has recognized IT as one of the vital sectors needed to rebuild the country. In addition, many Ugandan professionals are considering investment in informatics. Unfortunately, the informatics infrastructure is still very basic. Lack of an IT policy has delayed the implementation of many IT-enabled developments (Mulira 1995).

Since IT cuts across several sectors, development of an IT policy has not been confined to a single sector. In fact, some sectors have formulated IT policies in respect of their mandates. To some extent this has resulted in duplication of efforts. This discussion will therefore focus on the efforts that have been made in proposing a concrete national IT policy, particularly, efforts that have been made by information professionals.

In recognition of the important role of IT in national development, the Uganda National Council for Science and Technology was formed in 1990 and charged with formulating an IT policy as part of an overall Science and Technology Policy. A draft policy has since been drawn up but has not yet been approved by government. Approval of the IT policy is still pending owing to the lack of an explicit national policy on science and technology. However, government has included some of the proposed science and technology policy issues in its sectoral development plans. This policy proposal presents a starting point in harnessing IT for development. Notable in the general technology policy is a statement that advocates for the establishment and development of up-to-date science and technology data banks for technical information such as project reports and other statistical information, with links to national and international networks of libraries and information centres.

The objective of the general national technology policy is to ensure continuous and sustained uplifting of the general quality of life and national security, through a reliable, integrated, self-sustaining national technological base, acquired in the shortest possible time, compatible with the nation's cultural patterns and optimum utilization of the nation's resources (Uganda.UNCST 1991).

The Uganda National Council for Science and Technology (UNCST) has proposed the following sectors as requiring IT applications: agriculture, commerce, information and mass media, environment, natural resources, health, population, planning, mineral and mining, water resources, transport and communication, construction, military technology and meteorology.

The Information Technology Policy Objectives are:

- To create an enabling environment that can lead to the harnessing of information technology for development purposes.
- To increase awareness of the central role of information technology in development and thereby introduce it in the central education system.
- To establish an infrastructure for information technology by encouraging acquisition of, innovation in, and production of computer and communication systems for the purposes of spreading utilization of information technology.

The policy recommendations formulated by UNCST urge government to:

- Promote awareness and literacy in information technology at all levels of education and also through specialized computer training institutions;
- Encourage institutions of higher learning and research to include in their curriculum, fundamentals of IT;
- Assist in the mobilization of resources to help secure equipment for information technology laboratories;
- Abolish duties and taxes on imports in IT in order to make the technology affordable by a wider percentage of the population. Also to abolish the commercial transaction levy (CTL) that is charged during installation and maintenance of IT;
- Set up free data processing zones where information/data from anywhere in the world can be collected processed and accessed;

- Liberalize the communication industry in order to allow competition in the provision of voice and data communication services also in the provision equipment;
- Set up an IT board that will advise on IT issues;
- Strengthen the existing laws regarding copyrights in order to protect local and foreign investments in software development;
- Pass legislation regarding data security and the protection of individual rights from unauthorized access to personal data held in computerized data banks;

It is expected that government will incorporate the IT policy into a wider Science and Technology Policy.

Additional recommendations to strengthen the IT policy have been made by other concerned parties, for example Mulira(1995) calls on government for support and commitment in implementing the IT policy. Her suggestions include the following [Mulira 1995]:

- Application of IT should be a priority in those areas which have most impact on the day to day running of government and those critical for the economy. She suggests such areas as: agriculture; livestock and crop survey systems; employment and manpower planning; import and export; vehicle registration and licensing; banking including inter-bank networking; Uganda Electricity Board and the Post Office.
- Establishment of a Ministry of Science and Technology for the purpose of monitoring the IT transfer and diffusion in the country;

- Formulation of options and strategies for IT with emphasis on human resource development, in liaison with the concerned institutions, namely, the ministries of education, labour, planning; universities; and teacher training institutions along with experts in the field;
- Formulation of an implementation plan in education and training in informatics. This plan should initially emphasize computer application and training programs at tertiary levels, in particular she emphasizes the need to strengthen Informatics capacity at Universities and colleges;
- Introducing computer awareness programs in all urban secondary schools with the goal to institute "O" (secondary) level examination in computing. Changes in the education policy are recommended in order to promote appropriate teacher training and improvement of the domestic infrastructure;
- Encouraging employing organizations to train their staff for the required IT skills. Government support through economic and social policy incentives is required to persuade employers and workers to invest in skills development in IT; and
- Exploring the development of software, both at national and regional levels. Mulira (1995) notes that the graduates from Makerere University and other computer training schools form a modest manpower resource in software development. She therefore recommends investing in software development to enable further adaptation (of the software) nationally, for R&D activities and for commercial purposes at regional basis.
- Further efforts that have been made to develop an IT policy for Uganda. These include two separate occasions on which an IT policy was proposed as part of

a National Policy on Information Systems and Services. These are briefly discussed below:

1. In 1989, a team of Ugandan information professionals working together with a UNESCO Consultant proposed a national information policy which was approved by Cabinet in 1990 (Neelameghan 1990).
2. Bamuhiiga (1992) in his MSc(IS) Thesis entitled, " Policy of Information Systems and Services for Uganda: Suggested Formulation and Plans for Implementation"(Bamuhiiga 1992).

The following elements are common to both policies [Neelameghan 1990; Bamuhiiga 1992]:

- Stimulation and optimum utilization of emerging information technologies for data and information handling with a view to improving the quality, comprehensiveness and management of information systems and services in the country; and
- Facilitating access to, delivery and utilization of data and information.

It may be noted that these policies support the use of IT in enhancing access to information which is the theme of this thesis.

4.2 THE IT ENVIRONMENT IN UGANDA

4.2.1 The Development of computing and the use of computer applications

Although computers were introduced into Uganda over 25 years ago, until very recently their utilization has been confined to the most rudimentary tasks such as personnel records, payroll and accounting. Computers have seldom been used for gathering and processing vital data of strategic national importance or for decision support, an area which is of great benefit to the nation. There have been several reasons for this slow pace but the major ones were: lack of adequately trained manpower and lack of awareness among decision makers on the importance, threats and opportunities offered by informatics. Thus, IT capacity and capability has remained underdeveloped (Mulira, 1995).

4.2.1.1 Historical Background

The first computer, an IBM machine, was introduced in Uganda around 1967. It was based in the government treasury department. Later in 1969, an ICL computer was brought to Makerere University where a Computer centre was established under the Mathematics Department. This grew into the present day Institute of Computer Science. Both IBM and ICL machines were main frame single user batch systems. The IBM company then took on an institution known as the Uganda Computer Services. Uganda Electricity Board (UEB) and Shell (U) Limited were among the first institutions to take on computing, with UEB being the pioneer. Initially both ICL and IBM were offering short term training in computing at their respective training centres in Nairobi.

Because of the political instability in the 1970's, IBM withdrew its support. However ICL stayed on. That period saw a downward trend in computing activities in Uganda.

4.2.2 Computer Applications in Information Management in Uganda

Government computing has for long been mainly associated with the payroll and for marking examination papers by the primary section of the Ministry of Education. Currently, some government offices are acquiring computers which are mainly used for simple tasks such as word processing.

On the other hand, since the 1980's computing has become more popular in the private sector particularly with NGO's, Banks, Insurance companies, and to a smaller extent in individual businesses. Most of these institutions are acquiring stand alone computers (PC's). As such, the phenomenon of distributed processing is not common and networking has hardly been adopted. However, some institutions such as banks are now starting to implement local area networks (LAN'S). Below are examples of some business institutions that currently use computers [Galiwango 1995]:

1. The Uganda Posts and Telecommunications Corporation (UPTC) which uses a WANG VS for billing. UPTC intends to install a system for payments and messaging in all its' districts offices.
2. The Bank of Uganda (BOU) (the central bank) which has computerized most of its activities.
3. The Uganda Grain Milling Company (UGMC), a local manufacturer of human and animal feeds. UGMC has used computers to automate its machinery.

4. The Uganda Commercial Bank uses a WANG machine in a proprietary network of tellers.
5. The Uganda Computer Services Financial Information System uses a UNIX Operating System.

4.2.2.1 Use of IT in libraries

Library and documentation centres of several government and non-government institutions are beginning to acquire and use IT. Computers, CD-ROM databases, Micro-fiche readers, and E-mail are some of the information technologies that are being acquired. Automation of the catalogue is being implemented by some institutions for easy management of the library collection. International Organizations, NGO's, research and academic libraries are playing a leading role in this activity. Examples of Institutions which have or are starting to use IT in their library /Information Centres are give below:

Academic Institutions

<u>Institutes' Name</u>	<u>IT/Tool in use</u>
1. Makerere University Main Library	E-mail
2. Makerere Univ. (Africana Sect.)	Catalogue (Starting)
3. Makerere University, Albert Cook Library	Catalogue database & on Healthnet
4. Child Health Library Ministry of Health)	Catalogue database & on Healthnet

5.	Institute for Social Research, Library, Makerere University	Catalogue database & LAN
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Business Institutions

	<u>Institution name</u>	<u>Tool in use</u>
1.	Bank of Uganda Library	Catalogue database
2.	Uganda Commercial Bank (UCB), Library	Catalogue database

Non-Governmental Organizations

	<u>Institutes' name</u>	<u>IT/ Tool in use</u>
1.	Centre of Basic Research (CBR)	Catalogue database
2.	Peace Corps Library	Catalogue database

Government Institutions

1.	Women in Development Documentation Centre (Ministry of Women in Development)	Catalogue database
2.	Uganda Aids Commission Library	Catalogue database
3.	Ministry of Health Library	Catalogue database
4.	Ministry of Planning Library	Catalogue database

- | | | |
|----|---|-------------------------------|
| 5. | National Environment Information
Centre (NEIC) | Databases
(GIS technology) |
| 6. | The Trade Information Centre | Databases |

International Organizations

	<u>Institution name</u>	<u>IT /Tool in use</u>
1.	United States Information Service (USIS) Library/Doc Centre	OPAC & E-mail
2.	United States Agency for International Development, Library	OPAC & & E-mail
3.	The British Council Library	OPAC
4.	United Nations African Institute for the Prevention of Crime and Treatment of offenders (UNAFRI)	Catalogue database

4.2.3 Education and Training in computer applications

The Institute of computer science at Makerere University is currently playing the leading role in computer education/ training. It offers a BSc and a Post graduate diploma in Computer Science. There are also short term training courses in the use of standard packages (Mulira, 1995). Plans to upgrade the institute to full fledged faculty are underway. The Institute of Statistics and Applied Economics at Makerere University also offers one semester of computing commonly known as the "Computer Workshop" to its undergraduate students doing a Bachelor of Statistics degree. Graduates from these Institutes are mostly employed as programmers in government departments.

At the lower levels, there is (currently) no computer technology manpower development through the formal education system, especially at secondary school level. Even the few schools that have acquired computers cannot make good use of them because of lack of teachers with the necessary skills in computing (Mulira 1995).

On the other hand, private computer training has been a lucrative business. Since the 1980's, computer courses organized by vendors and private computer training schools have mushroomed. Courses offered so far are mostly those on standard application packages such as: WordPerfect, dBase and Spreadsheets such as Lotus 1-2-3, etc. Unfortunately, the majority of such courses have been criticized of being academically deficient in scope and content. Nevertheless, a few training schools conduct courses leading to certificates and diplomas in computer science. These courses are yet to be standardized and accredited.

4.3 THE LEGAL AND REGULATORY ENVIRONMENT

4.3.1 The role of the Uganda Posts and Telecommunications Corporation

4.3.1.1 Historical Background

The Uganda Posts and Telecommunications Corporation (UPTC) was established in 1977 after the breakup of the East-African Posts and Telecommunications Corporation which was one of the collaborative bodies of the defunct East African Community. UPTC has since been the main voice and data carrier nationally and internationally.

Since 1978, the telecommunications sector has made significant progress, albeit slower than the needs of today's communication demands. In Uganda, the telecommunications infrastructure which is a basic requirement for effective data communication remains largely inadequate to meet Uganda's social, political, economic, educational and scientific needs. This inadequacy need is expressed by the state of the switching network (Owor and Wadunde, 1995).

4.3.1.2 State of the switching network

Uganda's switching and transmission (telecommunications) network remains largely analogue. There are currently four digital exchanges in the country. The main digital exchange is in Kampala and has about 30,000 lines. There are over 16 automatic analogue exchanges in the country serving the major axes in the country namely the Western, Eastern, Northern and North- Western axes. However, with the on-going laying of optic cables and replacement of analogue by digital switches, the quality of the network and is improving (Uganda. UPTC and JICA, Master Plan 1993)(Refer to Appendices 5 and 6 for details of state of the telecommunications network).

Although, the level of telecommunications penetration is still low with only 40,000 lines for the 17 million people in Uganda, it is expected to increase. Improvements in the network and in particular, the on-going privatization of the telecommunication services show government's intention to restructure and liberalize the sector (Owor and Wadunde 1995). The Uganda government views the development of the communications network as very vital in order to maintain communications throughout the country and thereby increase economic growth (Uganda. UPTC and JICA, Master Plan 1993).

By maintaining communication in the productive areas of the economy, the Uganda Posts and Telecommunications Corporation plays an important role in social and economic development (Uganda. UPTC and JICA, Master Plan 1993).

4.3.1.3 The role of UPTC in data communication

Data communication in Uganda has largely been based on the traditional methods such as; telex and facsimile communications. Both services have, until recently been offered by UPTC. Besides giving the basic postal and telecommunication services within and outside the country, UPTC is responsible for authorizing and coordinating the use of the telecommunications network and data and voice communication equipment. It is also responsible for allocating frequencies to private investors in the telecommunications sector. Since 1986, there has been an increase in the use of computers in data communication as can be seen from the following indicators [Owor and Wadunde 1995]:

- (1) Increased lease of data communication circuits by Airlines Organizations, Banks, Meteorological Organizations, Newspaper Publishers, etc.
- (2) Establishment of private telecommunication companies. Examples include:
 - **Starcom (U) Limited** which is currently providing mobile trunk radio and telephone service. The service is initially implemented in three towns of Uganda (Kampala, Entebbe and Jinja) but will be extended to cover the routes along the Kenya border and the Rwanda border thereby effectively covering the southern part of the country along the main routes (Refer to Appendix 5 and 6).

- **Celtel Limited** : Commissioned in June 1995, Celtel Limited offers cellular telephone services to the central region of Uganda (Kampala, Entebbe, Jinja), and has plans to extend to the East, South and Northern regions of the country. The company has rented circuits from UPTC; hence users of cellular phones can dial UPTC subscribers. With their advantage of total security, secrecy and high switching speed, cellular phones seem to be growing in popularity in Uganda (Wajega 1995).
- (3) There is an increase in the number of computers connected to the MUKLA FIDONET electronic network based at Makerere University.
 - (4) The establishment of computer companies; and
 - (5) The increasing number of inquiries received by Uganda Posts and Telecommunications Corporation for more robust data communication alternatives (Owor and Wadunde, 1995).

Despite these developments, the use of data communication is still very low and concentrated in the capital (Kampala) and a few urban areas. As mentioned earlier in section 4.1.1 of this chapter, there is need to develop an overall national IT policy which can guide the developments in all sectors involved in the use of IT. Meanwhile, government is currently reviewing the informatics and telematics sectors. Tariffs on telecommunications have been halved. Liberalization has taken place in the non-core sectors of UPTC. These developments aim at attracting private sector participation in telecommunications which should increase the use of telematics in all sectors of the national economy and therefore increase the pace of development. Since early 1995

companies offering VSAT, cellular and paging services have been operating in the country.

UPTC is responsible for allocating frequencies to institutions which use communication equipments such as radio systems. However, for UPTC to participate effectively in economic development, it needs long distance, highly reliable communications infrastructure (Uganda. UPTC and JICA, Master Plan 1993). Fortunately, as indicated earlier, there are plans to effect this change.

Future Plans of UPTC include restructuring of the core sector. The Postal services will be separated from the telecommunication sector and an independent National Communications Commission will be set up. These measures are intended to improve the contribution of telematics in the development of the country (Owor and Wadunde 1995).

4.4 DEVELOPMENT OF ELECTRONIC NETWORKS IN UGANDA

4.4.1: The Mukla Network

Established in May 1991, the Mukla network is the pioneer of electronic networking in Uganda. It was established by merging two projects funded by the International Development Research Centre (IDRC), Ottawa, Canada. These Projects are: the East and Southern African Network Project (ESANET); and the Non-Governmental Organization Network Project (NGOnet). The ESANET project was established to link

the computer centres at the Universities of East and Southern Africa while NGOnet was initiated to serve NGO's. This merger came out of the desire to cooperate.

The ESANET Project, or the East and Southern African Networking (ESAnet) research project which was briefly mentioned in Chapter 3, Section 3.3.3. The project links the Institutes of Computer Science at Nairobi and Makerere, and the Computing Centres at the Universities of Dar-es-Salaam, Lusaka and Harare. The countries of the five participating centers are all members of The Preferential Trade Area.

The objectives of ESANET were: to investigate various micro-computer based technologies for communication and to work out the technical bugs involved with the poor telephone lines, erratic management of the telephone lines, long-distance dialling system, and hardware and software equipment (Musisi 1996). He further expounds on the specific objectives of this project which were to:

- experiment with alternative techniques for data communications between the five nodes of the five East and Southern African countries named above;
- evaluate the technical, economic, sociological and management aspects of the communication network experiments;
- disseminate information to the research community within the region about the development and the results of the project with a view to increasing awareness and the possibility of stimulating new, wider applications, and inviting feedback on related topics; and
- make recommendations to the research community (users and telecommunication authorities in the region) on cost effective data communication modalities, and

appropriate network models and policies for specific environments and applications.

The long term goals of the project were to:

- achieve more cost effective and relevant data collection and assessment by identification of users, in both the public and private sectors and of their information needs at the local, provincial, national and international levels;
- strengthen the capacity and capability of the concerned sectors in collecting, analysing and using multi-sectoral information in the decision-making process;
- make relevant information accessible in the form and at the time required to facilitate its use.

On the other hand, the objective of the NGOnet project was to provide E-mail services to NGO's within another IDRC funded project, NGOnet-Africa. Thus right from its inception, the Mukla network was mandated to provide services to the academic and research institutions as well as NGO's. Collaboration was also sought with the HealthNet project whose aim was to facilitate communication amongst health professionals within the African region and with their peers elsewhere (Musisi 1996).

While the mode of communication used by Healthnet was store and forward Low Earth Satellite (LEO) with tracking ground stations, the regional interconnection of the ESANET and NGOnet nodes was via dial-up telephone network using Fidonet technology.

Initially the Mukla traffic was sent to GreenNet (Gn Fido), London via Nairobi. Since 1994, the Mukla traffic is sent direct to London via four daily calls. At the end of the first year of operation, the Mukla had 50 users (Musisi 1996).

4.4.1.1 Current status of the Mukla Network

The Mukla Network can be taken as an example of a successful home-grown network in Uganda. Since its establishment, the network has grown exponentially and extends to several up-country towns. By July-September 1995 when this research was carried out, the Mukla network had 1500 users.

The majority of the installed user base is around the capital city area. However, there are also 15 sites in Entebbe (37 km from Kampala), five sites in Jinja (80 km to the East of Kampala), three sites in Mbale (150 km to the East of Kampala, next to the Kenya boarder), three sites in Mbarara (220 km South West of Kampala), three sites in Kabale (400 km) South West of Kampala, close to the Rwanda boarder (Refer to Appendix 5 for these locations). The up-country installations have to make long distance calls to Kampala.

With the increase in numbers of users, there was increasing need to establish another node. As such, in February 1996, a second node was established in Entebbe at the Uganda Virus Research Institute. Similar nodes are planned for Mbarara, Kabale, Jinja and Mbale (Musisi 1996).

Services offered by the Mukla Network [Musisi 1996]:

- E-mail messages, which form the bulk of the traffic;
- Listserves, APC Conferences/Usenet;

By July 1995 Mukla was participating in 50 listserves

(international conferences/discussion groups). Notable among these is UgandaNet, which links up over 600 Ugandans from all over the world;

- E-mail/Fax service - Users can send, faxes to destinations all over the world, at the price of E-mail. This service has been very popular because it is cheaper than a similar service offered by Uganda Posts and Telecommunications Corporation (UPTC).

In regard to sectoral involvement, Musisi(1996) reports that E- mail has had a particular attraction for the following groups of users:

- Researchers and students who are increasingly using E-mail. About 25% of the Mukla traffic is for University related activities while 40% is from Non-Governmental Organizations;
- Businessmen who are concerned with sustainable development issues;
- Some government departments, particularly those projects that have need to communicate with donors;
- Other individuals and independent groups who do not necessarily fall in any of the above categories are showing interest in the service.

The network has been sustained through two main ways; initially, it benefitted from the ESANET research fund as seed capital, later cost recovery was instituted, hence the network is self sustaining through fees levied from users.

The usage charges are as follows [Musisi 1995]:

Students (per month)	US\$ 10
Monthly rate-individual/small NGO	US\$ 30
Monthly Corporate rate	US\$ 50
Big Corporate/International (per month)	US\$ 100

Faxes are billed separately. However, information on fax charges could not be obtained.

Telephone bills are paid for separately by the users.

4.4.2 The HealthNet (Project)

This project links the Faculties of human medicine in the five Universities, namely, Makerere, Nairobi, Dar-es- Salaam, Zambia and Zimbabwe by Satellite communication. Its objectives are similar to those of the ESANET Project discussed earlier in Section 4.4.1 of this Chapter. It serves as a comparative study for computer networking. As is the case for ESANET, Healthnet’s overall objective is to promote the use informatics/ telematics for development (Mugambi 1992).

4.4.3 : The Impact of E-mail on Development in Uganda :

Current Status

The researcher and author of this study has been involved in an on-going study to assess the impact of E-mail on development in Africa. The study which started in July 1995, is organized under the CABECA project which is discussed in Chapter 3, Section 3.3.3. Uganda is one of the four African countries that are participating in the study, the other three being Ethiopia, Zambia and Senegal. In order to show the impact of E-mail in Uganda, the preliminary findings (as on 5th January 1996) of the Uganda case study are summarized below, in accordance with one of the specific objectives of this particular study, namely; to explore the possibility of using electronic in information retrieval.

The findings are:

- As of January 1996 Mukla had an installed base of 300 sites with an estimated 1500 users.
- The majority (60%) of users were from academic and research institutions;
- Among the E-mail users, 35% were using E-mail for general academic activities while 25% were using it for research;
- In the research sector (this includes agricultural research, medical research, etc.), E-mail has helped in the following ways; improving research collaboration (35%), broadening participation in research agenda (12.3%), and research management (16.8%);
- Nearly 95% of the E-mail users use the service fairly frequently. Nearly 95% were sending/receiving mail between once a day and once a week;

- Nearly all users attested to the resultant improvement in their professional productivity, improved quality of their work and were better off with E-mail than without it;
- 40% of the users were using E-mail mainly for general correspondence;
- E-mail has also strengthened professional contacts both inside and outside Uganda;
- E-mail has supplemented and in some cases replaced other communication channels such as fax, telex and travelling to deliver/obtain documents, thus reducing the expenditure on these items and saving on time;
- The majority of E-mail users had a fairly high level of education, 60% were from academic and research institutions;
- Knowledge of the availability of E-mail has been limited to a few people, mostly those working in academic and research institutions. Most of these people came to learn about E-mail through individual contacts. Five percent of the users only started using E-mail in 1993. However, with the advent of Internet Providers who have mounted a rigorous campaign, the situation is expected to improve.

4.4.4 Internet Service Providers in Uganda

Although electronic communication is a new technology, it is rapidly being embraced by an increasing number of people in Uganda. Currently, the country is busy with Internet Providers (IP). At the time of this survey (July-Sept 1995) there were four known groups, all set up during 1995 and offering either E-mail services or full Internet connectivity on commercial basis. However only two companies viz Infomail

and StarCom were giving "live" interactive connectivity. Below are brief accounts on the IP groups operating in Uganda [Musisi 1996]:

4.4.4.1 Starlight Communications (U) Ltd (StarCom)

This company is a joint venture between Telenor of Norway i.e. the Norwegian PTT monopoly, StarCom US which is a small New Hampshire based Telephone Company and a group of Ugandan Investors. Launched in August 1995, StarCom offers live connectivity to the Internet for the following services:

- Internet services such as E-mail and e-mail Fax services
- Telnet
- File Transfer Protocol (FTP)
- World Wide Web

As indicated in Section 4.3.1, this company also offers other services such as trunk radio and telephone services and credit card services. Its usage charges are shown in Appendix 7.

4.4.4.2 The Infomail (U) Limited

Infomail was the first company to establish Internet connectivity. Its' services include:

- Internet services such as E-mail and Fax services
- World Wide Web

- Telnet
- FTP

4.4.4.3 Infoma (U) Limited (InfomaNET)

The company works in collaboration with Informa Corp based in USA. They offer the following services:

- E-mail
- Fax services

4.4.4.4 Transmail Ltd

Offers the following services:

- E-mail
- Mail Broadcasting
- Electronic Fax
- Conferencing

4.4.5 Summary of the IT situation in Uganda

Currently, there are positive developments taking place in Uganda. These are leading to increased use of electronic communication. The major developments can be summarized as follows:

1. Development of an IT Policy which urges Government to take certain actions that will promote and support the use of IT for national development (Refer to Section 4.1.1);
2. Increase in the use of IT and in particular the use of computers (Refer to Section 4.2.1);

3. Development of low cost-based electronic communication such as the Mukla Fidonet Network and increase in the enthusiasm of the people on the use of E-mail. Users of this network are expected to increase and so is the level and type of activities for which the network will be used (Refer to Section 4.4.1);
4. Deregulation of the Uganda Posts and Telecommunication Services and licensing of private investors in this sector;
5. Establishment of Internet Providers in Uganda. These are offering several communication services which users can benefit from. The only limiting factor to the use of electronic networking is likely to be the high usage charges levied by the Internet Providers (Refer to Appendix 7). So far, the Mukla Network offers the most affordable services (Refer to Section 4.4.4);

This study has therefore been carried out at a time when conditions are favourable for electronic communication. As such, there are good opportunities for using electronic communication for improving information retrieval.

CHAPTER 5

INFORMATION FACILITIES IN NARO LIBRARIES

5.0 INTRODUCTION

It was earlier indicated in the research methodology, (Chapter 1, Section 1.5.1.2) that a survey of NARO institutes was undertaken to assess the existing information facilities and services with a view to identifying and analyzing their weaknesses and /or strengths. The ultimate goal was to use the findings as a basis for developing an improved information retrieval system that can satisfy the users' needs. The survey was broad in scope, for the purpose of elucidating a broad perspective of the existing information facilities and services in the agricultural research (or NARO) libraries. However, the survey particularly focused on understanding the information retrieval and dissemination practices being used.

The response rate to the Information managers/librarians questionnaire was 100%. Additional information was obtained through interviews conducted during visits to the institutions. Secondary sources of information, such as, manuals and reports of previous studies, and institutional reports were also consulted.

The collected data was analyzed by using statistical methods. The main findings of the survey are discussed in this chapter, in relation to the objectives of the study.

5.1 PRESENTATION AND ANALYSIS OF DATA

5.1.1 General Information on NARO libraries

5.1.1.1 Identification of the libraries/ documentation centre involved in the survey

The librarians who responded to this questionnaire were responsible for the eight NARO libraries which have already been enumerated in Chapter 1 , Section 1.5.2.2. These libraries are located at the research institutes which are shown on the map of Uganda showing the location of the Agricultural Research Institutes (Chapter 2, Figure 2.2).

5.1.1.2 Objectives of the information system/library

All the eight librarians who answered the questionnaire indicated that the objective of their libraries' is, to provide information to research scientists in order to facilitate their research activities. The information provided varies from one library to another. Several disciplines of agriculture are covered, namely: crop production and protection, animal production and protection, forestry production and protection, fisheries production and natural resources management, etc. For each library, this information was relevant to the mandate of the parent institution.

5.1.1.3 Categories of users of library and documentation centres

Respondents were asked to indicate the categories of their users. In response all eight categories of users indicated that research scientists are their first category of users. The other responses are given in Table 5.1

TABLE 5.1 : CATEGORIES OF USERS OF LIBRARY/DOCUMENTATION CENTRE

Library	Category of Users in decreasing order of numbers						
NADIC	Res.	Ext.	Stud	Lect.	Adm.	Ind.	Farm
NAROSE	Res.	Adm.	Stud	Lect.	Ind.	Sup.S	---
C							
KARI	Res.	Ext.	Adm.	Stud.	Lect	Farm.	Farm
NAARI	Res.	Ext.	Adm.	Stud.	Lect	---	---
SAARI	Res.	Ext.	Adm.	Stud	Lect	Sup.S	---
LIRI	Res	Adm.	Ext.	Stud.	Farm	---	---
FIRI	Res.	Sup.S	Stud	Adm.	---	---	---
FORI	Res.	Ext.	Adm.	Sup.S	---	---	---

KEY: Res. - Research Scientists (1)

Ext. - Extension workers (2)

Adm. - Administrators (3)

Stud. - Students (4)

Lect. - Lecturers (5)

Sup.S - Support Staff (Non-technical) (6) Ind. - Industrialists (8)

Farm. - Farmers (7) --- means none

Direct sub. - Direct subscription (to publishers/Agents).

Semin/Work. - Seminar / Workshop papers.

5.1.1.6 Staffing of libraries

The staffing situation in NARO libraries was investigated in order to find out whether the libraries had adequate staff. All (100%) the librarians responded to this question. Three (37.5%) librarians reported that they had adequate staff, while five (62.5%) indicated that their staff was inadequate.

The reasons given for inadequacy of staff were:

1. Lack of enough established positions for the library in the entire organization due to the current institutional setup.
2. Budget constraints which restrict the number of staff that can be recruited to work in the library. Details of the size and designation of professional library staff in NARO are given in Table 5.4.

TABLE 5.3 SIZE OF DOCUMENT COLLECTION IN NARO LIBRARIES

Type of publication (abbreviated)

Acronym of library	BK	PE	REP	RES	MA	MC	GP	UN	IJ	NGO	IGO	IARC	RFB
NADIC	3497	1029	485	100	18	1000	65	2447	3	15	22	85	20
NAROSAC	190	120	-	23	1	-	28	14	-	32	24	30	2
NAARI	1542	5000	600	20	5	-	28	52	2	2	-	60	5
KARI	2175	473	430	40	8	-	31	-	2	25	-	74	65
SAARI	400	200	200	100	11	-	40	300	2	-	-	50	2
LIRI	500	4300	500	82	20	-	-	35	-	3	10	48	4
FIRI	3000	250	300	22	5	-	43	43	3	3	45	21	2
FORI	1500	750	100	24	-	-	76	100	3	2	-	-	2
TOTAL	12804	12,122	2225	388	68	1000	444	370	3	17VOLS	129	437	105

KEY: BK - Books (volumes)

MA - Maps

- PE - Periodicals - foreign (bound vols.)
- MC - Microfiche
- REP - Reprints (Box files)
- GP - Government Publications (Vols.)
- RES - National Research Reports (Vols.)
- IARC - Reports from International Agricultural Research Centres
- LJ - Local (National) Journals (Titles)
- UN - Publications from United Nations Organizations (Volumes)
- NGO - Publications from Non-Governmental Organizations (Vols.)
- IGO - Publications from Inter-Governmental Organizations (Vols.)
- RFB - Reference books (volumes).
- means publications not available in library.

TABLE 5.4: SIZE AND DESIGNATION OF PROFESSIONAL STAFF IN NARO LIBRARIES

Acronym of library

Category of staff	NARO	NADIC	NAARI	KARI	SAARI	LIR I	FIR I	FOR I
Princ. Librarian	N/A	1	N/A	N/A	N/A	N/A	N/A	N/A
Librarian	1	—	1	1	1	1	1	—
Doc. Officer	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A
Asst. Libr	—	1	1	1	—	—	1	1
Library Attendant	—	—	—	1	—	1	—	—
TOTAL	1	4	2	3	1	2	2	1

KEY: N/A means position is not available __ means position is vacant

[Note : Recruitment of staff to fill the currently established positions was still pending at the time of investigation.]

5.1.2 Information facilities in NARO libraries

5.1.2.1 Information and communication technologies

5.1.2.1.1 Availability of computer facilities in Institutes

When asked to indicate whether there were computer facilities available at their (parent) institutes, even though not necessarily in the library, all (100%) librarians indicated that there were computers available at their institutes.

5.1.2.1.2 Location of computer facilities

When further asked where the computer facilities were located, 87.75% of the respondents answered this question. Their responses are shown in Tables 5.5.

TABLE 5.5: LOCATION OF COMPUTER FACILITIES

Location of computer facilities	Libraries	% of total responses
Within the library/Documentation Centre	NADIC, LIRI, NAROSEC	37.7
Other Departments in parent institution and accessible	NAARI, FORI, KARI	37.7
Other Departments in parent Institution but not accessible	FIRI	12.3
No answer	SAARI	12.3

<u>Activity for which computer is used</u>	<u>Number of responses</u>
1. Maintenance of a research MIS database.	8 (100%)
2. Word processing	8 (100%)
3. Preparing budgets, payroll and financial statements	2 (25%)
4. Management of bibliographic databases	2 (25%)
5. Conducting databases searches from CD-ROM and home-grown databases	1 (12.5%)
6. Analysis of research data	1 (12.5%)

5.1.2.1.4 Whether the use of computers is beneficial

When asked to indicate whether their library has benefited from using computers, four (50%) of the respondents indicated that their libraries had benefited, three (37.5%) librarians indicated that their libraries had not benefited from the use of computers and one librarian (12.5%) did not respond to this question.

5.1.2.1.5 Benefits derived from using computers

When further asked about the benefits of using computers, 87.75% of the respondents answered the question, each giving several answers which are given in Table 5.7.

TABLE 5.7 : Benefits derived from using computers

Benefits derived from using computers	No. of benefiting Libraries	% of benefiting libraries
Increased timeliness in information services	3	37.5
A variety of information services	3	37.5
Increased accuracy of information	2	25.0
Increased user population	1	12.5
Value added information services	1	12.5
No answer	1	12.5

[Note: Totals are more than eight (for number of libraries) and more than 100 for (benefiting libraries) because the respondents had chosen more than one option simultaneously].

5.1.2.1.6 Training in using library application software

The respondents were asked to indicate the type of training that their technical staff had received in library application software. Table 5.8 below shows their responses:

TABLE 5.8 : TRAINING RECEIVED BY LIBRARY STAFF IN LIBRARY APPLICATION SOFTWARE

Training course attended	No. of staff trained	Benefitting Institution
Micro-computer-based Agroforestry Information Management	3	LIRI/NADIC, NAROSEC
Application of Micro CDS/ISIS in libraries	1	NAARI
Application of dBaseIV in library management	1	NAARI

Note

[No training has been provided in library management software for the librarians at KARI, FIRI, SAARI, FORI]

5.1.2.1.7 Training requirements in library application software

When asked about additional training required by library staff, the librarians indicated that they require training in the following areas:-

1. Over eighty seven per cent (87.5%) require training in library application software, mainly micro CDS/ISIS which is currently used by many institutions and which is likely to be used by the libraries that are yet to be automated.
2. Over eighty seven per cent (87.5%) require training in CD-ROM technology.
3. Over sixty two percent (62.5%) require general introduction to information technology, including introduction to DOS, etc.
4. Fifty percent (50%) of the librarians require professional training in Library/Information Science at MSc level.

5.1.2.1.8 Availability of E-mail facilities at the Research Institutes

Respondents were asked whether there were E-mail facilities either within their Institutes or in the Institute Libraries. Their responses are shown in the Table 5.9.

5.1.2.1.10 Benefits from using E-mail

When asked whether the use of E-mail has benefited their Institutions, all (100%) the institutions with E-mail facilities were affirmative.

The respondents were then asked about the ways in which E-mail has complemented other Information services, they indicated that it was facilitating communication both within and outside the country. Table 5.10 shows the responses.

TABLE 5.10 BENEFITS TO THE INSTITUTION/SCIENTISTS OF
USING E-MAIL

Benefits of using E-mail	No. of Insts. benefitting	% responses
Better communication within the country	5	62.5
Better communication abroad	5	62.5
Improved rendering of information services	1	12.5

[Note: Totals are more than eight in the case of number of institutes and more than 100% for the percentage of total responses because the respondents selected more than one choice simultaneously].

5.1.2.1.11 Plans to install E-mail

The respondents were also asked whether there were plans to instal E-mail facilities in their libraries. Five (62.5%) indicated that their institutes had plans to install E-mail in the libraries, while one (12.5%) was not aware whether his institute had plans to install E-mail. Two (25%) institutes

which already had E-mail in their libraries did not answer this question as it was not applicable to them.

5.1.2.1.12 Possibility of using E-mail in information dissemination

When asked whether they thought E-mail facilities would facilitate dissemination and sharing of information, all respondents indicated that they were positive that it would.

5.1.2.1.13 Anticipated services to be rendered through E-mail

The respondents were further asked what kind of services they would wish to provide to their users if E-mail was installed, and they responded by giving a number of services. Table 5.11 shows the response given by the number of librarians who preferred a particular service.

TABLE 5.11 : SERVICES THAT LIBRARIANS WOULD LIKE TO PROVIDE THEIR USERS IF E-MAIL IS INSTALLED

Type of Information Service	No. of responses	% for each Inf. service
Selective dissemination of Information	7	87.5
Database searches	6	75.0
Communicating with colleagues	6	75.0
Document Delivery services	5	62.5

[Note: Totals are more than eight in the case of number of responses and more than 100% for the total percentage for information services because the respondents selected more than one choice simultaneously].

5.1.2.1.14 Libraries/Institutions with whom information would be shared

The librarians were further asked to indicate the institutions/libraries which they would wish to share information with, if on E-mail. They responded by giving several answers which are shown in Table 5.12

above.

**TABLE 5.12 : LIBRARIES/INSTITUTIONS PREFERRED FOR
ELECTRONIC COMMUNICATION**

Library/Institution	No. of respondents	% response
International Agricultural Research Institutes	7	87.5
Research Institution within the country	6	75.0
Libraries in NGO's and International Institutions	6	75.0
Academic Institutions/Universities	6	75.0
Libraries in Government Departments	4	50.0
No answer	1	12.5

[Note: Totals are more than eight in the case of number of respondents and more than 100% for the percentage response because the respondents chose more than one choice simultaneously].

5.1.2.1.15 Availability of CD-ROM databases for use in the library/documentation centre

The Information managers were asked to indicate the CD-ROM databases that were available in their libraries. NADIC was the only centre which indicated the availability of these facilities. The information is given in Table 5.13 below.

TABLE 5.13 : CD-ROM DATABASES AVAILABLE AT NADIC.

Title of database	Source	Years covered	Subject Scope	Usage (Searches/Month- Average)
AGRIS	FAO-UN	1975-Nov 1995	Agriculture (broad)	20
AGRIS- Fisheries and Aquaculture	FAO-UN	1975-1993	Fisheries and Aquaculture	5
CAB PEST-CD	CABI	1988-1995	Pest Management	7
CARIS (Prototype)	FAO-UN	1994	Current Agriculture Research Projects	5
AGRICOLA (Prototype)	National Agricultural Library (USA)	1985-June 1989	Agriculture- general (USA)	8

5.1.2.1.16 Home-grown databases in use in NARO libraries / documentation centre

The respondents were asked to indicate the home-grown databases in use in their libraries. Two libraries namely, NADIC and LIRI had established home-grown bibliographic databases for their documentation centre and library collections, respectively. However, all research Institutes had an MIS Database (INFORM), though not necessarily located in the library in all institutes. The librarians were nevertheless aware of the databases. In fact, NADIC indicated that it was actively participating in INFORM activities. Table 5.14 shows the home-grown databases available at NADIC and LIRI.

TABLE 5.14 : HOME-GROWN DATABASE AVAILABLE AT NADIC AND
LIRI LIBRARIES

Library Code	Title of database	Software used	No. of Records (As on Aug 30th 1995)	Searches per month
NADIC	AGRIN	CDS/ISIS	1450	On an average 15 searches are carried out per month for local research scientists ,mainly those who live on site.
	CARIN	CDS/ISIS	270	
	AGRINF	CDS/ISIS	27	
	ULIST	CDS/ISIS	400	
	INFORM	REFLEX	213 (On research scientists,14 on disciplines,47 on Sub-disciplines	
LIRI	LIT-DISC	PROCITE	1021	Searches are minimal as databases are prototype
	UTROBIBL	PROCITE	170	
	KINETIK	PROCITE	87	

5.1.3 Information services offered by the libraries

5.1.3.1 Types of information services offered by NARO libraries

The librarians were asked to indicate the type of services that they offer to their users.

They all responded to this question. Their responses are given in Table 5.15

TABLE 5.15 : TYPE OF INFORMATION SERVICES OFFERED BY
LIBRARIES AND THE NUMBER OF LIBRARIES OFFERING
EACH SERVICE.

Type of information service	No. of libraries offering this service	% of libraries offering service	% of service over total volume of services
Reference services	8	100.0	20.5
Current awareness service	7	87.5	17.9
Referral service	7	87.5	17.9
Selective dissemination of information (on a manual basis)	5	62.5	12.8
Question and answer service	4	50.0	10.2
Literature searches from CD-ROM databases	2	25.0	5.1
Literature searches from home-grown agricultural databases	2	25.0	5.1
Newspaper clipping service	2	25.0	5.1
Document delivery services	2	25.0	5.1

5.1.3.2 Common format for presenting information

The respondents were asked to indicate the common format in which they present information to the users when responding to all types of queries and 87.5% of the librarians answered this question. Their responses are given in Table 5.16.

TABLE 5.16 : COMMON FORMAT WHICH IS USED BY LIBRARIANS TO PRESENT INFORMATION TO THE USERS

Format for presenting information to users	No. of responses (librarians)	% response
Full text original document	7	87.5
Abstract of original document	4	50.0
Bibliographic citation from database	2	25.0
Other(Extrac/Photocopy on request)	1	12.5
No answer	1	12.5

5.1.3.3 Efficiency and effectiveness of information services in NARO libraries

The information managers were asked to give an honest evaluation of the methods they were using to disseminate information to the users in terms of efficiency and effectiveness. Their responses (rating) of the efficiency and effectiveness of the library services was made on a scale ranging from excellent to poor. As regards effectiveness of the library services, four (50%) librarians rated their libraries as good (effective), three (37.5%) rated their libraries as, fair (i.e. fairly effective), and one (12.5%) rated his library as being poor (ineffective). As regards efficiency, three (37.5%) librarians rated their libraries as being good (efficient), four (50%) indicated that their libraries were fair (fairly efficient), and one (12.5%) librarian gave no answer.

5.1.3.4 Reasons for Ineffectiveness

When further asked about the reasons / causes for the ineffectiveness in the libraries, they gave the following answers:-

- Lack of cooperation from the users;

- Lack of IT facilities; and
- Lack of current literature covering all the relevant research disciplines.

5.1.3.5 Reasons for inefficiency

On the other hand, inefficiency was attributed to the following factors:

- Under staffing
- Low morale of library staff due to lack of recognition of the profession (apathy);
and
- Poor library budgets

5.1.3.6 Coverage of User Community

When the respondents (librarians) were asked whether the information services offered by their libraries reach all users, all (100%) indicated that their services did not reach all users and no measures were in place to ensure that the services reach all intended and potential users.

5.1.3.7 Constraints encountered while giving information services

The librarians/information managers were asked to name the problems that they encounter while giving services to the users. The following is summary of their responses:-

- Poor infrastructure and in some cases, complete lack of facilities for

disseminating information. For example, lack of computers, telephone lines, faxes, and other relevant technology; and

- Poor subscription for current scientific literature. The information resources available in the libraries are often outdated and irrelevant.

5.1.3.8 Suggestions for alleviating problems in the NARO libraries/information services

The respondents were then asked to propose ways of alleviating the problems outlined above and they gave the following suggestions:-

- Establishment of sustainable library budgets for journal and book subscriptions;
- Installation of telecommunication facilities such as telephones, faxes, etc., in the libraries;
- Improvement in the position of library staff both in terms of numbers of professional staff running the libraries and in their status;
- Establishment of means of networking and resource sharing so as to use the available resources effectively;
- Introduction of an SDI service that can benefit all scientists;
- Introduction of electronic connectivity for fast communication among the libraries. This would be one way of effecting networking;

5.1.4 Information Flows

5.1.4.1 Research Publications

The respondents (librarians) were asked to indicate the principal publications that are produced by their institute /library, the frequency of publication and distribution. Table

5.17 shows the response obtained.

TABLE 5.17: PRINCIPAL PUBLICATIONS FROM NARO
INSTITUTES

INST CODE	Type of publication	Frequency of Publication	Distribution
FIRI	Research Report	Quarterly	Internal(Inst.)
	Annual Reports	Annually	NARO Research Institutes
	FIRI Newsletter	Bi-annual	Internationally
FORI	Accessions list	Monthly	NARO Research Institutes.
		Quarterly	Internal/ Limited
LIRI	Annual Reports	1/year	NARO Research Institutes
	Accessions List	Quarterly	(for both publications)
NADIC	Accessions List	Monthly	NARO Research Institutes
	Contents Pages Bulletin	Monthly	Makerere University, Faculty of Agric & Forestry -do-
	Annual Report	1/year	NARO Research Institutes -do-
	Agriculture in the News (A Newspaper clipping Service)	Quarterly	
KARI	Accessions List	Monthly	NARO Research Institutes

(TABLE 5.17 CONTINUED)

INSTITUTE CODE	Type of Publication	Frequency of Publication	Distribution
NAROSEC	NARO Newsletter	New- Frequency not yet determined	NARO Research Institutes
SAARI	Research Report	Quarterly	Internal/Limited NARO research Institutes
	Annual Report	1/year	
NAARI	Research Report	Irregular	NARO Research Institutes and the Agricultural Dept. (for all these publications)
	Annual Reports	1/year	
	Newsletter	1/year	
	Accessions List	Quarterly	

5.1.4.2 Cooperative networking

The respondents were asked to select from a list of activities, the methods they were using to share information with other libraries/information centres (cooperative networking activities). Table 5.18 below shows the responses given.

It may be noted that no library indicated that it was participating in production of the Union list of periodicals nor in electronic networking though there were plans to start both the services. (ISNAR, NARO Information Strategy, 1995). NADIC had in fact already established a ULIST database to serve as a Union list of periodicals for Agricultural libraries (Refer to Table 5.14). However, development of this database was very slow due to lack of staff to handle this task.

**TABLE 5.18 : LIBRARY PARTICIPATION COOPERATIVE
ACTIVITIES**

ACTIVITY	No. of libraries involved	% activity
Exchange of Accessions List	3	37.5
Exchange of research Publications	3	37.5
Circulation of pages of contents	3	37.5
Circulation of bibliographies	3	37.5
Interlibrary loans	2	25.0
Production of Union Lists of Periodicals	0	0
Participation in electronic networking	0	0

[Note: The totals are more than 8 and more than 100% because the libraries were involved in more than one activity]

5.1.4.2.1 Institutions/Countries collaborating with NARO libraries.

The respondents were asked to give examples of institutions with which their libraries share information and the kind of information shared. Below is a summary of the Institutions that were identified/named:

- Research Institutes' under NARO
- Research Institutes in the CGIAR (through sharing the Serials List Database.)
- Countries participating in AGRIS, the International Information System for the Agricultural Sciences and Technology to which Uganda is a member and contributes inputs through NADIC.

5.1.4.2.2 Whether networking was desired

On the question of whether the respondents would wish their libraries to participate in a formal network, all (100%) respondents indicated that it was their wish to do so.

5.1.4.2.3 Preferred Networking Activity/Information Service

Respondents were then asked to select from a list, the kind of cooperative service and /or networking activity that they preferred. They selected more than one networking activity. Their choices which are given in Table 5.19, are ranked in descending order of preference (i.e. by frequency of selection of a particular activity). The corresponding percentage represents the number of libraries that would benefit from a particular activity if it were established.

TABLE 5.19: TYPE OF COOPERATION PREFERRED BY INFORMATION MANAGERS/LIBRARIANS

Type of Networking Activity	No. of librarians who selected this activity	% of libraries that would benefit
Selective Dissemination of Information	8	100
Interlibrary loans	8	100
Exchange of research Publications	7	87.5
Sharing of Bibliographies	7	87.5
Production of Union Catalogues	6	75.0

5.1.4.2.4 Standards used in NARO libraries

The respondents were asked to indicate the classification schemes and vocabulary control tools used in their libraries for information processing. Their responses are given in Tables 5.20, 5.21 and 5.22.

TABLE 5.20 : CLASSIFICATION SCHEME(S) USED BY NARO LIBRARIES

Name of Classification Scheme	No. of libraries using Scheme
Library of Congress (LC)	1
Dewey Decimal Classification	1
Universal Decimal Classification	4
Cyril Bernard Classification	1
Oxford System of Decimal Classification	1

TABLE 5.21 : VOCABULARY CONTROL DEVICE(S) THAT ARE USED IN NARO LIBRARIES

Vocabulary control device used	No. of libraries
Sears list of subject headings	4
AGRIS/CARIS Categorization Scheme	1
AGROVOC Thesaurus	5
None	1

[Note: Some libraries were using more than one vocabulary control device, hence the totals exceed 8]

TABLE 5.22 : METHOD OF INDEXING USED IN NARO LIBRARIES

Method of indexing used	No. of libraries
Subject	6
Title	3
Author	7
None	1

CHAPTER 6

INFORMATION NEEDS OF RESEARCH SCIENTISTS IN NARO INSTITUTES

6.0 INTRODUCTION

In the research methodology, (Chapter 1, Section 1.5) it was indicated that a total of 60 questionnaires were distributed to users of library services in NARO libraries. These users were mainly research scientists working in NARO institutes. The purpose of this questionnaire was to collect data on the information needs of users' of libraries in NARO Institutes. This was one of the objectives of the study (Refer to Chapter 1, Section 1.3.2.2). The identified needs would be used as a basis for proposing and designing an improved prototype information retrieval system which is the ultimate goal of this study.

The details of the methodology and the respondents who were selected for the users survey have already been given in Chapter 1, Section 1.5.2.1, Table 1.1. Out of the 60 questionnaires that were distributed, 43 were returned, thus giving a response rate of 71.6%. The responses to this questionnaire will be presented in this chapter.

The researchers who responded to this questionnaire were asked to give their identification data such as: their designation /rank and their highest qualifications. Table 6.1 below gives a summary of the identification data of the respondents who answered the questionnaires.

6.1 ACTIVITIES THAT THE RESEARCH SCIENTISTS ARE INVOLVED IN

When the research scientists were asked to indicate the activities that they were involved in, the 43 researchers who responded to the questionnaire indicated that they were involved in at least one and often, more than one activity. Their responses are presented in Table 6.2.

**TABLE 6.1: IDENTIFICATION DATA OF THE RESPONDENTS TO THE
USERS QUESTIONNAIRE**

IDENTIFICATION DATA OF RESPONDENTS				RESPONDENTS					
				QUALIFICATIONS			DESIGNATION		
NAME OF LIBRARY	LOCATION OF LIBRARY	No. in Sample	No. OF RESPONDENTS	PhD	MSc/M A	B.SC/DIP	PRO	SRO	RO/TEC
NAROSEC	REMOTE	6	4	2	1	1	2	1	1
NADIC	ON-SITE	11	8	5	2	1	4	3	1
KARI	ON-SITE	11	7	2	4	1	3	3	1
NAARI	REMOTE	9	5	2	3	—	2	3	—
SAARI	REMOTE	7	6	2	2	2	1	3	2
LIRI	REMOTE	5	4	1	2	1	2	2	—
FOSRI	REMOTE	2	2	1	1	—	1	1	—
FORI	REMOTE	5	3	1	1	1	1	1	1
FIRI	REMOTE	4	4	1	3	—			
TOTAL		60	43	17	19	7	17	20	6

KEY:

PRO - Principal Research Officer

SRO - Senior Research Officer

Tec - Technician

RO - Research Officer

ON-SITE - means users are located at the same site as NADIC

REMOTE - means users are far from the central library/documentation centre at NADIC

From the data in the above table, it can be deduced that 62.8% of the respondents to the Users questionnaire were from remote locations (research institutes) while 37.2% were on-site users.

TABLE 6.2 : ACTIVITIES OF RESEARCH SCIENTISTS

ACTIVITY	Number of research scientists involved	% of total response
Research	39	90.6
Consultancy	6	13.9
Agricultural extension	5	11.6
Research-extension liaison	2	4.6
Research management / Administration	1	2.3

[Note: The total number of respondents is more than 43 and consequently more than 100% because some of the research scientists were involved in more than one activity].

6.2 USE OF LIBRARY / DOCUMENTATION CENTRE(S)

6.2.1 Frequency of use of library / documentation centre

When asked about the frequency of use of libraries /documentation centres, 99% of the users responded to this question. Their responses are shown in Table 6.3. However, it may be noted that the majority i.e. 42% use the library 2 - 5 times a month, while the minority 2% use the library once a week; and 16% indicated that, apart from reading newspapers, they rarely use the library.

TABLE 6.3 : FREQUENCY OF USE OF LIBRARY / DOCUMENTATION CENTRE

Frequency	No. of Scientists	% of Scientists
Everyday	4	9.3
Once a week	1	2.3
2 - 3 times a week	12	28.0
Once a month	1	2.3
2 -5 times a month	18	42.0
Rarely	7	16.0

6.2.2 Reasons for using the library

When asked about the reasons for using library facilities, 96.7% of the users responded to this question while 3.2% did not respond. Those who responded gave more than one answer to this question. The answers are shown as number of respondents who gave a particular reason and the corresponding percentage (of respondents). The responses are presented in Table 6.4 below.

TABLE 6.4 : REASONS FOR USING LIBRARY FACILITIES

Reason for using the library	Number of respondents	% responses
Borrow books / journals for research	30	69.7
Consult journals to keep updated	27	62.7
Browsing through journals / monographs	18	41.8
Borrow books/journals to prepare papers	13	30.2
Read Newspapers	12	27.9
Look for special materials	11	25.6
Make reference inquiries	6	13.9
No answer	4	9.3
Literature searches from databases	2	4.6
Not applicable	1	0.8

[Note : The total is more than 43, hence more than 100%

because respondents had chosen more than one option, simultaneously]

6.2.3 Reasons for not using the library facilities

When asked about the reason(s) for not using the library at their institution or other institutions, the respondents who are mainly research scientists gave the following reasons:

- a) Lack of current and relevant literature in the libraries.
- b) Remoteness of libraries at other institutions hence inability to access them.
- c) The respondents from FOSRI, a newly established research institute, indicated that they are lacking library facilities.

6.2.4 Distance that users have to travel whenever they need to use another library

Users were asked the distance they travel when they need to use libraries other than the library at their institutes.

The research scientists (66.7%) who answered this question indicated that they travel to other libraries mostly when they are involved in some academic work or when preparing scientific paper(s). In such cases, they may travel distances ranging from 5 -100 km.

6.3 INFORMATION SERVICES PROVIDED TO RESPONDENTS BY INSTITUTE LIBRARIES

6.3.1 Type of Information Services provided

Users were asked to indicate what kind of services they were receiving from their libraries. Thirty four (79%) users responded to this question. From a given list of

information services, users selected more than one service that they were receiving from their libraries. The results are presented in Table 6.5 below. Because of the multiple choices that were selected simultaneously, the totals are greater than 43 and 100% for the number and percentage of users, respectively.

TABLE 6.5 : INFORMATION SERVICES PROVIDED BY THE LIBRARIES

Information service provided by library	Resp. No. of User's	% Response
Current awareness services:-		
Display / circulation of new items	35	81.4
Selective dissemination of information	4	9.3
Pages of contents	15	43.8
Searches of databases (CD-ROM & national (local))	4	9.3
On-line Searches	0	0
Question and Answer services	9	20.9
Photocopying services	11	25.6
Off-line searches through E-mail	2	4.6
No answer	9	20.9

6.3.2 Users rating of the services provided to them by their libraries

When the respondents were asked to rank the information services provided by their libraries on a scale ranging from excellent to very poor, no respondent indicated that the services were very good. On the other hand 51.2% of the respondents rated the services as being average while 28% and 4.6% respectively ranked the services as being poor and very poor respectively. Table 6.6 below, shows details of the responses.

TABLE 6.6 : USER'S RATING OF INFORMATION SERVICES PROVIDED BY THEIR LIBRARY.

Scientists rating of information services	No. of Scientists	% response
Good	4	9.3
Average	22	51.2
Poor	12	28.0
Very Poor	2	4.6
Not Applicable	2	4.6
No answer	1	2.3

6.3.3 Alternative sources of information used by scientists

As regards alternative sources of information used by scientists, the following responses were given:

- (a) In addition to using the library at NADIC and other research institutes, scientists visit libraries of other organizations and /or institutions, namely; the libraries at: NADIC, FAO and World Bank country offices; academic libraries such as Makerere University Libraries, etc. . This study also established that though open to the general public, foreign mission libraries are mostly used by expatriate scientists while the academic libraries are mostly use by local scientists.
- (b) Scientists have an invisible college of colleagues within the country and abroad with whom they exchange information. This is a very important source of current information for them.

6.3.4 The extent to which inadequate information facilities hamper research

When asked about the extent to which inadequate information and information technologies hamper research, scientists gave several responses among which were the following:

- (a) The majority of respondents (82%) indicated that conducting research without sufficient background information on the research area has often led to duplication of effort and wastage of time and material resources.
- (b) Seventy five percent (75%) indicated that due to lack of sufficient and relevant information, scientists are not confident enough to write scientific papers.
- (c) Another 75% stated that formulation of research proposals is difficult in the absence of adequate information.

6.3.5 Scientists’ priority information requirements

When asked to rank their priority information requirements, they gave the responses shown in Table 6.7

TABLE 6.7 : SCIENTISTS’ PRIORITY INFORMATION REQUIREMENTS

Type of (priority) information required	Scientists (%)
Scientific information to support research	83.0
Agricultural extension and production	7.0
Social- economic development information	2.3
Research Management information	5.0
Environmental information	2.3

6.4 INFORMATION SERVICES AT THE NATIONAL AGRICULTURAL DOCUMENTATION AND INFORMATION CENTRE (NADIC)

6.4.1 Scientists' awareness of the information services at NADIC

When asked about whether they were aware of the services provided by the NADIC, 93.0% of the respondents indicated that they were aware while, 4.7% indicated their ignorance; and 2.3% did not respond to this question.

6.4.2 Use of information services available at NADIC

Users (scientists) were asked to indicate whether they use the information resources /services at NADIC. Fifty six percent (56%) indicated that they use the services, 37% indicated that they do not use the services, and 7% did not respond to this question.

6.4.3 Type of information requested for by scientists

As regards the type of information requested for, the respondents selected more than one service, hence the total responses are more than 43 and more than 100%. Table 6.8 below shows the responses.

TABLE 6.8 : TYPE OF INFORMATION REQUESTED BY SCIENTISTS

Type of information requested for	No. of responses.	% responses.
Full text information	38	88.3
Photocopies of articles from journals	22	51.1
Bibliographic information from databases	12	27.9
No answer	9	20.9
Not applicable	4	9.3

6.4.4 Users' satisfaction with the information services given by NADIC

The user's were asked whether they were satisfied with the information services given by NADIC. Their response shows that the majority of the user's (58.1%) were not satisfied. Only 20.9% indicated that they were satisfied, while 7% indicated that this question was not applicable to them and 14% gave no answer. Users who indicated that the question was not applicable to them are those who have never used NADIC's services.

6.4.5 User's expectations of information provided by NADIC

When further asked to describe the type and source of information that the users would wish NADIC to provide, the respondents gave the following responses as shown in Table 6.9.

TABLE 6.9 : USER'S EXPECTATIONS OF INFORMATION PROVIDED BY NADIC

Information desired by users (scientists)	No.of responses.	% of total responses.
Scientific information from developing countries	15	35.0
Local (country) information	14	32.5
Scientific information from developed countries	10	23.2
No answer	4	9.3

In addition, 65% of the respondents indicated that they needed timely and relevant information.

6.4.6 Databases preferred by users

The respondents were asked to indicate which databases they preferred. Their answers are given in Table 6.10

TABLE 6.10 : DATABASES PREFERRED BY USERS

Databases preferred by users	% response
Home-grown databases at NADIC	12.0
CD-ROM databases at NADIC	32.4
Both home-grown and CD-ROM databases	32.4
No answer	23.2

[Note: The low preference of home-grown databases is due to lack access to these databases by the majority of who are at remote research institutes.]

6.4.7 Use of information from Databases

The respondents also indicated several purposes for which the information sought from the database is used. The responses showed that information from databases is mainly used for planning research activities, making research management decisions and writing scientific papers. These responses are given in the Table 6.11. The totals are greater than 43 for number of responses and more than 100% for percentage response, because the respondents choose one than one choice simultaneously.

TABLE 6.11 : USE OF INFORMATION FROM DATABASES

Purpose for which information from databases is used	No. of responses.	% of total responses.
Planning research activities	23	53.5
Writing Theses/Papers	13	30.2
Lecturing/Training	3	6.9
Agricultural Advisory Services (extension)	5	3.2
Making research management decisions	18	41.8
Non-use of the database	1	2.3
Not applicable	18	41.8

6.4.8 Users' participation in conducting database searches

When asked whether they participate in conducting database searches personally or whether the librarians help them to do the searches, only 7% of the respondents indicated that they do the search personally, 19% are helped by the librarian/documentalist, 40% rely on the librarian /documentalist to do the searches for them, while 12% did not answer this question. Twenty-two percent indicated that this question not applicable. The last two groups are among the users who had not have access to NADIC's database services.

6.4.9 Ease of getting full text information

On the ease of getting full text (original) information after getting bibliographic information from database searches, 23% of the respondents found it easy to get full text material; 9% found it fairly easy; 30% found it difficult; 20% found it very difficult; another 9% indicated that the question not applicable and 9% gave no answer. It was noted that it was more difficult to secure original (full texts) of records cited

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from CD-ROM databases. This is because most of these records have to be requested for from abroad.

6.4.10 The extent of use of databases at NADIC

Responding to the question regarding the extent to which the databases at NADIC have been made use of, the scientists gave the answers which are presented in Table 6.12.

TABLE 6.12 : EXTENT OF USE OF INFORMATION FROM THE
DATABASES AT NADIC

Extent of use of information from databases at NADIC	% response
Useful	9%
Fairly useful	24%
Limited use	34%
No use	9%
Not applicable	12%
No answer	12%

6.5 INFORMATION SOURCES

6.5.1 Ways in which users discover information

The respondents were asked to select the ways in which they discover information which is of interest to them. They selected more than one choice simultaneously, as such the total responses are greater than 43 and greater than 100%. The responses are shown in Table 6.13.

6.5.2 Sources of information used by scientists

Users were asked to indicate the sources of information which they use. Because the respondents chose more than one source simultaneously, the total responses are more than 43 and 100% respectively. Table 6.14 shows the responses.

TABLE 6.13 : WAYS BY WHICH USER'S DISCOVER INFORMATION

Ways of discovering information	No. of responses	% response
Accidental discovery	23	53.4
Attendance of conferences	33	76.7
Searching databases	18	41.8
Browsing through publications	20	46.5
Searching the library catalogue	28	65.1
Approaching librarians for assistance	24	55.8
Follow up references and Footnotes	20	46.5
Communication with fellow Scientists (Invisible college)	20	46.5
Personal visits to other institutes/libraries	1	2.3

TABLE 6.14 : SOURCES OF INFORMATION USED BY SCIENTISTS

Source of Information	No. of responses	% response
Scientist's own collection	23	53.4
Conference proceedings and Workshop papers	27	62.7
Books in the library	28	65.1
Government/Private Institutions	4	9.3
Magazines/Newspapers	16	37.2
Bibliographies, indexes and Abstracts	20	46.6
Current Awareness bulletins	7	16.3
Technical reports	27	62.7
Scientific journals	18	41.8

6.5.3 Timeliness of Information

When asked whether they get the information they require on time, 30% of the respondents indicated that they get the information on time, 9% occasionally receive the information in time, 59% receive the information late and 2% did not respond to this question.

6.5.4 Time taken while waiting for information from other sources

Users were also asked to indicate how long they have to wait when they request for information from outside sources through their Institute library. The response obtained is shown in Table 6.15 were obtained.

TABLE 6.15 : TIME THAT USERS TAKE WAITING FOR INFORMATION FROM SOURCES OUTSIDE THE INSTITUTION.

Time (in days, months)	User's response (%)
1 - 7 days	5
8 - 15 days	0
1 month	19
> 1 month	30
Not applicable	16
No answer	30

6.6 PREFERRED INFORMATION SERVICES

6.6.1 Information services preferred by respondents

Respondents (users) were requested to select the information services which they prefer. They indicated more than one preferences hence, the totals are more than 43 and more than 100%. Their responses are indicated in Table 6.16.

TABLE 6.16 : INFORMATION SERVICES PREFERRED BY RESPONDENTS

Type of information service	No. of responses	% for each service
Selective dissemination of information	29	67.4
Current Titles	28	65.1
Searches from home-grown databases	22	51.2
CD-ROM Search service (At NADIC)	19	44.1
Research management information service	12	27.9
Newspaper clipping service	8	18.6
Reprographic Service	6	13.9
Provision of primary and abstract journals	2	4.6
No answer	1	.3

6.7 USE OF INFORMATION TECHNOLOGIES

6.7.1 Users familiarity with the use of computers

When asked about their familiarity with computers, the majority (61%) of the scientists indicated that they were familiar with the use of computers while 39% were not familiar with the use of computers. However, users were only proficient in applications that are relevant to their work.

6.7.2 User's familiarity with the use of E-mail

Scientists were asked to indicate whether they were familiar with the use of E-mail, 23% indicated that they were, while 77% were not familiar. This is because E-mail is still a fairly new technology in Uganda. Although E-mail facilities have been installed at three of the research institutes, this is a recent development and few research scientists have had opportunity to use the facility. Furthermore, because of lack of sufficient exposure to IT, scientists lack confidence to try using technologies before they are properly trained in using them.

6.7.3 User's Interest in E-mail Services

Users were asked to indicate whether they were interested in having E-mail services installed at their institutes. The majority (86%) of the respondents were keen on having E-mail services installed at their institutes. Table 6.17 below shows the responses to this question.

**TABLE 6.17 : SCIENTISTS DESIRE TO HAVE E-MAIL SERVICES
INSTALLED AT THEIR INSTITUTES.**

User's desire to have E-mail installed at their Institutes	% response
E- mail desired	86
E-mail not desired	2
No answer	7
Not applicable	5

6.7.4 Usefulness of E-mail

The respondents who indicated a desire to have E-mail installed at their institutes gave the following reasons for the usefulness of E-mail:

- (a) Speedy and cheap communication with colleagues at other institutions for example when requesting for research materials.
- (b) Research collaboration with colleagues abroad.
- (c) Electronic publishing of their research findings.

6.7.5 How user's would use E-mail if it was installed at their institutes

When asked to indicate how they would use E-mail service if it was provided to their institute libraries, the respondents who selected more than one reason, gave the following responses as ways in which they would use the E-mail service:

- (a) Nearly ninety eight percent (97.7%) indicated that they would use E-mail to communicate with scientists abroad.
- (b) Eighty six percent (86.0%) indicated that they would use the E-mail service to request for information from NADIC and other libraries.
- (c) Nearly seventy seven percent (76.7%) indicated they would share research information with colleagues at other research Institutes within the country.
- (d) One respondent, (2.3%) indicated s/he would use the E-mail service to query the Internet using tools such as the World Wide Web (WWW).

6.7.6 Respondent's expected usefulness of E-mail

When further asked if the respondents think that the use of E-mail would contribute to better performance of their duties, 90% of the respondents in the category that desired to have E-mail at their institutes, indicated that the service would contribute to

improved performance of their duties, 5% were not sure whether the service would improve their performance, and 5% did not answer this question.

6.8 RESEARCH FINDINGS

Scientists were asked what they do with their research findings. Their response is shown in the Table 6.18.

TABLE 6.18 : WHAT RESEARCH SCIENTISTS DO WITH THEIR RESEARCH FINDINGS

Present at Seminar	36.0%
Publish in Journals	25.0%
Deposit in library	16.0%
Distribute to fellow researchers	16.0%
Give research reports to Donors	3.5%
Not Applicable	3.5%

Over one percent (1.2%) of the users did not respond to this question.

[Note: 'Not applicable' was a response obtained from users who do not do actual research but are involved in research support activities such as administration].

CHAPTER 7

ANALYSIS AND INTERPRETATION OF SURVEY FINDINGS

7.0 INTRODUCTION

This chapter presents an analysis and interpretation of the findings of the survey, which were presented in the preceding two chapter(s). In some cases, these findings are supplemented by information obtained from relevant NARO publications such as; reports and manuals. Interpretation of the findings is given along with the analysis. The purpose of this interpretation is to identify in concrete terms: the weaknesses (problems) and strengths of the information services and facilities in NARO libraries; the underlying causes of these weakness; and the users needs in terms of priorities.

Section 7.2 gives a summary of the analysis and interpretation, which highlights the observations made from the findings of the survey of NARO institutions as well as the findings of the minor survey the of IT environment in Uganda. The latter findings were presented in Chapter 4.¹ These observations serve as a basis (for drawing objectives) for proposing improved information retrieval services in NARO libraries.

7.1 ANALYSIS AND INTERPRETATION OF FINDINGS

7.1.1 Users' and Information Services

- (a) The majority of users of the research libraries are research scientists (Refer to Chapter 5, Table 5.1). Information services should be designed according to their needs;
- (b) Low usage of the libraries can be attributed to:
- Lack of current literature. Library collections are old and almost obsolete (Refer to Chapter 5, Table 5.3).
 - Remoteness of users from better equipped libraries hence inability to access their collections. (Refer to Chapter 6, Table 6.1). Users who consult other libraries have to travel long distances to access these collections (Refer to Chapter 6, Section 6.2.4). This is prohibitive in terms of both time and costs of travelling.
- (c) Low percentage for database search services indicated in Table 6.5 and the corresponding low usage of databases, given in Table 5.13 is because:
- Most libraries offer only reference and current awareness services and only one library (NADIC) offers database search services, (Refer to Chapter 6, Tables 6.5).
 - Users are at remote institutions;
 - There is lack of full text information to complement the bibliographic information from databases; and
 - There is lack of skills in the use of IT.

- (d) Due to poor library budgets, the majority of libraries do not subscribe to publications. Publications are mainly obtained through gifts and donations and through photocopies of publications (Refer to Chapter 5, Table 5.2);
- (e) There are efforts to resume subscription to scientific journals for all research Institutes. Local publications are still very few. (Refer to Chapter 5, Table 5.17);
- (f) Accidental discovery of information (53.4%), conferences (76.7%), the invisible college (46.5%) and the scientists own collection (53.4%), are important sources of information for the majority of users (Refer to Table(s) 6.13 and 6.14). However, these are not reliable ways of obtaining information;
- (g) The main reason for the users' rating the information services as being average (51.2%), poor (28.0%) and very poor (4.6%) is because the library collections are very old and have little current literature to offer (Refer to Chapter 6, Table(s) 6.6; and Chapter 5, Table 5.3);
- (h) Lack of adequate, current and relevant information has led to formulation of poor research proposals; and poor conducting of research, duplication of effort and wastage of time and material resources, and inability of scientists to publish research findings (Refer to Chapter 6, Section 6.3.4);
- (i) The majority of scientists expressed the need for relevant, current and timely scientific information. IT would be required for fast processing and dissemination of information. Fortunately, a modest number of computers are available in NARO institutes (Refer to Chapter 5, Table(s) 5.5, 5.6 and E-mail has already been installed in some institutes, while other institutes hope to get it fairly soon (Refer to Chapter 5, Table 5.9 and Section 5.1.2.1.11).

7.1.2 Information Services provided by NADIC

- (a) Although the majority (93%) of users are aware of the information services at NADIC, such as: CD-ROM and local databases (Refer to Chapter 6, Section(s) 6.4.1; 6.4.2; and Chapter 5, Table(s) 5.15 and 5.16); and library loan services (Table(s) 6.4 and 6.5), usage of these services is low. The resources at NADIC are modest and could be used by all research scientists including those at remote institutes (Refer to Chapter 6, Table 6.8). Some scientist are already using NADIC's services while others have shown interest in using them (Refer to Chapter 6, Section 6.4.2 and Table(s) 6.9, 6.10 and 6.11);
- (b) Different standards are used across NARO libraries. There is need for standardization so as to achieve compatibility in Information technologies and information processing methods and tools (Refer to Table(s) 5.20, 5.21 and 5.22);
- (c) In spite of their interest in information from the databases at NADIC, the majority (58.1%) users were not satisfied with the services. (Refer to Chapter 6, Table(s) 6.11, 6.13 and 6.16 and Section 6.4.4). More local (national) information is required. This underlines the need to strengthen the home grown databases at NADIC;
- (d) Current titles (65.1%), SDI (67.4%) and searches from home-grown databases (51.1%) and CD-ROM databases (44.1%) were identified as priority services needed by users (Refer to Table 6.16). The librarians shared the same views. This calls for improvement in these services. Information from databases is required mainly for planning research activities (53.4%) (Refer to Table 6.11);

(e) Chapter 6, Section 6.4.8 indicates that the majority of users are unable to conduct databases searches on their own the main reasons for this factor are:

- The majority (62.7%) of respondents are at remote institutions and therefore have to request for searches through the librarian/documentalist. Only 37.2% of the respondents are on-site;
- The majority of user's are not familiar with using computers for information retrieval, they are therefore not able to conduct the searches on their own;
- lack of a user-friendly search interface discouraged users from searching the database themselves;

(f) Fifty percent of the users were not satisfied with NADIC's database services because of the difficulty in obtaining original documents of records cited in CD-ROM databases. Bibliographic information alone was often not adequate for users, except when abstracts were given. (Refer to Chapter 6, Section 6.4.9). The causes of dissatisfaction are:

- CD-ROM databases mainly come from foreign sources. NADIC uses snail mail to request for copies for full text (original) copies of these documents and responses take time to come;
- NADIC can only provide full copies of documents that are in its collection. In this respect, home grown databases have an advantage over CD-ROM databases.
- Thirty percent of the users experienced delays (in getting information) of over one month (Refer to Table 6.15). Since delays reduce the value (usefulness) of the information, a faster method of delivering information to users is required;

(g) Due to lack of access to the databases, 34% of respondents rated the databases at NADIC as being of limited use. (Refer to Table 6.12);

7.1.3 Information Facilities/Resources

- (a) The difficulty of attracting and keeping librarians in NARO libraries particularly those in remote Institutes was noted. Incentives may be necessary to attract and retain well trained librarians at remote research institutes;
- (b) Nearly thirty six percent (35.7%) of the users present their research findings at seminars, 25.3% publish their findings in journals, (15.8%) deposit their reports in the library and 15% or distribute their findings to fellow researchers (Refer to Table 6.18). This shows that scientists can sustain databases by through writing / publishing;

7.1.4 Information Technologies in NARO Libraries

- (a) Several computers available in NARO institutes are not optimally utilized. NARO libraries need to be computerized. There is need to plan and coordinate effective use of computers. (Refer to Tables 5.5, 5.6 and 5.7). Computerization was desired by the majority of the librarians who indicated that it would benefit their libraries (Refer to Table 5.7). NARO's information policy includes the provision of computers to all NARO libraries (NARO, Information Strategy, 1995);
- (b) Fifty percent of the librarians have received some form of training in library applications (Refer to Table 5.8). NARO has plans to provide basic computer training for NARO librarians (NARO, Information Strategy, 1995).

- (c) NARO has plans to instal E-mail in libraries of all research institutes so as to promote information exchange. The institutes which had E-mail were already experiencing benefits (Refer to Table 5.9). The majority of users (86%) and librarians desire to have E- mail in their institutes and anticipate many benefits from its use (Refer to Chapter 6, Table 6.17, Section(s) 6.7.3, 6.7.4; and Chapter 5, Table 5.10 and 5.11);

7.1.5 Information flow and networking among research libraries

- (a) Informal and limited cooperation and networking exists among NARO libraries/Institutes. It is done through sharing and exchange of publications (Refer to Table 5.18 and 5.19). Both users and librarians indicated that limited information flow is a constraint to research collaboration;
- (b) The potential of E-mail and its ability to strengthen research has been identified by NARO management. This potential has now (through this survey) been endorsed by the scientists and librarians (Refer to Chapter 5, Table(s) 5.10. 5.11, 5.12 and Chapter 6, Table 6.17, Section 6.7.4 and 6.7.5,);

7.1.6 Staffing in NARO libraries

The majority (63%) of NARO libraries have the problem of inadequate staffing. Automation would considerably resolve this problem (Refer to Chapter 5, Section 5.1.1.6 and Table 5.4);

7.2 SUMMARY OF THE ANALYSIS

The summary presented here covers two complementary surveys that were conducted for this study namely: the major survey which covered NARO libraries and the users (scientists) of these libraries; and the survey of the IT environment, particularly the electronic communication situation in Uganda. This summary analysis is done using the 'position analysis' or SWOT method. Underwood (1990), Stueart and Moran (1993), identify SWOT i.e. the analysis of strengths, weaknesses, opportunities and threats as a quick means of establishing the position of the organization with respect to the present and future lines of endeavour.

7.2.1 Problems (weaknesses) identified

- (a) Lack of current scientific information in NARO libraries;
- (b) Poor library budgets in NARO libraries;
- (c) Low usage of NARO libraries by scientists;
- (d) Remoteness of users from NADIC and other libraries;
- (e) NADIC's services are under utilized;
- (f) Most of the on-site users' cannot interact with databases;
- (g) Requests for information are not answered promptly by NADIC;
- (h) Full text information is often difficult to get from external sources which are cited in CD-ROM databases;
- (i) Available information services are inadequate for supporting research;
- (j) Information flow among NARO institutes is very limited.

- (k) Research scientists rarely publish; and local research publications are few;
- (l) The majority of libraries are not yet computerized;
- (m) Knowledge of library management applications and general IT skills are still low among librarians;
- (n) Lack of standardization of information processing; and
- (o) Staffing is inadequate in most NARO libraries;

Problems (a) - (m) are urgent and require immediate action. They are in the first priority category, while problems (n) and (o) are in the second priority category.

7.2.2 Resources (Strengths) Identified

- (a) The majority of users' have had some exposure to the use of information technologies such as computers and E-mail. They require little additional training in the use of IT;
- (b) Libraries are manned by professional librarians;
- (c) Awareness of the benefits of computerization is high in NARO, among management, librarians and users;
- (d) Computers are available in three NARO libraries;
- (e) E-mail facilities exist in five of the eight Institutes; at NADIC and NAROSEC, E-mail is in the Library;
- (f) E-mail has benefitted those who have it; and library users and librarians are interested in using it;
- (g) Many users would like to collaborate and share information with their colleagues through E-mail;

- (h) NADIC's information services, have current information and have potential to grow and serve all users in NARO Institutes;
- (i) Database information is useful to scientists in planning research activities and when writing scientific papers;
- (j) Manual card catalogues exist in most NARO libraries and can form a basis for computerization;
- (k) Restocking of NARO libraries with current literature, mostly journals, is underway;
- (l) Standardization of information processing activities in NARO libraries is planned in NARO's information strategy;
- (m) Training of information professionals is one of NARO's priority themes;
- (n) NARO is currently installing E-mail facilities in its institutes. (Uganda. NARO Newsletter, 1(2) (December)1995);
- (o) All NARO libraries will be equipped with computers;
- (p) NARO has plans to train librarians in the basics of IT;
- (q) NARO management supports information activities as can be seen by: establishment of MIS activities; acquisition and coordination of information technologies; and the formulation of the NARO information policy. This is probably the greatest strength that exists for improving the information services in NARO;

7.2.3 Opportunities Identified

- (a) There is growing awareness of the usefulness of information technology (IT) in the Ugandan society. Government support for the use of appropriate IT in

development activities is shown through formulation of the IT policy (Refer to Chapter 4);

- (b) There is growing enthusiasm in electronic communication as is shown by the growth of the Mukla, a low cost Fidonet network. The E-mail facilities already available in some NARO institutes could be extended to facilitate retrieval of information in NARO Institute libraries;
- (c) The presence of the Internet service providers (IP) in the country, offers competition to the Mukla network which provides cheaper services. Hence, Mukla's clients can anticipate to benefit from improved services. When there is need to search external databases, IP (though expensive) would offer the fastest means to do so.

It may be noted that many the strengths and opportunities discussed above are already providing solutions to a number of the problems identified in the survey (See Section 7.21).

7.2.4 Threats Identified

- (a) Inadequate staff will frustrate any efforts to establish/implement an improved IRS;
- (b) Fast developments in IT will render technologies less useful or even obsolete. NARO requires adequate financial resources to replace outdated IT. There is also to train and retrain human resources who are required to work with these technologies;
- (c) Until the telecommunications infrastructure improves, unreliable telephone lines (due to frequent breakdowns) are likely to frustrate electronic communications.

CHAPTER 8

THE PROPOSED SYSTEM FOR INFORMATION RETRIEVAL

8.0 INTRODUCTION

In the previous chapter, it has been established that the information retrieval facilities currently available in NARO libraries fall far short of satisfying the needs of the users. There is need to improve these facilities in order to serve all users including the research scientists working in remote NARO institutes. In view of this fact, an improved information retrieval System (IRS) is proposed and developed.

The goal of the IRS is two fold: to demonstrate that it is possible to resolve the problem of inadequate and in some cases, total lack of information by exploiting the databases at NADIC and the low cost information technologies (E-mail) available in the country; and to recommend this (prototype) system to NARO management for implementation. Implementation of an improved IRS will be necessary in order to resolve the problems which were identified by the survey (Refer to Chapter 7, Section 7.2.1). The identified problems which reflect the users needs as well as the deficiencies in the NARO libraries, have been used in formulating objectives and strategies for the proposed improved IRS. The objectives as well as the strategies adopted in designing the proposed IRS are discussed below.

8.1 OBJECTIVES OF THE PROPOSED INFORMATION RETRIEVAL SYSTEM

8.1.1 General objective

The primary objective of the proposed Information Retrieval System (IRS) is to provide improved access to the information resources at NADIC, mostly the home-grown agricultural databases, to all users (research scientists) including those at remote locations. The IRS should be capable of satisfying, initially, the priority information needs of the users in NARO research institutes through provision of timely, current and relevant information. Later, the IRS should cater for the second priority needs that were identified by the survey (Refer to Section 7.2.1) It could also serve other users outside NARO.

8.1.2 Specific Objectives of the Proposed IRS

- (1) To provide a current awareness service through Selective Dissemination of Information (SDI) services to on-site and remote users;
- (2) To provide retrospective database search services to both on-site and remote users; and
- (3) To provide referral and reference services to users through provision of products such as directories of: experts in agriculture; projects; agricultural information systems and institutions which are closely or remotely related to agriculture.

8.1.3 Strategies for the proposed IRS

In order to design the proposed IRS, the following strategies were adopted;

- (1) As indicated earlier in Chapter 1, Section 1.5.6.5, a search of the available software was made and the bibliographic server, ECASRV, an E-mail database search tool was adopted. ECASRV interfaces databases established with CDS/ISIS and FrontDoor, a Fidonet E-mail software (PADIS. 1996. ECASRV: CDS/ISIS Database Search Program Via Email, Version 1.0). This tool will enable users at remote research institutes to search and retrieve information from NADIC's home-grown databases;
- (2) The NADIC SEARCH INTERFACE, a user-friendly search interface has been developed using the ISIS/Pascal interface. It is recommended as part of the proposed IRS in order to enable on-site users to access the databases at NADIC without need of an intermediary; and
- (3) A CDS/ISIS based SDI program, which comes with the CDS/ISIS application software was selected and has been modified to make it fully automated. The fully automated program can conduct searches and send the search output to users based at remote research institutes via E-mail, with minimum human intervention.
- (4) In addition to the databases already available at NADIC, three prototype databases have been developed to provide additional information that is required by users. They include the SDI, AGREXP, and AGRORG databases. These databases will be discussed later.

8.2 DESIGN OF THE DIFFERENT MODULES OF THE PROPOSED SYSTEM

8.2.1 The SDI Module

It may be recalled that, SDI service was identified as a priority need by the users' survey. The proposed IRS has been designed to address this need.

8.2.1.1 The Selective Dissemination of Information (SDI) Program

In order to implement an effective SDI service that would cover all the research scientists in NARO, this study has recommended a fully automated SDI service that is run from NADIC's own home-grown databases. The SDI Program that comes with UNESCO's CDS/ISIS application software, has been adapted to implement the SDI program. The original SDI program (SDI.PAS) searches databases and saves all the search outputs (for different users) in the same text file which can be printed out. Later, each user's output is identified, separated and sent to the user through ordinary post. Since the goal of this study is to provide information to remote users through E-mail, it was necessary to modify the SDI program to match this goal. The modified SDI program is discussed in detail in Section 8.2.1.1.1 below.

8.2.1.1.1 The Modified SDI Program

In order to fulfill the objectives of the proposed IRS, namely to provide SDI and retrospective database search services to all research scientists including those at remote research institutes in Uganda. The original SDI program was modified in order to make

it save the search output in separate files for each user. With this provision, the program searches and sends the search output for each remote user via E-mail. The output for on-site users is saved as text files for each user. This file can either be printed or downloaded on floppies.

Modifying the program entailed major changes which included developing the following procedures:

- (1) A procedure for reading the user profiles and identifying the user names and truncating each name to eight characters thus forming another variable known as user identification (UID) which subsequently forms the output file for the search output for each user;
- (2) A procedure that reads the E-mail addresses of each user from the PROFILES files and supplies this information to the procedure that mails the output file for each user (Refer to number (4)) below;
- (3) A procedure that reads the users profiles, differentiates the on-site users from the remote users so that the search output for the remote users is sent to each individual automatically (via E-mail), after the search has been conducted, while the search output for the on-site users is saved in separate files (with the UID file name) and can be printed or down-loaded to floppies for each user;
- (4) A procedure that calls AUTOMAIL, a utility that picks each remote users' file and mails it to them through Frontdoor, the E-mail software. This procedure is connected with the procedure in (3) above. AUTOMAIL is a utility developed by Mats Wallin (Automail 3.00, Copyright 1989-90 Mats Wallin).

In addition, users' profiles, which constitute the SDI database, were developed following the guidelines given in the original SDI program (SDI.PAS). It is from this database that the PROFILES file is developed. The following minor modifications had to be made to the original structure of the user's profiles database (SDI database);

- Field v4 for the country name was deleted since it was not necessary for the local situation in Uganda;
- The user's E-mail address was included as field v4, which was originally the country field;

Details of the mode of work of this program are given in Section 8.3.1.

8.2.1.2 User profiles

The sample user profiles should have the following details: the users' name; users' address (including the E-mail address); Subject(s) of search; and the keywords that best describe the users information needs. These keywords are required as search terms while identifying the documents that could be of interest to the user(s) (i.e. matching the user profiles with the document profiles or databases). A prototype SDI database containing the profiles of users of NARO library /Information services has been developed.

Appendix 8(A) shows a sample of the Users' Profile. Two fields were added to the profile: one for the documentalist / librarian who compiled the profile and the corresponding date on which the entry was made; the second field is for the date of updating the profile. This underlines the importance of regularly updating the profiles

(at least every three months) in order to provide relevant information to the user. The display format of the SDI database is given in Appendix 8(B).

8.2.1.3 Document profiles

The document profiles refer to the home-grown databases namely, AGRIN and CARIN, that are already established at NADIC. Preliminary information on these databases was given earlier in this thesis (Refer to Chapter 2, Section 2.1.3.1.4; Chapter 5, Section 5.1.2.1.16, and Chapter 6, Section 6.4.6 - 6.4.10). Therefore, the discussion below will cover only the information retrieval features of these databases. In addition, there are other complementary home-grown databases, prototypes of which have been developed for the proposed IRS. These are AGREXP and AGRORG. These have been discussed in Section(s) 8.3.1.1 and 8.3.1.2. The databases are established using UNESCO's Micro CDS/ISIS software.

8.2.1.3.1 The AGRIN database

AGRIN is a bibliographic database with records of nationally generated (published and unpublished) literature on agriculture. Records indexed in this database include: conference papers; books; and periodicals such as journals, bulletins, etc. Indexing documents for this database is done at five levels namely the analytical level, the monograph level, the serial level, the descriptor (indexing terms) level and the abstract level. The major fields of the bibliographic records are: record number; primary subject category; type of record; author(s); degree; title; report number; ISSN/ISBN; descriptors or keywords; location of publication; and abstract. There are 15 searchable

fields. The Indexing terms or keywords are selected from FAO's AGROVOC Thesaurus. The database has six worksheet descriptions, six display formats, and six field select tables. An example of a search output from the AGRIN database is shown in Appendix 8(C).

8.2.1.3.2 The CARIN database

CARIN is database of on-going and completed agricultural research projects in Uganda. The records indexed in this database have the following major fields: project number; project code; starting date; termination date; title; objectives; primary subject category; descriptors; institution name; institution address; cooperating institutions; type of research; research leader; etc. It has three worksheets, nine display formats and two Field Select Tables. Appendix 8(D) shows a search output from the CARIN database.

8.2.1.3.3 The AGRINF and ULIST databases

AGRINF is a database of agricultural information systems in Uganda. Currently it has 27 records of agricultural libraries. The records contain information on: the name and location of the library, its parent body, subject coverage, working hours etc. The database was established to serve as a referral source of information. The ULIST database contains records of periodical holdings of the agricultural libraries. The output of this database is a union list of periodicals in agricultural libraries. However, these two databases have not been active, as such, they are relatively small in size but are expected to grow.

8.2.1.3.4 Establishment of home-grown databases at NADIC

As indicated earlier, the home-grown databases at NADIC were established with assistance of the Food and Agriculture Organization of the United Nations (FAO). Therefore, the FAO AGRIS/CARIS Standards are used for indexing and vocabulary control. NADIC participates in the International Information System for the Agricultural Sciences and Technology (AGRIS) and the Current Agricultural Information System (CARIS). As such, records of on-going research projects and national documents that are indexed two years or less, after their publication date, are exported to CARIS and AGRIS, respectively. Because of their international nature, the databases are trilingual, using English, French and Spanish as indexing languages. The above reasons have posed restrictions on any possible modifications that would be made on the databases. For example, it was not possible to define an integrated database of institutions, projects, experts, etc. Details of the field select tables of these databases appear in Appendices 8 (E),(F) and (G), respectively.

8.2.2 **The Database Search Module**

8.2.2.1 The NADIC User Interface

The NADIC user interface has been developed to offer more user friendly features than the ones currently offered by the conventional CDS/ISIS interface. The NADIC SEARCH INTERFACE would ensure that the novice users are able to interact with the databases with little or no assistance from an intermediary.

The NADIC search interface therefore offers the following desired facilities:

- (1) Easy access to the database through several access points namely: author; AGROVOC terms or keyword(s); local indexed terms; title; dictionary terms; ANY term searches; and subject categories;
- (2) Help messages at every stage in the search;
- (3) Different display formats of the records retrieved e.g detailed, brief and proof reading formats;
- (4) Displays the search strategy and the number of records retrieved;
- (5) Options for browsing, printing or downloading the search output, one record at a time;
- (6) Retrieval and display abstracts for all those records that have them, thus making it easy for the user to decide whether the document is relevant to them before printing or down-loading the record.
- (7) Ability to terminate the search at any stage and go back to where one started;
- (8) The ability to ensure economy in the use of resources, since only relevant records are down-loaded; and
- (9) Ability to search several databases.

8.2.3 The Bibserve module

One possible way of improving the retrieval of information from databases is the use of a software known as a "bibliographic information server". NADISRV is an information server (or an infoserve for short), or a software that receives queries in a predefined format by E-mail, executes the commands therein by searching the database

and sends back the retrieved information or files by E-mail without any human intervention. because NADISRV performs these operations on a bibliographic database, it is known as a **bibserve**. Implementation of the bibserve (NADISRV) will provide an avenue for the research scientists at remote institutes to search the databases at NADIC, thus enabling them to obtain relevant and timely information to keep abreast with developments in their fields of interest.

The use of bibserve would ensure that inquiries for information are sent fast to NADIC and the search output (from the databases) is sent to the user's equally fast. The bibserve will replace the human intermediary thus freeing the staff to do other duties.

8.2.3.1 The NADISRV Module

NADISRV is a database search tool that has been adapted from ECASRV, a program that has been mentioned in Section 8.1.3(1), of this Chapter. Essentially, ECASRV and NADISRV are the same program. However, for the purpose of adapting NADISRV for use at NADIC, it was necessary to rename ECASRV as NADISRV. This provision was necessary because the NADISRV program should be installed as an E-mail user at NADIC. As such, there is need to distinguish this user (server) from any other server that may be installed elsewhere in the network. This would ensure that search requests meant for NADISRV are not misdirected. In order for NADISRV to work, it uses three main files of its own and two utility program files. The explanation below gives a brief insight on how NADISRV works.

The main program files are:

- (1) The compiled program file: ECASRV.PCD this program is stored in the prog sub-directory of CDS/ISIS.
- (2) The configuration file: ECASRV.CFG : This file supplies to the ECASRV program the following information: the name of the server (in this case NADISRV); the directory where the message files are stored (e.g. Netmail folder); and the temporary work area where temporary files created by the program are written. In the case of NADISRV where it is anticipated that the program will be installed on drive C (C:) of a stand-alone machine, the configuration file would appear as shown below:

NADISRV.CFG File:

Toprog NADISRV

scandir c:\fd\netmail

workdir c:\Asaba\msgs

- (3) The help text file: NADISRV.HLP : This file is useful when users request for help from the server. In this case, the program picks this file and mails it to the user. The NADISRV.HLP file is stored in the same directory as the syspar.par file which runs micro CDS/ISIS.

8.2.3.2 Formatting messages to NADISRV

In order to retrieve information through NADISRV, the user must send queries to the database (via E-mail) in a pre-defined format. Formatting messages will be discussed together with querying of the home-grown databases at NADIC in Section 8.3.5.1 of this Chapter.

8.3 FUNCTIONS OF THE PROPOSED IRS

8.3.1 Provision of information to on-site and remote users through SDI

Mode of work of the modified SDI Program

Periodically, the modified SDI program reads the users profiles that are found in the profiles database. It identifies the users' names, postal addresses, E-mail address and keywords or search terms which best describe the users interests.

Running the SDI program can be done in two ways, a user may invoke option (U) under the Information Retrieval Services using the conventional CDS/ISIS menu. The program has been installed here as a menu option. In the fully automated mode, the utility KEY-FAKE is used to invoke the program. Prior to running the program, the lower limits of the records to be searched in the database must be set to the last record searched in the last SDI search. This is automatically done by the program itself. It is necessary to set these limits so as to avoid searching the same section(s) of the databases twice. The names of the databases to be searched by the program are put on

separate lines in the file SDI.DBN which is saved in the ISIS directory. In the case of the SDI Service for the proposed IRS, this file reads as follows:

AGRIN
CARIN

[Note: It may be noted that the names of other databases to be searched can be added as desired]

The users profiles are stored in the SDI database.

When the SDI program is invoked, it searches the SDI profile database for keywords for each user and returns the information in a defined format in a separate PROFILES file. Then the program conducts a search on the bibliographic database(s), in this case AGRIN and CARIN, The user name is automatically identified by the SDI program from the user profile. The program matches the keywords for each user (from the PROFILE file) with the keywords in the bibliographic database. The output is saved in a separate file for each user. The format for this file is USERNAME (truncated to eight characters). These files can then sent to on-site users in print form or on floppy. In the case of the remote users, after the SDI program has accomplished the search for each user, the system uses AUTOMAIL to pick each file and mail it to the user automatically, via E-mail. Figure 8.1 (A) and 8.1 (B) below, show the screen features of the SDI program after it has executed a search and the search output from the SDI service, respectively.

```
Profiles data base [SDI/RETRO/] SDI

New limits were found as follows:

AGRIN    1

CARIN    1

Selecting user profiles for data bases AGRIN

8 profiles selected for 6 users

Selecting user profiles for data base CARIN

7 profiles selected for 6 users

New MFN limits were set as follows:

AGRIN    806

CARIN    261
```

FIGURE 8.1(A) : SCREEN FEATURES OF SDI PROGRAM AFTER A SEARCH

Note that the third and fourth rows give the following information : AGRIN 1; CARIN 1; indicating the lower MFN limits that were set for the two databases before searching. On the other hand, line 10 and 11 give the limits as 806 for AGRIN and 261 for CARIN. These are the upper MFN limits for this particular search which will be the lower MFN limits for the next search.

An example of a search output of the SDI service for one user is shown in Figure 8.1(B).

Robert Mwesige

KARI, P.O.Box 7065, Kampala, Uganda,

Tel. +256-41-567623

E-mail: 5:573/1.459

Citation of the day

"... since wars begin in the minds of men,
it is in the minds of men that the defence of peace must be
constructed..."

From the Unesco Constitution

16 Nov 1945

FIGURE 8.1(B): A SEARCH OUTPUT FROM THE SDI SERVICE

(see also the continuation of this figure on the next page)

Date: 05-08-96 Data Base: AGRIN

Subject : Marketing Search #1: Marketing

Search #2: Grain Crops

Search #3: #1 + #2

Record 1

00052

Report of the Committee on the Marketing of Livestock, Meats, Fish and the Dairy Products in Uganda, 1969. (En). Committee on the Marketing of livestock meats, Fish and their products in Uganda. Kampala (Uganda). 1969. 148 p. 41 tables.
AGROVOC: LIVESTOCK; MEATS; FISH; MARKETING; UGANDA. (En).

Rec.status....: N.

Prim.sub.cat.: E70.

Type of rec....: R. Bibl.lev....: M. Lit.ind.: NV.

Location/access: NADIC

Record 2

00103

Uganda Cottons; their origin, production and marketing. (En). Uganda Lint Marketing Board.
Kampala (Uganda). Uganda Lint Marketing Board. 5 p.
AGROVOC: GOSSYPIMUM; PROCESSING; MARKETING; PRODUCTION. (En).

Rec.status....: N.

Prim.sub.cat.: Q60.

Type of rec....: B. Bibl.lev....: M. Lit.ind.: YV.

Location/access: DOC

Record 3 00142

Plant protection activities in Uganda. (En). Ocen Ayer, J.R. (Ministr Agriculture, Kampala (Uganda). Kawanda Research Station). Ministry of Agriculture, Kampala (Uganda).
Nairobi (Kenya). Nov 1987. 5 p.
1. FAO, DLCO-EA International Group Training on refined and ecological management of migratory pests. Nairobi (Kenya). 16-27 Nov 1987.
AGROVOC: GRAIN CROPS; FOOD CROPS; ?SPODOPTERA EXEMPTA; LOCUSTS; PEST

Total number of records selected 27

FIGURE 8.1(B): A SEARCH OUTPUT FROM THE SDI SERVICE

8.3.2 Prototype databases that have been proposed for the IRS

8.3.2.1 The AGREXP database

AGREXP is a database of experts in the broad field of agriculture. This database has been established to serve as a referral source of information for users. It was found necessary to establish this database because the databases available at NADIC do not provide information on experts in the broad field of agriculture. For example, the CARIN database has information on only the research scientists who are involved in active research at the particular time that the information for the database is captured/updated. The INFORM database is also biased towards research scientists in NARO. Experts could be any of the following categories: extension workers, University lecturers, private consultants agro-industrialists, etc. It was therefore found necessary to establish a common database which can serve as a directory of all agricultural experts irrespective of their affiliation. Such a directory is required by users in all sectors of agriculture as well as other interested users. It would be useful in selecting experts for consultancy work, training, etc.

The AGREXP database can be searched from any of the following access points: the name of the expert whose particulars may be required; his affiliation; his subject of specialization; nationality; language of competence etc. A sample of an experts profile from the AGREXP database showing details of one record is shown in Figure 8.2

Name	:	Ssali, W.M. (Dr)
Gender	:	Male
Date of Birth	:	25-06-50
Marital Status	:	Married
Nationality	:	Ugandan
Contact Address	:	P.O.Box 7852, Kampala, Uganda.
Qualifications	:	PhD (Food/Fish Technology)
Specialization	:	Food Technology
Language of competence	:	English, French, Swahili
Affiliation	:	Food Science and Technology Research Institute (FOSRI)
Current employer	:	Research and Administration
Work Experience	:	Food and fish processing technologies; Research Management
Honours and Awards:	:	Information not obtained
Publication	:	The nutritive value of fish. Post Harvest processing of food.
Assignments	:	National Task Force for food Security 1991, Consultant

FIGURE 8.2: SAMPLE RECORD FROM THE EXPERTS PROFILE

Details of the AGREXP database such as the AGREXP Worksheet and Field Select Table (FST) are shown in Appendices 8(H) and 8(I).

8.3.2.2 The AGRORG database

AGRORG is a database of Organizations that are closely or even remotely connected with agricultural activities. These include: agricultural research institutions, extension institutions, agro-industries, agricultural enterprises, etc. Like AGREXP, AGRORG is a referral source of information. It was necessary to set up this database because

research scientists and other users need information on matters such as: particulars of organizations that are concerned with various agricultural-related activities, e.g. seed production and marketing; the government and non-governmental organizations involved in extension services; agricultural projects, the fertilizer, pesticide and veterinary drug industries/ companies, etc. AGRORG will provide this kind of information. A sample record from the AGRORG Database is shown in Figure 8.3.

Name of Organization	:	Uganda National Council for Science and Technology
Start Date	:	1972
Type of Organization	:	Government
Location	:	Kampala, Uganda
Address	:	UNCST, P.O.Box 6884, Kampala, Uganda. Tel. + 256-41-250431
Objectives	:	1. Research coordination 2. Research Policy formulation 3. Promotion of use of indigenous technologies, etc 4. Promotion, adoption & use of appropriate foreign technologies, etc.
Activities	:	Planning, Coordination, Implementation, advise and promotion of research in various disciplines of Science and Technology.
Subject Scope	:	Social Sciences, Agriculture, Industry & Engineering Sciences, Medical & Veterinary Sciences, Natural Sciences, Physical Sciences & Humanities
Head of organization	:	Nyirira, M. Z. (Dr)
Parent Organization	:	Ministry of Finance and Economic Planning
Associated Entities	:	Research Institutes in Science & Technology, Industries
Services offered	:	Funding of academic research activities
Priority activities	:	1. Formulation of Science and Technology Policies for all sectors of the economy 2. Coordination of national research activities
Financial Aspects	:	Government/Donors

FIGURE 8.3 : SAMPLE PROFILE OF INSTITUTIONS

A user may access the AGRORG database from the following access points: name of organization, type of organization, subject scope, services offered, activities of the

organization and priority activities.

Details of the AGRORG database namely, the AGRORG worksheet

and the AGRORG Field Select Table (FST) are shown in

Appendix 8(J) and 8(K) respectively.

8.3.3 Screen features of the NADIC SEARCH INTERFACE

8.3.3.1 The First (WELCOME) Screen

The NADIC USER INTERFACE has been designed to offer an easy and convenient way of searching the databases, even by novice users. The features of the First(WELCOME) Screen, the Main Menu and sub Menu's of the NADIC USER INTERFACE have the features shown in Figures 8.4 (A),(B) and (C).

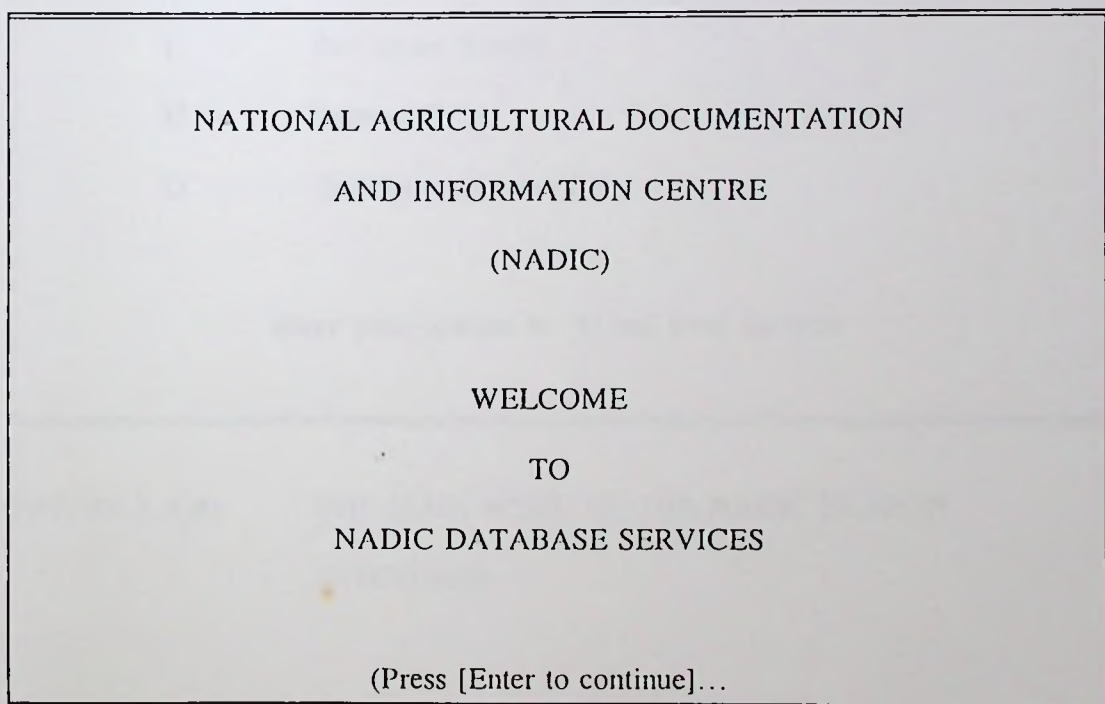


FIGURE 8.4(A) THE FIRST (WELCOME) SCREEN OF THE NADIC SEARCH INTERFACE

Date : 05 02-96

Time :19-08 ;08

THE NADIC SEARCH INTERFACE

***** MAIN MENU *****

- A -- Title Search (words)
- B -- Personal Author Search
- C -- Corporate author Search
- D -- Search through Dictionary
- E -- Search by subject Category
- F -- Keyword Search -- AGROVOC
- G -- Local Terms Search
- I -- Any terms Search
- H -- General Help
- Q -- Quit Searching and Exit

Enter your opinion A - Q and Press Return]

FIGURE 8.4(B) : THE MAIN MENU OF THE NADIC SEARCH
INTERFACE

Enter the Author's Name :

Enter H - for Help

FIGURE 8.4(C) (i) : AUTHOR SEARCH SUB-MENU

Enter the Title words :

Enter H -- for Help

FIGURE 8.4(C) (ii) : TITLE SEARCH SUB-MENU

B-- Brief Display

D-- Detailed Display

R-- Proof Reading Format

S--Save in an output file

P-- Send output to Printer

Q-- Quit

Select ---D/B/R/S/Q

FIGURE 8.4(C) (iii) : DISPLAY SEARCH OUTPUT SUB-MENU

FIGURE 8.4(C) : SAMPLES OF SUB-MENU'S OF THE NADIC SEARCH INTERFACE

Before printing, the user has an opportunity to view each record as it is displayed on the screen, s/he can also select the records to be printed or downloaded and send them to the relevant files, one by one. By selecting only the relevant records, the user can economize on resources and also minimize on information overload.

8.3.4.2 The Search Output

On-site user(s) can interact with the home-grown databases at NADIC using the NADIC SEARCH INTERFACE. A sample of a search output from AGRIN, a bibliographic database resulting from this interaction is shown in Appendix 8(C).

8.3.5 Information retrieval through NADISRV

8.3.5.1 Retrospective Search Services

In order to conduct a search through NADISRV, the user must compile the E-mail message (which is sent to NADISRV) as follows:

BY : users' address (user@user.address)

To : NADISRV@Mukla.gn.apc.org (Address can be a Fidonet or Internet address but must be unique)

Re : Search_Request

In the body of message:

The following are valid keywords or reserved words used for searching (i.e. the program recognizes these as reserved words and therefore they cannot be used for any other purpose:

DATABASE	:	Tells the database to be searched;
FIND	:	Tells to search the specified string after it. FIND works with DATABASE (above);
FILE	:	Tells the list of available database files to search;
LIST	:	Lists fields of a database (works with DATABASE); and
HELP	:	Sends back the HELP message.

An actual example would be as shown in Figure 8.5

BY : BalirwaJ@FIRI.gn.apc.org

To : NADISRV@Mukla.gn.apc.org

Re : Search_Request

In the body of the message:

DATABASE : CARIN

FIND : Food Policies and Uganda

FIGURE 8.5 : AN EXAMPLE OF A SEARCH REQUEST THROUGH NADISRV

information) that will be used in planning, decision making, general management and for creating general awareness among the users. The SDI database should be maintained for the purpose of rendering a regular SDI service to the users.

8.4.2 Fidonet network requirements

Like databases, Fidonet technology is a prerequisite requirement for the prototype IRS. This technology was discussed earlier in Chapter 3. Section 3.3.1. It may be recalled that Fidonet is a low-cost point-to-point, store and forward wide area electronic network (WAN). Fidonet uses modems over telephone lines to exchange messages and data. FrontDoor is one of the commonly used (Fidonet) software in Africa and is already in Uganda. It will be required for the prototype IRS. FrontDoor can be obtained free for non-commercial use from the developer. It operates in DOS environment and can be supported by relatively unsophisticated programmers.

8.4.2.1 E-mail Services

Implementing the recommended IRS will not be difficult basically because the hardware and software requirements for establishing E-mail systems are affordable. In the case of NARO E-mail services are already in place in 62.5% of the NARO research Institutes (Refer to Table 5.9). Plans to instal E-mail in the remaining research institutes are underway. However, currently E-mail is installed in only two (25%) of the libraries. In order to implement the prototype IRS, E-mail facilities should be extended to all NARO libraries. The requirements for the proposed IRS are discussed in the next section.

8.4.3 Hardware and Software Requirements

This study identified the availability of several models of computers in NARO institutes, some of which were not being put to optimum use. It is therefore assumed that most institutes have at least one PC that they can commit for E-mail services. Preferably, such a PC should be based in the library so that it can be used to perform other library management activities. If this is not possible, then it will be necessary to acquire at least one new computer for each NARO library.

The list below gives guidelines on the minimum configuration required for setting up a centralized, E-mail-based Information Retrieval System (IRS) at NADIC, which will serve as a coordinating node for the proposed IRS. These specifications have been made with the awareness that E-mail facilities exist at NADIC and therefore the information provided will not all be of immediate use. However, this information will be useful in cases where there will be need to upgrade the facilities. Similar requirements will be needed for setting up in the NARO institute libraries.

The configuration required for setting up E-mail facilities in NARO libraries which will be required for accessing the information at NADIC is also given.

8.4.3.1 Hardware and Software requirements for the centralized facility at NADIC:

The key factors that need to be considered in the selection or evaluation of hardware should be efficiency of the equipment and its capability of accommodating various user requirements. The minimum configuration should include the following:

- A dedicated computer with a serial communication port.
A 386 IBM compatible machine with a minimum of 640KB RAM, and sufficient hard disc space depending on the work load the computer will take on, a speed of at least 25 Mhz and a monitor. If funds permit, a high capacity (200MB and above) and faster machine would be preferred due to the heavy work load anticipated as both the databases and number of users grow. It is necessary to have a dedicated computer since it will have the bibliographic server, NADISRV which will incorporate the centralized home-grown agricultural databases which will be used for SDI and retrospective search services (manually and through NADISRV). This computer will be required to work full time;
- 220 V AC Supply;
- Uninterruptible Power Supply (UPS) device with a stabilizer. This is necessary for protecting the computer and the modem from fluctuating currents;
- A standby generator. This will be needed for providing power to the computer during times when there are electricity cuts;
- A 2400 baud asynchronous modem with cable. This is sufficient for local communication within the country. However, since international communication is anticipated, a 9600 baud modem would be more suitable. In Uganda, Telebit Worldblazer and GVC 2400 modems have been observed to perform well. In addition, external modems are preferred to internal modems (Musisi 1996);
- Initially when the E-mail facility is running on a stand-alone machine, it will require an MS or PC DOS, versions 3.00 or above, operating environment. When LAN's are established within institutions and E-mail is put on the LAN, the network operating environment should be Novell or Lantastic. However, E-mail

can also run under other multi-tasking environments, such as DESQview. These may be used where the computer on which the E-mail is based has to perform several tasks.

- A telephone line (even an extension would do the job). This telephone line could be an ordinary line. However, an international packet switched data network should be more suitable for (future) international connections;
- A printer. Any dot matrix printer such as Epson Printer is sufficient. It is needed for printing out the messages or search output(s) for individual users.
- UNESCO's Micro CDS/ISIS Software, version 3.07 is required for running the NADISRV program.
- Fidonet communications software such as FrontDoor Non-Commercial version which can be obtained free of charge from the Mukla Fidonet System Operator or from PADIS. The software should be accompanied with user documentation to facilitate the users in learning how to use the system.
- The bibserve software, ECASRV for performing the database searches at NADIC.

8.4.3.2 Requirements for the NARO Institute libraries

Except for some variations, each of the NARO Institute Libraries will require the same basic configuration as for NADIC. However the following clarification is being given about the institute requirements:

- Since the Frontdoor Software is works in several operating environments, the brands of computers that are already available in NARO could be used without

any constraints. This would eliminate the need to buy new machines. However, if a decision to buy new computers is taken, IBM compatible computers which are widely available in the country would be preferred.

- For two (25%) institutions (SAARI, FOSRI) which are still lacking telephone lines, arrangements should be made to restore terrestrial telephone services to the institutes;
- Although FrontDoor and CDS/ISIS are obtained free of charge, Copyright Laws prohibit copying of these applications therefore each institute will need to acquire its own copy of the Fidonet communications software (FrontDoor Non-Commercial version) and CDS/ISIS Software and the accompanying user documentation from the suppliers.

8.4.4 Personnel requirements

Trained staff will be needed to implement the proposed IRS.

Fortunately, the survey findings revealed that NARO libraries are currently being manned by professional librarians. Although, the staff existing at NADIC and NARO libraries at the moment may, initially be able to implement the prototype IRS. Additional staff will be required to take on the added activities that the new IRS will bring.

8.4.5 Management issues

8.4.5.1 Staff Training

Once the E-mail facilities are installed in the research libraries, the librarians will require basic training in major areas such as: the use of E-mail facilities; searching databases through NADISRV; compiling users profiles for the SDI service, etc. Regular refresher training will also be required in the general field of information and documentation.

8.4.5.2 Establishment of databases at institute level.

Librarians will be required to set up similar databases at their institutes. These databases include bibliographic databases of institute publications, databases of research projects, etc. In addition, they may be required to contribute important (specific) information or current records to the central databases at NADIC.

8.4.5.3 User Training

The librarians will, from time to time be required to conduct user orientation courses on the use of the IRS and use of the libraries in general.

8.4.5.4 Marketing of information services

The NARO librarians and the Information staff at NADIC will be required to market the proposed IRS, through avenues such as seminars, brochures, circulation of IRS products such as directories of: research workers, organizations, and experts. Day to day promotion of the available services will also be necessary.

8.4.5.5 Establishing budgets to cover electronic communications

Each library participating in the IRS will incur additional costs as a result of using telecommunication facilities such as telephone and fax, for data communication. Individual libraries will therefore be required to pay for their own connection (for the E-mail) and communication charges (for the telephone services). In addition, they will incur monthly service provider charges for E-mail facilities. In the case of the Mukla network to which a number of institutes are already connected, the monthly charges for Corporate institutions is US\$ 50 (See Appendix 7 for more details).

8.4.5.6 Feasibility of implementing the proposed IRS

The recommended IRS will largely depend on the available telecommunication and E-mail facilities in the country. Although building and maintaining a sustainable IRS that is based on E-mail facilities in Uganda may seem, an unrealistic proposal because of problems such as unreliable electricity supply, and unreliable telephones, low cost solutions are available and with proper planning, these solutions can be made available.

A good example is the ESave, a UPS that can power a 486 computer with 18v dc from 12v dc car battery using an automobile adaptor. ESave was invented by E-mail enthusiasts namely, Douglas Rigby based at the Environmental Liaison Centre International (ELCI), Nairobi, Kenya and Nicholas Perrier a Kenyan based electronic engineer. ESave has been installed at the ELCI and at the African Regional Office of Standards (ARSO), Nairobi, Kenya and can provide up to 72 hours of unfluctuating 18 volts dc (Douglas and Nicholas 1995). The problem of unreliable telephone lines will be resolved soon as the UPTC is already modernizing the telephone infrastructure countrywide (Refer to Chapter 4, Section 4.3.1).

Databases are another very important input that the IRS will depend on. The researcher and author of this thesis is responsible for maintaining homegrown databases at NADIC. She will therefore endeavor to solicit the necessary support from the NARO management to maintain the databases and to implement the proposed IRS.

8.4.5.7 Summary

The proposed IRS is an effort to alleviate the problem of lack of information by enabling the research scientists to access and share the modest information resources available at NADIC. The System has have the following merits:

- The SDI and retrospective search services will keep the research scientists updated of the currently available literature in their fields of interest;
- It will be a fast, relatively cheap and efficient way of providing information to users;

- It will serve all research scientists irrespective of their location;
- It will provide a user-friendly interface for on-site users thus enabling them to search with little or no help from an intermediary;
- It will be cheap to establish and maintain as the basic infrastructure and personnel to operate the system are available in the country;
- The proposed IRS is particularly suitable for the research environment where information is often required for immediate use and therefore must be delivered fast.
- The E-mail network will bridge the gap between NADIC and the remote research institutes.
- The IRS will resolve the major problems that were identified in the survey namely: lack of current information in NARO libraries due to poor library facilities/budgets, scientists' inability to publish; limited flow of information among NARO institutes; under-utilization of the databases at NADIC; and inefficiency in providing information services arising from inadequate human resources.

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CHAPTER 9

CONCLUSION AND RECOMMENDATIONS

9.0 INTRODUCTION

This chapter gives a summary of what this study has been able to accomplish. It also outlines the follow up actions that will be required in order to implement the improved IRS. Additional recommendations cover problem areas that were identified but that have not be resolved by the proposed IRS.

9.1 SUMMARY AND CONCLUSION

The survey findings revealed that all research scientists in NARO institutes need a well organized information system to enable them obtain information whenever they need it. The current library and information facilities are inadequate in meeting this need. However, the existing information (mainly database) resources at NADIC have great potential for satisfying the needs of users in NARO. The improved IRS that has been proposed in Chapter 8 aims at alleviating and to a large extent solving the problems identified in this study.

The findings of this study can be summarized as follows;

- (1) Agriculture is the mainstay of the people of Uganda. It contributes over 50% of the GDP and over 90% of the total exports. As such, the Uganda government has instituted reforms that are aimed at modernizing the agricultural sector. Among these measures was the establishment of the National Agricultural

Research Organization (NARO), in 1992.

- (2) Agricultural research has been given priority in national development plans. Government relies on agricultural research to produce tested technologies which can lead to increased agricultural production.
- (3) NARO has eight institutes and five smaller research stations where researchers are engaged in different aspects of agricultural research. However, the research scientists experience inadequate information and this is a constraint to their research activities.
- (4) Poor library budgets are largely responsible for the lack of information in most NARO libraries.
- (5) Subscription for scientific journals and books is an expensive undertaking and may not be sustained for all NARO libraries. Sharing of the available information resources is a better and cheaper alternative.
- (6) NADIC has some current information sources such as home-grown agricultural databases, CD-ROM databases and publications that can be shared by research scientists at sister research institutes in the country. However, the distance between NADIC and the research institutes limits the sharing of these resources. The use of E-mail for retrieving information from home-grown databases at NADIC could bridge this distance.
- (7) External (foreign) databases would be a good source of current scientific information for scientists. Internet service providers offer database access and file transfers facilities. However, in Uganda access to the Internet is available through SLIP/PPP protocols. It is expensive to make database searches on the internet and most research scientists cannot afford it.

- (8) Cheap alternatives to searching on databases are available. For example Bibserve, a bibliographic information server uses conventional E-mail facilities (Fidonet technology) for information retrieval.
- (9) An improved information retrieval system (IRS) could alleviate the existing problems of information retrieval in NARO. Hence This study has made an attempt to develop and recommend such a system.
- (10) The proposed IRS comprises of a bibserve, NADISRV which can provide access to the databases at NADIC through E-mail. It could be adopted for solving the existing problems in information retrieval. This would facilitate remote database search facilities.
- (11) The majority of scientists were interested in SDI services. The proposed IRS has a component for an SDI service which uses E-mail. This could be used to provide the research scientists at remote research institutes regular updates of information in their fields of interest.
- (12) The on-site users who have been experiencing difficulties in conducting searches will find it easier to search home-grown databases through the NADIC SEARCH INTERFACE, a user-friendly interface that has been developed as part of the improved IRS.
- (13) In Uganda, agricultural research policies recognize the value of information in increasing research productivity. The NARO information policy which is due to be ratified has a component of establishing electronic communication in all NARO libraries, therefore support for the proposed improved IRS is anticipated.

It may therefore be concluded that the proposed IRS based on E-mail can reinvigorate NARO libraries thereby providing information to facilitate the research scientists in

doing their work. The environment provided by NARO and the general IT environment in Uganda is favourable for implementing the proposed improved IRS.

In addition to the requirements for the proposed IRS, given in Section 8.4 of Chapter 8, Section 9.2 below gives recommendations on what actions will be required (of NARO) in order to implement the improved IRS. Additional recommendations for improving the information /library services in NARO in general are also given. These recommendations are being made for consideration by the management of NADIC and NARO.

9.2 RECOMMENDATIONS

9.2.1 Recommendations that are directly relevant to the proposed IRS

- (1) E-mail should be installed in all NARO institute libraries. Plans should also be made to extend E-mail connectivity to the Research Stations under NARO.
- (2) Trained professionals should be appointed to develop and manage databases.
- (3) Equipment and facilities should be provided for supporting indexing of information into databases.
- (4) The process of document collection /acquisition should be improved.
- (5) NARO should develop a mechanism for ensuring that scientists publish their research findings frequently.
- (6) Regulations should be formulated to ensure that each author submits his/her publication to NADIC.
- (7) Information products from home-grown databases such as directories should be produced and circulated regularly.

- (8) Librarians should be trained in basic Information technologies in order to furnish them with the skills needed for using the improved IRS.
- (9) The librarians should in turn, impart these skills to the users.
- (10) A courier service should be introduced in NARO for physical delivery to users, of original texts of publications that they request from NADIC.
- (11) The formation of an information committee, a body which has been proposed for harmonizing information standards and technologies (IT) in NARO should be expedited. The committee should be composed of information professionals, IT specialists and representatives of research scientists.
- (12) NADIC should be given full mandate and support for organizing and coordinating the proposed improved IRS.
- (13) Libraries should be set up at the new research institutes namely, FOSRI and EATRI (the latter is yet to be inaugurated) so that scientists at these institutes can have access to the databases at NADIC as well as share the benefits of the proposed IRS.
- (14) In the long run, the proposed information retrieval system could be made accessible for users in the rest of the agricultural sector and other related sectors.

9.2.1 Additional Recommendations

- (15) NARO institute libraries should be improved through restocking with current and relevant literature only. The development of huge library collections for

each institute is expensive and should be discouraged, instead rare and expensive publications could be kept in a central national agricultural library, preferably at NADIC, where they can be accessed by all users.

- (16) In order to make maximum use of the library facilities, interlibrary loan services should be introduced. Requests for interlibrary loans could be made through E-mail;
- (17) A reliable mechanism should be established for securing original copies of documents cited in CD-ROM databases, from foreign sources. The NARO Information committee should address this matter;
- (18) Computerization of library catalogues is recommended in order to overcome the problem of backlogs of unprocessed documents and delays in answering queries due to lack adequate library staff.
- (19) Although the computerization of NARO Institutes (in general) has been surveyed (O'Nolan 1995), there is need to conduct a fully fledged study of NARO libraries before undertaking major computerization projects.
- (20) Institutes should set up their own specialized databases e.g on livestock diseases, tree species, etc.
- (21) To avoid duplication of records, a policy should be set on what documents should be indexed by each library.
- (22) When the institute databases have grown to a reasonable size, bibserve facilities could be installed to enable users in searching the databases directly i.e without going through NADIC.
- (23) Additional trained staff will be needed to handle the work load in NARO libraries.

- (24) Since NADIC is a national node for the agricultural information system, it should establish and maintain linkages with national and international systems for exchange of information.
- (25) Realistic budgets should be provided for NARO libraries to cover all expenditures.

To sum up this study, I will quote Balson, et al (1989) who notes that "Information gains value when it is exchanged and consumed. To be exchanged and consumed, it must be transferred and delivered". With increasing recognition of the importance of information in agricultural development and development in general, there is urgent need for a timely, effective and efficient means of transferring and delivering scientific and technical information to scientists. This is true for Uganda. This study has attempted to answer this need.

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APPENDIX 1 (A) : USERS QUESTIONNAIRE

SURVEY OF THE INFORMATION NEEDS OF USERS OF THE LIBRARIES AND
DOCUMENTATION SERVICES IN THE NATIONAL AGRICULTURAL RESEARCH
ORGANIZATION IN UGANDA.

QUESTIONNAIRE

USERS NEEDS NO. []

Instructions for filling the questionnaire

1. Use the spaces provided to write your answer to the preceding question. You may use additional paper if the space is not enough.
2. For clarity, please print your answers and tick in the box [] where necessary. If the questions do not apply, indicate N/A for 'not applicable'.

PART 1 - IDENTIFICATION DATA

1. Surname/Other names _____ 2. Nationality _____
3. Date of Birth (optional) __/__/__ (Day/Month/Year).
4. Official Mailing Address (of the Institution to which you are affiliated) _____
Telephone (Office): _____ Fax: _____
Telex : _____ E-mail: _____
5. Designation/Rank : _____

6. ACADEMIC Qualifications: _____
Highest Degree/Diploma : _____
Subject (Major): _____ Subject (Minor) _____
7. Category of the work you are currently involved in the
Institution ☐ Research ☐ Consultancy ☐
Agricultural extension ☐
Others (Please specify) _____
8. If you are currently conducting research,
briefly specify what the research is about.

Part II - Use of Library/Documentation Centre

9. If your institute has a library, how often do you use
the library to search for information related to your
work?

☐ everyday ☐ Once a week ☐ 2-3 times a week
☐ Once a month ☐ 2-5 times a month ☐ Rarely
☐ Other(specify) _____
10. For what specific purpose do you use the facilities of
the library (Tick the applicable options)
☐ To look for special materials (indicate materials)

☐ Borrow books and journals for preparation of
research
☐ Borrow books and journals for preparation of

papers

- ☐ Consult journals in order to keep abreast with developments in your field
- ☐ Make reference inquiry
- ☐ Browse through journals and monographs
- ☐ Make literature searches from CD-ROM and home grown databases
- ☐ Read newspapers, magazines etc.
- ☐ Other (please specify) _____

11. If you do not use the library, please briefly explain why. _____
12. If you travel in order to have access to other libraries/information centre facilities, how far do you travel?
- ☐ 5 - 20 km ☐ 41 - 60 km ☐ above 100 km
- ☐ 21 - 40 km ☐ 61 - 100 km

Part III - Information Services

13. Does your Library provide you with any of the following services? (Tick one or more choices where appropriate)
- a) Current Awareness Services (Informing users in general of new publications received) through:
- ☐ Display or circulation of new items received;
 - ☐ Selective dissemination of Information (i.e giving specific information to individuals about new developments in their field of specialization;
 - ☐ Circulation of Contents Page;

- b) ☐ Searches of databases on CD-ROM;
- c) ☐ On-line searches of databases (interactive interrogation of databases containing bibliographic information or source data, held on host computer);
- d) ☐ Question and answer services (where one asks questions for specific required information);
- e) Reprographic Services:
- ☐ Photocopying/xeroxing documents
- ☐ Microfilm/fiche reproduction ☐ Photography
- ☐ Others (please specify) _____
14. How would you rate the services that your library provides in relation to your information needs?
- ☐ Excellent ☐ Good ☐ Average ☐ Poor
- ☐ Very poor.
15. If the answer to Question 14 is in your view, poor, what other sources of information do you use to meet your information requirements?
- _____
16. Please indicate briefly, the extent to which inadequate information facilities/sources hamper your work.
- _____
- _____
17. Please use the space below to describe your priority information requirements. ☐ Purely research (specify discipline(s)) _____
- ☐ Social economic/development information
- ☐ Agricultural production (specify) _____
- _____

☐ Other (specify) _____

18. Are you aware of the information services offered by the National Agricultural Documentation and Information Centre (NADIC)? ☐ Yes ☐ No

If YES, do you use the services available at NADIC?

☐ Yes ☐ No

19. If you request for information from NADIC, what information do you ask for?

☐ Bibliographic information from (database searches)

☐ Full text information on particular topics from books

☐ photocopies of journal/book articles

☐ Other (specify) _____

20. Are you satisfied with the information services provided by NADIC? ☐ Yes ☐ No

If NO, which of these categories of information would you wish to have more information? (Tick as appropriate)

☐ Scientific information from developing countries

☐ Scientific information from developed countries.

☐ National (local) information

☐ Other (specify) _____

21. If you request for information from databases, which databases do you prefer to search? (Choose one option).

☐ home grown databases (for national information)

☐ CD-ROM databases (for international information)

- ☐ Both CD-ROM and home-grown databases
22. How do you make use of information from database searches? ☐ Planning research activities
☐ Writing Theses/Papers
☐ Lecturing ☐ Agricultural advisory services
☐ Other (Specify) _____
23. Do you participate in making the database searches or does the library/documentation centre staff do it on your behalf? ☐ I do the search personally
☐ Participate in the search with the help of library staff ☐ Librarian/Documentalist does the search for me.
24. After searching the database, would you say that you find it easy to get the required (full text) information?
☐ Very easy ☐ Easy ☐ Fairly easy
☐ Difficult ☐ Very difficult
25. To what extent have the database services at NADIC been of use to you? ☐ Very useful ☐ Useful ☐ Fairly useful ☐ limited use ☐ No use

Part IV - PUBLICATIONS

26. What do you do with your research findings ie reports, Theses etc ☐ Deposit in the library
☐ Present at a seminar or conference

- ☐ Distribute to fellow researchers/colleagues
☐ Publish ☐ Other (specify) _____

PART V INFORMATION SOURCES

27. There are many ways of discovering information of interest, from the list below, please tick the ways you use.

- ☐ Accidental discovery of information
☐ Attendance at Conferences, Seminars, etc.
☐ Database searches
☐ Follow up references and footnotes
☐ Browsing through publications ☐
☐ Search Library Catalogues
☐ Communication with experts/fellow researchers
☐ Approach librarians for assistance
☐ Others (Please specify) _____

28. Indicate the sources of Information that you use (Please tick): ☐ Own collection of literature

- ☐ Scientific Journals
☐ Bibliographies, indexes and abstracts
☐ Books in Libraries
☐ Current awareness bulletins
☐ Govt./Private Institutions ☐ Use of magazines
/newspapers
☐ Conference proceedings/ Workshop/Seminar papers
☐ Technical reports ☐ Other Sources (specify)

29. Do you get the information you require in time?
☐ Yes ☐ No
30. If you get materials from other sources through your library/Documentation Centre, how long does it take?
☐ 1 - 7 days ☐ 8 - 15 days ☐ 1 month ☐ more than a month.
31. What type of information services do you prefer (Tick as appropriate).
- (a) ☐ Current titles (A regularly published list of documents currently received in the library).
- (b) ☐ Selective Dissemination of Information ie a (personal) Current awareness information service based on user interest / project file/
- (c) ☐ Research Management Information Services (Provide managers with information for decision making, planning evaluating performance of institution and individuals
- (d) ☐ Newspaper clipping Service (provides substantial coverage of events and information relevant to agriculture.
- (e) ☐ Reprographic Service
- (f) ☐ CD-ROM search services of Databases at NADIC
- (g) ☐ Searches from home-grown (national) databases at NADIC.
- (h) ☐ Other (specify) _____

Part VI - Use of Information Technologies.

32. Are you familiar with using computers? ☐ Yes ☐ No

33. Is your Institute on E- mail? ☐ Yes ☐ No
If NO, would you wish to have an E-mail facility
installed at your institute? ☐ Yes ☐ No

If Yes, briefly explain how the use of E-mail would
facilitate your work? _____

34. Are you familiar with the use of E-mail in data
communication? ☐ Yes ☐ No

35. If an E-mail facility was provided to your institute
library, would you use it to:

- ☐ Share research information with your colleagues
☐ Request for information from NADIC/Other libraries
☐ Communicate with scientists abroad
☐ Other (Please specify) _____

36. Do you think that the use of E-mail would contribute to
better performance of your duties? ☐ Yes ☐ No

Please mail this questionnaire to ;-

Jane Frances Kanyunyuzi-Asaba at any of the following
addresses:

- | | |
|----------------------------------|-------------------|
| 1. SISA, Addis Ababa University, | 2. P. O.Box 8914, |
| P. O. Box 1176, Addis Ababa, | Kampala, |
| Ethiopia, | Uganda. |

THANK YOU FOR SPARING YOUR TIME TO FILL IN THIS
QUESTIONNAIRE.

APPENDIX 1(B) : LIBRARIANS INFORMATION MANAGERS
QUESTIONNAIRE

SURVEY OF INFORMATION MANAGEMENT IN LIBRARIES/ DOCUMENTATION
CENTRES IN THE NATIONAL AGRICULTURAL RESEARCH ORGANIZATION
(NARO), UGANDA.

QUESTIONNAIRE

INF MANAGEMENT No. []

Instructions for filling in the questionnaire.

- 1) Use the spaces provided to write your answer to the following question. You may use additional paper if the space is not enough.
- 2) Please print your answers for clarity and tick in the box [] where necessary. If the question does not apply indicate 'not applicable'.

PART I - IDENTIFICATION DATA.

1. Name and position of person filling the questionnaire.
Surname/Other names _____ Position _____
2. Name of the Information System (Library, Documentation and Information Centre).

3. Objectives and subject coverage of the library.

4. Name of parent Institution or Department (Acronym or abbreviated name, if any).

5. Year of establishment _____
6. Address of
Institution _____

Telephone number _____ Fax Number _____
Telex number _____ E- mail address _____
7. Mandate of parent Institution _____

PART II - INFORMATION USERS.

8. Who are the users of your library/Documentation Centre?
[] Research Scientists [] Administrators.
[] Agricultural Extension workers. [] Industrialists.
[] Students [] Lecturers [] Others(specify) _____
9. List in descending order of use of the library, the different categories of users

PART III - INFORMATION SOURCES.

10. What are the sources of information for your library/documentation centre (indicate with a tick).
[] Gifts [] Inter-library loans (National/International)
[] Exchange with other libraries [] Free subscription
[] Direct subscription to publishers
[] Other (specify) _____

PART IV - INFORMATION SERVICES

11. Type of information/ documentation services offered.
[] Reprographic services [] Literature searches from local databases [] Literature searches from CD-ROM databases
[] Current Awareness Services [] Selective dissemination of information [] Reference services [] Referral services.
[] Newspaper clipping services [] Question and Answer services [] Other (specify) _____
12. Indicate the size of the library document collection in the table below.

Type of Document	Number added in			
	1991	1992	1993	1994
a. Books				
b. Periodicals				
c. Reprints				
d. Research & Technical reports				

Library collection continued:

Type of Document	1991	1992	1993	1994
e. Maps				
f. Microfiche/microforms				
g. Patents				
h. Standards				
i. Govt. Publications				
j. UN Publications				
k. FAO Publications				
l. NGO Publications				
m. IGO Publications				
n. National Publications				
- Books/Monographs				
- Periodicals				
o. Others (Specify)				

PART V - INFORMATION PROCESSING TOOLS USED

13. Classification scheme used

- ☐ Library of congress ☐ Dewey Decimal
classification.
☐ Colon Classification. ☐ Others _____
(specify)

14. Vocabulary control device used

- ☐ Library of congress ☐ AGRIS/CARIS Categorization
☐ Sears list.
☐ Thesaurus (specify name) _____
☐ Other (Please specify) _____

15. Method of indexing.

- ☐ Subject ☐ Title ☐ Author ☐
Other(specify) _____

PART VI - STAFFING

16. Do you have adequate staff in your library?

- ☐ Yes ☐ No

If No, indicate the reasons why and how you are
addressing this problem.

17. Indicate the size, qualifications and responsibilities of the professional staff ie those required (R) and those available (A), in the table on the next page.

Category of professional staff	Number available	Number required	Qualifications	Responsibilities
a. Librarians				
b. Documentalists				
c. Information Scientists				
d. Systems Analysts /Programmers				
e. Data entry clerks				
f. Others (Specify)				

Total Number				

PART VII : INFORMATION AND COMMUNICATION TECHNOLOGY.

18. Does your institute have any computer facilities?

[] Yes [] No

19. If YES, where are the computer facilities located?

[] Within the library/Documentation/Information Centre and used exclusively for library work.

[] Within other departments in the parent institution and can be shared with another Department

[] Within other departments in the parent institution and cannot be used

[] Other (specify) _____

20. For what purpose are the computer facilities being used?

[] Bibliographic/library data base management.

[] Word processing

[] On-line search services

[] Financial Services eg Payroll, budgeting, etc)

☐ CD-ROM Searches

☐ Others (Please specify) _____

21. Has your library benefited from using computers?

☐ Yes ☐ No

If YES, how has it benefited?

☐ Increased timeliness ☐ Increased Accuracy

☐ More services rendered ☐ More users

22. Have you or any of your library staff received any training in library application software? If YES, indicate below the names of staff and nature of training received.

Number of trained staff

Type of training.

(a).

(b).

(c).

(d).

(e).

23. Indicate which additional training you require.

24. Is your Institution/library on E- mail?

☐ Yes ☐ No

If YES, go to number 25, If NO, go to number 28

If YES, what is the E- mail used for?

25. Which institutions are you communicating with?

26. Has the use of E-mail benefited your institution/library
in any way?
☐ Yes ☐ No :

27. Indicate the ways in which the E-mail facility has
facilitated/ complemented your services.
☐ Better communication within the country
☐ Better communication outside the country
☐ Improved rendering of information services to
clients
☐ Other (specify) _____

28. Do you have plans to instal an E- mail facility at your
Institution/library? ☐ Yes ☐ No

29. Do you think that use of E- mail to connect your
institute to other institutes would facilitate in
dissemination and sharing of information?
☐ Yes ☐ No

30. If E- mail facilities are provided, what services would you like to provide to the users.

☐ SDI ☐ Database Search

☐ Communicating with professionals in the field

☐ Document delivery ☐ Other (specify) _____

31. Indicate which institutions you would wish to share information with, if you were on E - mail

☐ Research Institutions with Uganda

☐ International Agricultural Research Institutions

☐ Libraries in Government Departments.

☐ Libraries in NGO's and International Institutions
represented in Uganda

☐ Academic Institutions/ Universities

☐ Other(specify) _____

32. What other information/communication facilities are available in your library or in the parent institution that the library can make use of? (Tick as appropriate)

☐ Microfiche readers ☐ Laser Printers ☐ Dot-

matrix Printers ☐ CD-ROM drives ☐ Scanner

☐ Stabilizer

☐ Generator ☐ Ininterrupted Power Supply (UPS)

☐ Telephone line ☐ Fax Machine ☐ Telex

☐ Radio ☐ Modem ☐ Other(Specify) _____

PART VIII - DATABASES

33. Describe the home-grown and CD-ROM databases in use in the library documentation centre (if any) in the table below.

Name of Database	Years covered	Subject Scope	Searches /month	Number of records	Remarks
CD-ROM Databases					
Home-grown Databases					

34. What is the common format in which you present information to the users?

- [] - Full text original document
- [] - Abstract of original document
- [] - Bibliographic citations from databases
- [] - Bibliographic citation from databases
- [] - Other (Specify) _____

35. How would you rate the methods that your library/documentation centre is using to disseminate information to the users in terms of effectiveness and efficiency?

(a) effectiveness.

[] Excellent

[] Good

[] Fair

[] Poor

(b) efficiency

[] Excellent

[] Good

[] Fair

[] Poor

Please give reasons for:

c) ineffectiveness _____

d) inefficiency _____

36. Do your information services reach all users? [] Yes
[] No

If YES, how do you ensure that your services reach the users in the remote areas?

37. What problems do you face when providing information services to the users? _____

38. How would you propose to alleviate these problems? _____

PART IX - PUBLICATIONS

39. What are the principle publications produced by your institute/library? (Please fill in the table below and tick).

<u>Publication</u>	<u>Frequency</u>	<u>Distribution</u>
Research Reports		
Annual Reports		
Newsletters /Journals		
Accessions List		

(Principal Publications continued)

Directories

Bibliographies

Other (Specify) _____

PART X - CO-OPERATION/NETWORKING

40. Does your library/information centre participate in any of the following activities.
- ☐ Exchange of Accession lists. ☐ Interlibrary loans
 - ☐ Exchange of bibliographies
 - ☐ Production of Union lists
 - ☐ Circulation of pages of contents
 - ☐ Electronic Networking
 - ☐ Other forms of resource sharing (specify)
-
41. Give examples of the type of institutions with which you share information and the kind of information exchanged/shared?
-
42. If your library does not participate in a network, would you wish this to happen? ☐ Yes ☐ No
43. What type of cooperation would you prefer?
- ☐ Sharing information from databases at NADIC / Research Institutes
 - ☐ Exchange of research publications
 - ☐ Union Catalogues
 - ☐ Selective Dissemination of Information
 - ☐ Interlibrary loans services
 - ☐ Exchange of bibliographies ☐ Other (Specify)
-

Please mail this questionnaire to:

Jane Frances Kanyunyuzi-Asaba, at any of the addresses below:

1. School of Information 2. P.O. Box 8914,
P.O.Box 1176, Addis Ababa, Kampala, Uganda.
Ethiopia.
3. National Agricultural Documentation and Information
Centre (NADIC), P.O.Box 11098, Kampala, Uganda.

THANK YOU FOR SPARING YOUR TIME TO FILL THIS QUESTIONNAIRE.

APPENDIX 2(A) : GUIDING QUESTIONS FOR THE INTERVIEWS WITH
THE RESEARCH GROUP OF INTERVIEWEES

INTERVIEW QUESTIONS FOR THE HEAD, PUBLICATIONS, INFORMATION
TECHNOLOGY AND ELECTRONIC COMMUNICATION, NARO SECRETARIAT,
ENTEBBE, UGANDA

1. From your designation, I imagine that NARO is well sensitized on IT matters, what is NARO's stand as regards the use of IT?
2. What information technologies are currently being used in NARO?
3. In your opinion, are these technologies appropriate?
4. What is the current situation as regards use of computers in NARO institutes?
6. I am aware that most NARO libraries do not use computers, are there any plans for computerizing NARO libraries?
7. How is electronic communication being embraced by NARO?
8. I understand there are plans to establish electronic connectivity among NARO institutes.
 - (a) What is the purpose of this network?
 - (b) How soon will these plans be executed?
 - (c) Do these plans involve the remote NARO institutes such as SAARI and LIRI?
 - (d) Apart from NARO research Institutes, what other institutions will be involved in this connectivity?
9. What are the envisaged benefits of this connectivity?
10. Has NARO experienced any problems in the use of IT? If

so, how have these problems been solved?

11. What in your opinion is the future of Electronic communication in NARO?

Thank you very much for participating in this interview.

INTERVIEW QUESTIONS FOR SELECTED DIRECTORS OF RESEARCH IN
NARO RESEARCH INSTITUTES

(Note: These interviews were conducted to validate the information obtained through the users and Information managers/librarian's questionnaire(s)).

1. What is the position of the library vis a vis other programs/departments in your institute?
2. In your opinion, has the library been of any use to the research scientists?
3. What are the priority information needs of the research scientists? Are these needs currently satisfied?
4. How do you rate the services provided by the library?
5. If these services are not satisfactory, what could be the cause of this situation and how do you think it could be rectified?
6. Do you think the use of IT such as computers and E-mail is appropriate for the operations of your library?
If so, would you support efforts to have the library computerized?
7. Do you have any other suggestions that you may wish to give for improving the library/information services at your institute?

Thank you for sparing your time to answer these questions.

APPENDIX 2(B) : GUIDING QUESTIONS FOR THE INTERVIEWS
WITH THE INFORMATION TECHNOLOGY GROUP OF
INTERVIEWEES

INTERVIEW WITH THE HEAD OF THE INSTITUTE OF COMPUTER SCIENCE
MAKERERE UNIVERSITY

Interview Questions

1. When was this Institute established?
2. When were computers introduced in Uganda? Who were the first people to use them?
3. When did Makerere start using computers?
4. In your opinion, have computers been useful? What model of computers is popular in Uganda?
5. What role has your Institute played in the promoting the use of computers and other technologies?
6. What role have other private computer Schools played?
7. What are the future plans of the Institute of Computer Science?
8. Who are the major users of computers in Uganda?
How has the servicing/repairs of computers been done?
9. What in your opinion, is the future of computing in Uganda?
10. Do you have any other developments on the use of computers or IT in Uganda, in general, that you would wish to talk about?

Thank you for sparing your precious time to answer these questions.

INTERVIEW QUESTIONS FOR OFFICIALS OF THE UGANDA POSTS AND
TELECOMMUNICATIONS CORPORATION (UPTC).

[Two officials interviewed were: The Executive Engineer/Quality Management; and The Chief/Computer Section]

1. When was the Uganda Posts and Telecommunications Corporation established?
2. What is the role of the Uganda Posts and Telecommunications in National Development?
3. What are the basic services offered by UPTC?
Does UPTC offer facilities for data communication?
Is the demand for data communication facilities high?
4. What is the state of the telecommunications network in the country? I understand that UPTC has plans to improve the network, can you say something about these plans?
5. Does UPTC sell any data communication equipment to users?
6. What other plans does UPTC have for developing the telecommunication services?
7. Currently, we see several private telecommunication service providers in the country, how does UPTC relate with these people?
8. Are there any major changes that have taken place in the telecommunication services in the past few years that you may wish to talk about?
9. In light of the current developments in IT such as the advent of the Internet, what is the future of telecommunications services offered by UPTC?

Thank you for sparing your time to answer these questions.

INTERVIEW QUESTIONS FOR THE NETWORK MANAGER, MUKLA FIDONET
NODE.

1. When was this Network established?
2. What have been the major developments in the growth of the Mukla network since its establishment?
3. What role has the network played since it was set up?
4. Who are the biggest users of Mukla?
5. Do you think that electronic networks like this one, have a future in this country?
6. What problems have you experienced in managing the network? Has it been easy to solve these problems?
7. With the advent of Internet providers in Uganda, what is the future of the Mukla Network?

Thank you for sparing your time to answer these questions

INTERVIEW QUESTIONS FOR THE DIRECTOR, POLYTECHNIC OF
INFORMATION TECHNOLOGY, KAMPALA, UGANDA

1. When was this School established?
2. What was the objective in establishing this School?
3. Who participates in your courses?
4. What awards do you give? Are these awards recognized by the government?
5. How has your Institute contributed to the spread of IT in Uganda?
6. What is your relationship with other Computer training Schools in Uganda?
7. Do you think that institutions/Schools like yours' are contributing to computer literacy in Uganda? How is this contribution benefitting the country?
8. Do you think that IT and in particular computing has a future in Uganda?

Thank very much for sparing your time to answer these questions.

INTERVIEW QUESTIONS FOR THE INTERNET SERVICE PROVIDERS IN
UGANDA

1. When did you setup this hub/business? Do you think that this is a viable business in this country?
2. What are the objectives of your business?
3. What services do you offer?
4. What are the costs of your services?
5. What has been the reaction\attitude of the Ugandan society towards electronic communication, so far?
6. Do you have a large clientell?
7. What is your relationship with other internet providers?
8. What problems are you eperiencing in the execution of your work?
9. What are the benefits (anticipated or otherwise) of using Email?
10. What are your future plans?

APPENDIX 3 (A) : LIST OF PEOPLE INTERVIEWED:

RESEARCH AND IT GROUPS (COMBINED).

1. Adupa, Joyce (Mrs)
Senior Documentation Officer,
National Agricultural Documentation and Information
Centre,
P.O.Box 11098,
Kampala,
Uganda.
Tel:+256-41-567622, E-mail: NADIC@Mukla.gn.apc.org
2. Bugenyi, F.W.B. (Dr.)
Director,
Fisheries Research Institute,
P.O.Box 343,
Jinja,
Uganda.
Tel:+ 256-043-22071 /21990/20484, Fax:+256-043-21727
E-mail: JBalirwa@Mukla.gn.apc.org
3. Galiwango-Kityo (Mr),
Director,
Makerere Institute of Computer Science,
Makerere University,
P.O.Box 7062,
Kampala,
Uganda.
Tel:+256-41-540648
4. Lwanga, Esther, (Ms)
Head/Principal Librarian,
National Agricultural Documentation and Information
Centre,
P.O.Box 11098,
Kampala,
Uganda.
Tel:+256-41-567622, E-mail: NADIC@Mukla.gn.apc.org
5. Mulira, Ham (Dr)
Chairman/Registrar,
Polytechnic of Information Technology,
Fountain House, Suite 6, Plot 55,
Nkurumah Road,
P.O. Box 10680,
Kampala,
Uganda.
Tel: +256-41-242238, E-mail PIT@Mukla.gn.apc.org

6. Nkuuhe, Johnson. (Dr)
Officer in-charge of Information Technology,
Publications and Electronic communication /NARO
Secretariat,
NARO Secretariat,
P.O. Box 295,
Entebbe,
Uganda.
Tel :+256-42-202341/20322 Ext 156,
E-mail:NARO@Mukla.gn.apc.org
7. Owor, Robert Steven (Mr)
Chief/Computer Operations,
Uganda Posts and Telecommunications Corporation,
P.O.Box 7149,
Kampala,
Uganda
Tel +256-41-256424;
E-mail: Steven_Owor@Mukla.gn.apc.org
8. Sentongo, J. (Dr.)
Director,
Livestock Research Institute,
P.O.Box 92,
Tororo,
Uganda.
Tel:
9. Wajenga, Charles(Mr)
Engineer,
Celtel (U) Limited,
Tel. +256-41-258270/1/2
10. Wambuzi Kavuma, Miriam. (Mrs)
Principle Executive Engineer/Quality Management,
Uganda Posts and Telecommunications Corporation,
P.O.Box 7171,
Kampala,
Uganda.
Tel:+256-41-246496/ 250999
Fax:+256-41-231110

APPENDIX 3(B) : LIST OF E-MAIL/ INTERNET SERVICE PROVIDERS (IP) IN UGANDA WHO WERE VISITED TO FAMILIARIZE WITH THEIR BUSINESS ACTIVITIES.

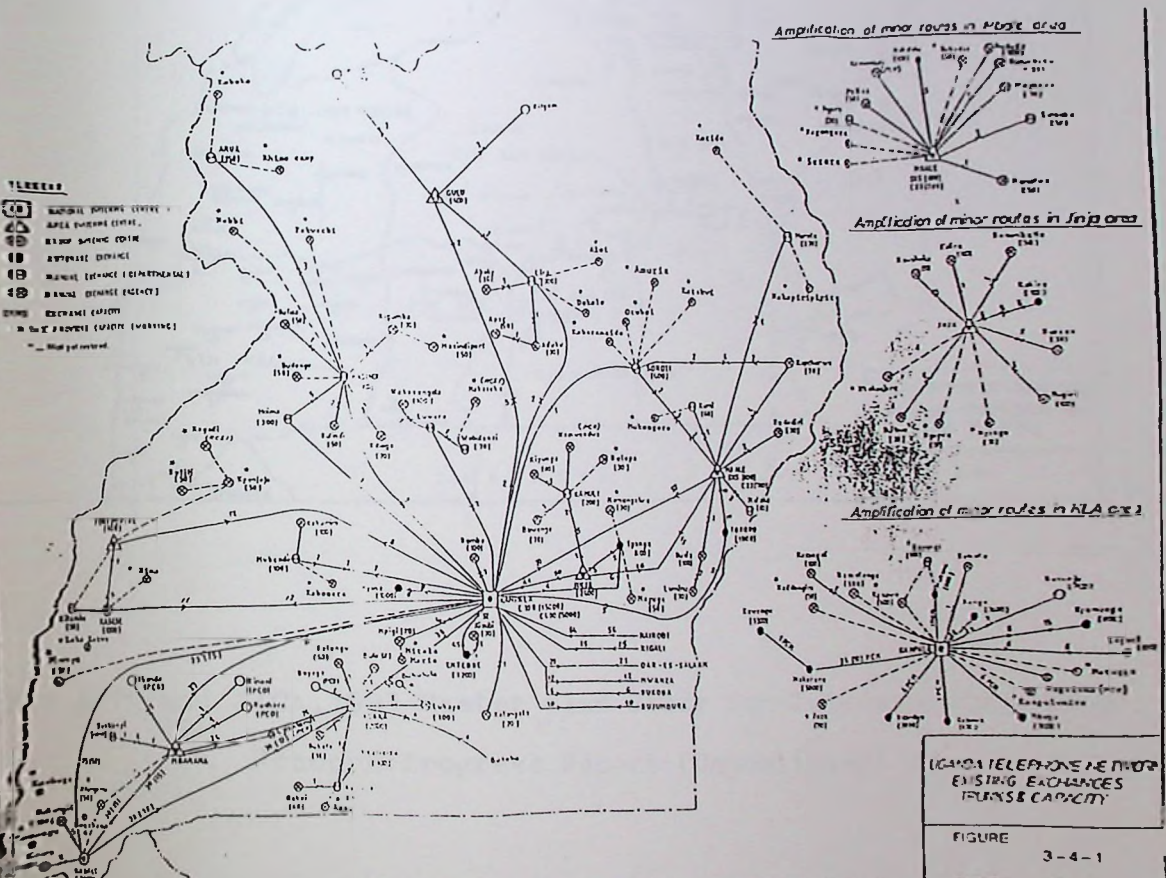
1. InfomaNET
Fourth Floor Impala House,
P.O.Box 8945,
Kampala.
Tel:+256-41-243958, E-mail: Xtina@Infoma.com
Contact: Chritine Nantongo
2. Informail (U) Limited.,
Plot 2, Clement Hill Road.
P.o.Box 11465,
Kampala,
Uganda.
Tel:+256-42-258361, E-mail: Info@imull.com
Contact: Mr M.M. Otyek, Manager
3. Mukla Institute of Computer Science,
Makerere University,
P.O.Box 7062,
Kampala,
Uganda.
Tel:+256-41-540628, E-mail Info@Mukla.gn.apc.org
Contact: Charles Musisi, Network Manager
4. Starlight Communication (U) Ltd (STARCOM)
Sheraton Complex, 14th Floor, Ternan Ave.,
P.O.Box 10524,
Kampala,
Uganda.
Tel:+256-41-245071/3/5, Fax:+256-41-245708
E-mail:Staff@starcom.co.ug
Contact: Kiggundu Mukasa, Internet Manager
5. Transmail Ltd,
Blacklines House, Suite 24B,
P.O.Box 7482,
Kampala,
Uganda.
Tel:+256-41-254777, E-mail: Pmawanda@tmail.gn.apc.org
Contact: Patrick Mawanda, Manager

APPENDIX 4 : THE CURRENT CONNECTIVITY SITUATION IN AFRICA

Country	Fido	Healthnet	SLIP	UUCP	Corp. IP	Comm. IP
Algeria	X	X	X			
Angola	X					
Botswana	X	X	X			
Burkina Faso			X			
Cameroon	X	X	X			
Chad	X	X				
Congo				X		
Cote D' Ivore	X			X	X	
Egypt	X					
Eritrea	X	X				
Ethiopia	X	X				
Gambia	X	X				
Ghana	X	X				X
Guinea				X	X	
Kenya	X	X			X	
Lesotho	X			X		
Madagascar	X				X	
Malawi	X	X				
Mali	X	X		X		
Mauritius	X			X		
Morocco	X				X	
Mozambique	X	X		X	X	
Namibia	X			X	X	
Niger				X		
Nigeria	X			X		
Senegal	X			X	X	
Seychelles				X		
S.Africa	X			X	X	X
Sudan		X				
Swaziland				X		
Tanzania	X	X				
Togo				X		
Tunisia	X				X	
Uganda	X	X				X
Zambia	X	X				X
Zimbabwe	X	X		X	X	

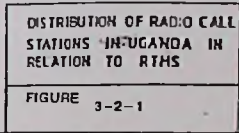
Source : Lishan Adam, "Electronic Communications Technology and Development in Africa", in FID News Bulletin, 45(10), 1995.

APPENDIX 5 : THE UGANDA TELEPHONE NETWORK : EXISTING EXCHANGE AND TRUNK CAPACITY



UPTC and JICA. 1993 Master plan study for Telecommunication
Network; progress Report.(Unpublished)

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APPENDIX 7 : USAGE CHARGES OF VARIOUS INTERNET SERVICE PROVIDERS IN UGANDA (AS OF JANUARY 1996).

Starlight Communications (U) Ltd (StarCom)

E-mail only (unlimited usage)	US\$ 30
Shell Account	US\$ 50
SLIP/PPP Account	US\$ 100
Full IP	Negotiable

The Infomail (U) Limited

Usage charges are:

	Monthly	Duration	Setup	Overtime
Basic	US\$ 50	3 hours	US\$ 50	US\$ 20
Premium	US\$ 120	8 hours	US\$ 50	US\$ 20
Big Corporate	US\$ 250	20 hours	US\$ 120	US\$ 15
Very big Corporate	US\$ 500	50 hours	US\$ 120	US\$ 10

Infoma (U) Limited (InfomaNET)

	<u>Quick start plan:</u>	<u>Power user plan</u>
Setup	US\$ 30	US \$ 50
E-mail sending (per page)	US\$ 1.2	US\$ 1.00
E-mail receiving (per page)	US\$ 0.70	US\$ 0.40
Fax sending (per page)	US\$ 2.95	US\$ 1.95
Subscription	—	US\$ 15
Security deposit	—	US\$ 50

Transmail Ltd

Transmail Ltd

Usage charges:

Traffic not exceeding 420 KB	US\$ 50/month
Traffic not exceeding 910 KB	US\$ 100/month

Note:

These charges exclude telephone charges, which the users have to pay for separately. There are also restrictions on the volume of data transferred, these restrictions vary from company to company, however details on this matter could not be obtained at the time of the study.

Source:

Musisi, C. 1996. The Evolution of a home-grown Network.

APPENDIX 8 (A) : SAMPLE OF A USERS' PROFILE (FROM THE
SDI DATABASE)

Name of User	:	Odogola. W.
Name of Institution	:	Kawanda Agricultural Research Institute.
Postal Address/Tel. No.	:	P.O.Box 7065, Kampala, Uganda. Tel. +26-41-567708
E-mail Address	:	5:732/1.432
Search expression	:	Farm Mechanization AGRIN Farm mechanization; Farm Power; Postharvest Technology
Filled by	:	Jane Asaba
Date	:	21/5/96
Date of next update	:	21/8/96
Updated by	:	
Date of update	:	

APPENDIX 8(B) : DISPLAY FORMAT OF THE SDI DATABASE

Base Name: SDI

Format name: SDI

MFN(4)/"Name of User : ",c30,v1^a,v1^b,v1^c/"Name of Institution : ",c30,v2(0)/"Address : ",c30,v3^b,v3^c,v3^e/"E-mail Address : ",c30,v4/"Search expres
sion : ",c30,v10(30,29)/

APPENDIX 8(D) : AN EXAMPLE OF A SEARCH OUTPUT FROM
THE CARIN DATABASE

Affiliation..... : Kawanda Agricultural Research Institute

Type of research..... : F

Record 2

00013 ---

Local Record Number.. : UG8900013 Status..... : T
 Project Code..... : UG0301050013
 Starting Date..... : 198908 Duration..... : 08
 Termination Date..... : 199009
 Exchange Language.... : En

Date of Information.. : 198911
 Title..... : An analytical framework of Uganda food
 and Agricultural

Objectives..... : To establish a policy framework for
 assessing
 agricultural policy objectives and
 government policy
 instruments and develop a consultative
 global selective
 strategy to allow Uganda government to
 produce basic
 policy options for future agricultural
 sector and
 economic development

Category(Primary).... : E10 Category(Secondary).. :
 E14

AGROVOC Descriptors.. : /FOOD POLICIES/ /AGRICULTURAL POLICIES/
 /UGANDA/
 /ECONOMETRIC GROWTH/

Institution Name..... : Makerere University. Faculty of
 Agriculture and
 Forestry. Department of Agricultural

Economics

Institution Address.. : PO Box 7062, KAMPALA (Uganda)
 Research Leader..... : Vanegas, M. ; Birth : '42; Nation. : NI
 Speciality..... : /AGRICULTURAL POLICIES/
 Co-worker 1..... : Mbowa, S. ; Birth : '64; Nation. : UG
 Speciality..... : /ECONOMICS/
 Co-worker 2..... : Kiiza, B. ; Birth : '65; Nation. : UG
 Speciality..... : /MARKETING/
 Co-worker 3..... : Bahligwa, G. ; Nation. : UG
 Speciality..... : /PRICES/

Source of funds..... : USAID

Type of research..... : F

APPENDIX 8 (E) : FIELD SELECT TABLE (FST) OF THE AGRIN
DATABASE

Name: AGRIN FST for Inverted File FST name: AGRIN

UT | Data extraction format

0 v2
0 v8
1 (v9/)
2 mp1,v1100
0 v1110
2 mp1,v1110
4 mhl,v1200
2 mp1,v2100
0 v2110
2 mp1,v2110
4 mhl,v2200
4 mhl,v4230
2 mpu,v5800,v5801
2 mpu,v5820
0 v7400
0 'ALL'

UT (after)	B - Insert (before)	C - Change line	D - Delete line
ious page	N - Next page	T - Top	E - Bottom
		X - Exit	J - Next line

APPENDIX 8 (F) : FIELD SELECT TABLE (FST) OF THE CARIN
DATABASE

Name: CARIN FST for Inverted File FST name: CARIN

T |Data extraction format

- 0 V01
- 0 V02
- 0 V03
- 0 V20
- 3 MPL,V25
- 3 MPL,V26
- 3 MPL,V27
- 0 V40~*
- 3 MPL,V41
- 0 V42~*
- 3 MPL,V43
- 0 V44~*
- 3 MPL,V45
- 0 V46~*
- 3 MPL,V47
- 0 V48~*

l (after)	B - Insert (before)	C - Change line	D - Delete line
ious page	N - Next page	T - Top	E - Bottom
		X - Exit	J - Next line

APPENDIX 8 (G) : WORKSHEET OF THE AGRORG DATABASE

IT: Replace

*** AGRORG Worksheet ***

Name of Organization : _____

Location : _____

Address : _____

Head of Organization : _____

Parent Organization : _____

Objectives : _____

Functions : _____

- Modify	R - Right just	S - Shift	D - Delete	C - Center
- Add field	<TAB> - Previous	J - Next	X - Exit	

AGROR / 1

APPENDIX 8 (H) : WORKSHEET OF THE AGREXP DATABASE

AGREXP Editing Worksheet

of Expert	:			
er	:			
of Birth	:			
ial Status	:			
ionality	:			
act Address	:			
	:			
ifications	:			
ject(s) of Specialization	:			
age competence	:			
olify	R - Right just	S - Shift	D - Delete	C - Center
id field	<TAB> - Previous	J - Next	X - Exit	
AGREX / 1				

APPENDIX 8(1) : FIELD SELECT TABLE (FST) OF THE
AGREXP DATABASE

Name: AGREXP FST for Inverted File FST name: AGREXP

IT Data extraction format

0 v1
 1 v7
 0 v9
 1 v10
 1 v11

ent (after)	B - Insert (before)	C - Change line	D - Delete line
vious page	N - Next page	T - Top	E - Bottom
		X - Exit	J - Next line

APPENDIX 8(J) : FIELD SELECT TABLE (FST) OF THE
AGRORG DATABASE

Base Name: AGRORG FST for Inverted File FST name: AGRORG

ID	IT	Data extraction format
----	----	------------------------

11	1	v11
12	4	v12
15	3	v15
16	2	v16
18	1	v18
19	0	v19

- Insert (after)	B - Insert (before)	C - Change line	D - Delete line
- Previous page	N - Next page	T - Top	E - Bottom
		X - Exit	J - Next line