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CGNET

Telematics International

CGNET

A DATA TRANSFER NETWORK FOR THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

Final Report

Submitted to:

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and

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IMPORTANT NOTE: Telematics International is contractually obligated to keep all information collected for the CGIAR studies confidential.

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EXECUTIVE SUMMARY

In 1983, the Consultative Group on International Agricultural Research (CGIAR) and the International Development Research Centre (IDRC) commissioned three studies: (1) the Data Transfer Network Study (DTNS), to investigate alternative approaches for improving the communication among CG Centers and their two Secretariats, (2) a pilot project on the usage of a computer-based message system (referred to as the CBMS pilot), and (3) a study to improve CG communication beyond the 15 CG sites (referred to as the extended network study). CGNET, the CG Center network, was the result of these studies.

In a world where food production is just barely keeping pace with the ever increasing demand for food, agricultural technology could very well be a key to survival. These studies were based on the belief that communication and communication technology will be a major tool for the agricultural scientist in this effort. The difficult task faced by the scientists of the CGIAR system demands increased effectiveness of the scientific system itself in form of a rapid and reliable system-wide information exchange.

Chapter 1: Introduction, explains the purpose, background and key issues for enhancing and expanding the communication capabilities for the CG community.

Chapter 2: Analysis of the Present Mode of Operation (PMO) and Technical Alternatives, looks at the current situation and the various possibilities available to the Centers. The PMO was examined from many angles, including types of computer and communication equipment, staffing, and information needs. We found, for example, that some $ 2 million are spent yearly to make 21,600 international telephone calls, send 61,560 telexes and 30,720 telegrams, and post almost a million letters and documents.

The second major effort of Chapter 2 was to identify the means by which the different CG Centers can gain access to a host of Value-Added Network (VAN) services. VANs can be thought of as data networks with special network features. We explored access via international gateways, which, as the name implies, serve as access points for a particular country to the VANs. (Nine of the Centers were able to access international VAN services through gateways or via domestic VAN interconnections.)

To provide VAN access to the remaining Centers, we looked at alternative methods. These involved the use of (1) the worldwide telephone network, i.e., the Public Switched Telephone Network (PSTN); (2) the Centers' telex facility as an interface to the VAN, and (3) a "relay" computer (in a location with VAN access) to transfer messages from the VAN to the Centers' computer via the PSTN (and vice versa).

Also examined were the major services which will prove beneficial to the CG Centers. Electronic messaging was considered in particular, including computer-based message systems (CBMS), CBMS-telex interworking, and CBMS-physical delivery. We also provided information on computer conferencing, electronic bulletin boards, electronic publishing, and a host of information services.

Chapter 2 concluded with an analysis of the various system access devices, and a description of the different methods which a Center may use for internal control of the communication media.

Chapter 3: The Extended CG Data Transfer Network, discusses the impact on CGNET of: potential traffic from Center remote facilities, organizations involved with the CGIAR, and countries with a high CG communication traffic volume. From our initial site visits we had learned that the majority of information sent from any given Center was directed to individuals and organizations outside the CG's 15 major sites. The somewhat unexpected volume of this "traffic" meant that we needed to broaden our project to include this larger, or "extended" community. The chapter focuses on how to obtain VAN access for the various members of the "extended community."

Chapter 4: The CG Pilot and CBMS Evaluation, describes the CBMS pilot project and its results. The original intent of the project was to provide CBMS services to seven sites: the TAC and CG Secretariats, CIMMYT, IBPGR, IFPRI, IRRI, and ISNAR. During the course of the study, however, we were able to add CIP and CIAT and several Center remote sites. By the conclusion of the project, we had interconnected 9 (10, if we include ICRISAT, where access is in a testing stage) of the 15 CG sites. We also worked with a number of Centers to add sites in Thailand, Portugal, Costa Rica, Chile, Brazil, Panama, France, Germany, Canada, and the United States.

We attempted to establish methods for extending the CBMS pilot network to Centers located in areas where data network access is not possible. Most of our efforts focused on a proof-of-concept test with ICRISAT, where we are testing the relay computer. At this writing, we have logged on to ICRISAT's VAX 780, and have successfully transferred messages to and from ICRISAT. Even though there are still some technical problems, the concept of a "relay computer" seems to be working.

At the conclusion of the pilot project, we conducted an informal survey of CBMS users to which all of the participating Centers responded. Chapter 4 describes this survey and its results. Our observations and conclusions for the pilot project are summarized in the last section of the chapter.

Chapter 5: Cost Model, presents the "bottom line" in terms of what the CGIAR can expect to pay for a network interconnecting all 15 sites, and the cost savings expected to occur as a result of the reduction in telex, telegraph, telephone, letter and courier traffic. It was desirable from a decision making and planning viewpoint, to have some basis for understanding the cost impact of the CGNET. This chapter is devoted exclusively to the presentation of a cost model for the network (with a 7-year time frame, from 1984 to 1990). We present three scenarios (all based on the same model) for cost analysis: (1) Pessimistic Case, (2) Minimum Expected Case, and (3) Optimistic Case. The basis for varying the three cases is related to two primary variables (1) the growth in expenditures for the PMO and (2) the potential impact of the CBMS.

The Pessimistic Case model indicated that for this time period the CGNET implementation could be expected to save about $ 1 million for the CG system, the Minimum Expected Case would save $ 3.3 million, and the Optimistic Case would save the CGIAR about $ 5.7 million.

Chapter 6: Recommendations and Phased Action Plan, again looked at the "bottom line" but from the point of view of what had to be done to make the CGNET operational. Our recommendations included how all 15 sites could participate in the CGNET and culminated in an action plan, an abbreviated version of which follows:

1. Make CGNET Operational. Operation needs to become routine with standard operating procedures and billing to Centers. An outside contractor with no vested interest in a particular CBMS product, should be retained for directory updating, problem solving, facilitation, and billing to Centers.

2. Inform Potentially Interested CGNET Participants. An invitation for their participation on CGNET needs to be generated along with descriptive materials outlining how they may join the network.

3. Establish CGNET Access to Off-Net Centers. This implies continuation of the ICRISAT relay pilot, providing telex gateway and IDD access information to off-net Centers, tracking changes in international gateway access capabilities, and developing and piloting inbound telex access to CGNET distribution lists.

4. Implement Additional VAN Services and Applications. Telex, telegram, lettergram re-filing, and physical delivery should be explored and implemented immediately. Also, CGNET participants need to pilot and implement computer conferencing and electronic bulletin boards. Applications for the piloting of these services need to be identified and encouraged. Centers should be made aware of the variety of VAN services available to them, e.g., on-line databases, newswire services, electronic publishing, etc.

CGNET will place the CGIAR at the forefront of organizations utilizing advanced computer-based communication technologies. The system will improve all types of communication, and will immediately provide substantial cost savings. By isolating improved communication as an important CGIAR-wide objective, a solution has been identified which will clearly advance the common objective--which is, of course, improvement in the quality of human life.

FOREWORD

CGNET is the acronym we chose to represent the culmination of a cooperative research effort which was begun in 1983, originally as a "Data Transfer Network Feasibility Study" (DTNS). The CGNET's "feasibility" is no longer a research question, it is a reality. Today, 9 of the 15 CG primary sites enjoy virtually the same enhanced communication or Value-Added Network (VAN) services, they would have, had they been located in the most technologically advanced nations.

This report is a synthesis of three separately funded projects: The Data Transfer Network Feasibility Study, The CG Computer-Based Message System (CBMS) Pilot Project and, The Extended Network Study. The reporting requirements of the three projects have been addressed in this document. A preliminary draft was distributed by the CG Secretariat to all Centers in August 1984, where it was reviewed by technical and administrative staff. Reactions and suggestions regarding the draft version have been taken into account in this final report.

Four themes appeared consistently throughout the review comments: (1) the report was too voluminous and therefore hard to read; (2) the treatment of technical approaches to the interconnection of Centers, which currently have no means of access to the CBMS service, was not detailed enough; (3) more specific cost analyses were desirable, especially those which could aid the Centers in their decisions regarding equipment and software acquisitions; and (4) a detailed phased action plan was needed to guide the CGIAR in its next stages of data transfer network planning and use.

Responding to the first issue, that of size and readability, we removed all non-essential information (such as study background, survey data and commentaries) to appendices, leaving only the most significant points in the body of the report. We believe that by doing so, we have created a readable document and, at the same time, retained valuable reference material.

The reader will notice that considerable attention has been paid to cost analyses and comparisons, as well as to more detailed descriptions of technical alternatives for the "hard-to-reach" Centers. The final chapter of the report contains a reorganized presentation of recommendations and a phased action plan for the CGIAR data transfer network.

New material was introduced in Chapter 4, in form of an evaluation of the CG Network CBMS Pilot Project. The results of the evaluation, which were unavailable at the time of the preliminary draft report, shed a great deal of light on costs, cost comparisons, and future actions regarding the CG data transfer network.

In some cases, reviewers felt certain recommendations or statements to be inappropriate, either because they went beyond the scope of the study, or because they were not relevant to the rest of the CG community. We have consequently either rewritten the paragraphs in question, or have omitted them alltogether.

It is to the credit of the Centers that numerous specific recommendations presented in the draft report have already been acted upon, and several of the technical suggestions have been implemented. The speed with which the CGIAR community has acted, is both gratifying and problematic. Problematic in the sense that for Centers which have already taken action on specific recommendations, some of the suggestions in this final report have become irrelevant. To rewrite those sections as recommendations were implemented, was, of course, not possible. We do urge that whenever suggestions are implemented with positive results, the findings be widely publicized within the CG community--preferably by means of the CBMS.

The CGNET is clearly underway. The major issue now is, how to best apply value-added network services, so that a larger user community can be established, and more VAN features can be used. Methods for obtaining this expansion are described in the "Phased Action Plan" in Chapter 6. Increasing the effectiveness of international agricultural research through enhanced communication was the objective for this project, and significant progress has been made towards its achievement.

CGNET
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Chapter 1

INTRODUCTION

Significant improvements of communication efficiency and effectiveness are achieved today in many organizations through the utilization of new computer-based communication technologies. These technologies present numerous opportunities for an organization like the CGIAR to upgrade its communication system. In recognition of these opportunities, the Information Science Division of the International Development Research Centre (IDRC) in Ottawa, Canada, commissioned Telematics International to undertake a feasibility study to investigate alternative approaches for improving the communication among the thirteen Centers, the CG Secretariat, and the TAC Secretariat. Throughout our report, this study will be referred to as the Data Transfer Network Study (DTNS).

In 1983, the Consultative Group on International Agricultural Research (CGIAR) contracted Telematics International to conduct a pilot project on the usage of a computer-based message system (referred to as the CBMS pilot), and a study to establish communication to a user group larger than the 15 CG sites (referred to as the extended network study). The CGNET, the CG Center network, was the result of these studies. (Appendix A describes the chronology of the IDRC and CGIAR studies.)

The CGIAR is an international consortium sponsored by the World Bank, the United Nations Development Program (UNDP), and the Food and Agriculture Organization (FAO) of the United Nations. Its mandate is, to support research programs with the purpose of improving the quantity and quality of food production in the developing nations. These programs are carried out by 13 autonomous international agricultural research centers (Centers); each Center has its own governing body, typically a Board of Directors. The work of these Centers is funded by the members of the CGIAR, comprising governments, foundations, and development banks. Funding for 1984 was approximately US$ 180 million. Descriptions and addresses for each Center are found in Appendix B.

1.1 RATIONALE AND PURPOSE OF THE DATA TRANSFER NETWORK STUDY

In the 1970s, a remarkable feat was achieved: agricultural production increased in the developing countries by 33 percent (IDRC, 1983). This progress was the direct result of a worldwide effort by a group of scientists of many nationalities working through a network of research centers, laboratories and experimental farms. This group was, and is, dedicating its scientific expertise, technological skills, and inventiveness toward one goal: food for all. The group is known as the Consultative Group on International Agricultural Research (CGIAR).

Today, in the mid-1980s, it is apparent that world food production is just barely keeping pace with the ever increasing demand for food. This is especially true in the developing countries, where the population growth causes import of basic foods at an increasing level, which in turn results in

higher prices, deeper poverty and the threat of starvation. Exporting countries will not be able to keep up with these demands because arable land is lost to spreading urbanization, soil degradation, salinity, and scarcity of water, for instance.

That agricultural technology will be the key to survival, is a belief shared by many. Communication and communication technology will be a major tool for the agricultural scientist in this effort. The difficult task faced by the scientists of the CGIAR system will demand increased effectiveness of the scientific system itself in form of a rapid and reliable system-wide information exchange.

Admittedly, this is not an easy task. Although difficult, calculations relating communication technology to the "bottom line" (from a business point of view), can and are being done. Applying these same calculations to sound scientific decision-making, however, is not possible. A timely and accurate scientific decision may have far reaching effects worth millions of dollars, but more so, millions of lives.

The decision-making of CG scientists can be improved through the application of technologies providing the timely and accurate information they need to accomplish their mission. It is our belief that these services can be provided with a cost effectiveness that is lower than the present mode of operation.

Currently, paper-based information, and, in time-bound situations, telex and telephone are heavily utilized. However, communication technology has produced information exchange media that are cheaper, faster, and more reliable. Among the most promising alternatives are computer-based messaging systems (CBMS), with the ability to transfer substantial amounts of information on a timely basis. The systems' asynchronous nature allows this transfer without restrictions by time zone differences or geographic distance.

Scenario 1: Tons of germplasm are shipped each year for trials in various parts of the world. Following these trials, several problems arise. One is the amount of time it takes to receive the data resulting from the trials. Decisions need to be made with respect to the next trial (crosses, selections, etc.). Often, crucial decisions have been made before much of the data from the first trial were even received. The inefficiency is obvious. In many cases, a Center's regional trials are conducted in the host country of another CG Center. With a CGIAR data network in place, the data can be forwarded through the CBMS, and can arrive in machine-readable form in minutes, rather than in weeks. For some international nurseries the return rate is about 60 percent. A low-cost messaging system can be used to send reminders and quite possibly increase the response rate.

Scenario 2: A large amount of field data is collected at Center remote sites. If these remote sites utilized a microcomputer as a data-logger, local "cleaning" of the data and statistical analysis could be done on the spot. Since the data would be in machine-readable form, they could be transmitted to the Center very quickly, and accurately. A "ruggedized" lap-sized microcomputer (typically weighing 3-4 pounds), for instance, could be taken even to the most remote locations.

Scenario 3: Standing special committees often require considerable extra travel on top of an already overburdened travel schedule. Using computer conferencing would minimize time and distance problems and reduce travel. Staff who would have to travel, could maintain communication with their Centers, and could have access to Center resources (e.g., computers, libraries, data, telex) by using lap-sized computers, or by making arrangements with cooperating organizations to use their equipment.

Scenario 4: A librarian receives each month a computer search of several hundred journals using key words relevant to areas of interest specific to the Center. He/she can then select and request the appropriate articles. This type of search gives the librarian access to a large store of information. Time can be saved in scanning the journals, and the cost of subscribing to hundreds of journals can be avoided. If the librarian can also seek information from other libraries (in the form of a CBMS message), the information pool is broadened once again. Finally, if the recipient of a request can search through his/her own data files, and forward the results of the searches back to the requestor electronically, a third efficiency factor is gained.

Benefits of speeding up information exchange within the CG system, accrue all the way to the CG "end-user", i.e., the local farmer.

Scenario 5: Each year, hundreds of abstracts are done by organizations located at great distances from the Centers. Using the postal system requires weeks to ship manuscripts, return draft copies, ship back changes, etc. Eventually, the resulting abstracts are distributed to national programs. By using the CBMS, documents and drafts can be transmitted quickly, and abstracting and shipping expenses can be cut considerably.

The concept of data communications as a method for improving information processes among the CGIAR Centers, is not original with this study. In the mid- and late-1970s, two projects (MIT, 1976, and CRC, 1978) were undertaken to address the possibilities available to the CGIAR community. The MIT study did define a computer-based system which was technically feasible. However, research focused on the technical aspects of the problem only, and failed to take into account the content of the needed information. There was little assessment of user and organization needs. The net output then, was a technology-driven design which might or might not meet the needs of the end-users.

To simultaneously assess end-user needs and technical feasibility, Telematics International prepared a document called the TmI Communication Audit. This audit provided a tool for each Center to summarize its own communication needs from a variety of perspectives. Appendix C describes the audit, its process and its methodology.

At the risk of presenting results in an introductory chapter, we find it necessary to point out two significant results of the communication audit analysis:

1. The majority of information sent from any given Center in the CGIAR is directed to individuals and organizations outside the CG's 15

major sites. While this was not totally unexpected, the extent to which this is true required that the data transfer network study be extended to include a much wider definition of the "CG Community".

2. Although the focus of the study initially was limited to scientific and technical communication, demand for speedy and cost-effective administrative communication within the "nucleus" CG and in an "extended" CG, was significantly greater.

Both of these findings led us to stress the concept of a "backbone" network, a major "network" linking the CG Centers and corresponding "high traffic" sites. The backbone network is a means by which the community may reach out beyond the "nucleus," to provide generally effective data communication to the "extended" community. The extended community includes those individuals and organizations with whom/which CG scientists and administrators need to communicate in a cost-effective manner, usually because they are thousands of miles away. Chapter 3 provides an overview of this "extended network."

Scenario 6: A telex needs to be sent from Colombia to a co-operator in Portland, Oregon. Instead of directly telexing from Colombia, a CBMS message is sent to an address in the U.S., where it is converted into a telex and sent on at U.S. domestic telex rates (about US$ 0.40 per minute versus US$ 3.00 per minute from Colombia directly).

Scenario 7: A regional office in Bangkok has to urgently ship a manuscript to a donor in the U.S. who is not on the CBMS. For a delivery within four days (at best), a courier would charge US$ 70.00. By using the CBMS-physical delivery interworking, the manuscript will arrive overnight for under US$ 10.00.

1.2 KEY ISSUES

Key issues for enhancing and expanding the communication capabilities for each Center, the CG System, and the CG community, will be the following:

1. How can state-of-the-art telecommunication services be supplied to the CGIAR on an ongoing basis?

2. Which services should be supplied, and what is the recommended order of introduction?

3. What actions do the Centers have to take to optimally participate and utilize communication services in terms of equipment and operational procedures?

4. What are the costs and benefits of such services? What kinds of hardware and software are needed?

5. Which responsibilities for administering and maintaining the services should be centralized and which responsibilities should reside with the Centers?

1.3 REPORT ORGANIZATION

The structural basis for the data transfer network study was provided by the IDRC "Guidelines" (IDRC, 1982) listed in Appendix D. In addition, Telematics International proposed a set of terms of reference, which are addressed in this report and are described in Appendix E. Appendix F outlines the design objectives for a CGIAR data transfer network and the assumptions and guidelines for the identification and selection of the technical alternatives.

The final report for the CGNET project is organized into the following chapters:

Chapter 1: Introduction, explains the purpose, background and key issues for the project.

Chapter 2: Analysis of the Present Mode of Operation and Technical Alternatives, describes the communication audit's major findings, i.e., the present mode of operation, and presents a summary of technical alternatives for the CGIAR.

Chapter 3: The Extended CG Data Transfer Network, discusses CGNET implications of potential traffic from Center remote facilities, organizations involved with the CGIAR and countries with high CG communication traffic volume.

Chapter 4: The CG Pilot and CBMS Evaluation, describes the CBMS pilot project and its results.

Chapter 5: Cost Model, presents the "bottom line" in terms of what the CGIAR can expect to pay for a network interconnecting all 15 sites, and the cost savings expected to occurr as a result of the reduction in telex, telegraph, telephone, letter and courier traffic.

Chapter 6: Recommendations and Phased Action Plan, outlines the steps which need to be taken to make the CGNET operational.

Chapter 2

ANALYSIS OF THE PRESENT MODE OF OPERATION AND TECHNICAL ALTERNATIVES

Multiple methods of data collection were necessary to analyze the ramifications of establishing a CGIAR data transfer network. These methods consisted of (1) interviews with staff at each Center, (2) a detailed questionnaire (communication audit), (3) discussions with telecommunications authorities in various countries, and (4) the collection and analysis of written materials. This chapter presents the "essence" of the data collection process and results. Detailed descriptions and precise information on the communication audit (survey and visits) can be found in Appendices G through I. Based on our understanding of the present mode of operation, which emerged as a result of our investigations, we provide a summary of the major technical alternatives that fall within the scope of CGIAR operations (see Section 2.2).

2.1 PRESENT MODE OF OPERATION

To understand the Present Mode of Operation (PMO), some 300 interviews were conducted in 20 locations worldwide. Each Center was visited with the exception of WARDA; an internal review was in progress there and scheduling could not be obtained. We were able to meet jointly with various Center staff when we attended the TAC and Center Directors' meetings in Tunis (June 1983), the meeting of Information Officers in Frankfurt (October 1983), Centers' Week in Washington (October 1983), and the Ottawa meeting of the Directors' General Committee on Data Processing (April 1984) (see Appendix G for a detailed description of the interview locations and logistics).

Quantitative data on the PMO and comments concerning future needs of the CGIAR, were collected by use of a detailed survey, the communication audit (see Appendix H). The 14 sections of the questionnaire covered such areas as: physical plant, communication facilities/equipment, international travel, communication needs for administrators and scientists, legal issues, and ideal telecommunications.

Detailed data were provided by 11 Centers, and those which did not complete the audit, did provide data on communication cost, frequency, types of equipment, and locations of remote facilities. Data for the 11 were coded and entered on an IBM 3081. Descriptive statistics were obtained for all variables using the Statistical Package for the Social Sciences (SPSS). Where available, data for the other four were manually integrated into relevant tables. The methods of handling missing data are described in Appendix H. Appendix I contains a detailed explanation of the data collection results.

Table 2-1 shows the CGIAR staff distribution. Thirteen autonomous Centers along with the CG and TAC Secretariats report the employment of 1119 scientists and engineers, 110 administrators, and 68 library staff. The total staff, including all classifications (professional support, clerical, farm workers, guards, technicians, etc.) amounts to 9400 people. Included in this total are Center staff in 131 remote sites in 51 countries. Research is con-

ducted, however, in many more countries through arrangements with their national, state, and local agricultural programs. Direct funding through the CGIAR totaled approximately $180 million for 1984.

There are 805 remote staff directly funded by the Centers. Traditionally, these remote staff have suffered from poor communication with their headquarters and much of our effort here is directed towards providing a greater degree of support for these personnel.

Table 2-1. CGIAR Staff Distribution

Category	Total
Professional staff	
Scientists/Engineers	1,119
Administrators	110
Library staff	68
	1,297
Professional staff at remote sites (domestic and international)	805
Other	7,298
Entire staff (all classifications)	9,400

Table 2-2 shows the monthly and annual communication expenses and traffic volume for the CG system as a whole. The costs shown for each medium are those paid to the carriers, and do not include equipment costs, supplies, or labor.

Some $2 million are spent yearly to make 21,600 international telephone calls, send 61,560 telexes and 30,720 telegrams, and post almost a million letters and documents. The length of an average call, telex, telegram and document is as follows:

Category	Length
Intl. phone call	9 minutes
Telex	138 words
Telegraph	74 words
Document	35 pages

Table 2-2. Communication Expenses and Volume

Category	Monthly Average (per Center)	Monthly Total (15 Centers)	Annual total
COMMUNICATION EXPENSES (US$)			
Intl. phone calls	2,965	44,475	533,700
Telex	2,234	33,510	402,120
Telegraph	1,640	24,600	295,200
Letters	1,731	25,965	311,580
Documents	2,452	36,780	441,360
Subtotal	11,022	165,330	1,983,960
Travel expenses	55,394	830,912	9,970,944
Total expenses	66,416	996,242	11,954,904
COMMUNICATION VOLUME (#)			
Intl. phone calls	120	1,800	21,600
Telex	342	5,130	61,560
Telegraph	177	2,560	30,720
Letters	2,025	30,375	364,500
Documents	2,679	40,185	482,220

Access devices which can be used for a data network for the CG Centers, are shown in Table 2-3.

Domestic access to international data networks is possible from nine of the Centers, and has been established for them. Mainframe computers in operation include VAX, IBM, and HP. Of the five Centers with VAX facilities (CIMMYT, ICARDA, ICRISAT, IITA and the CG Secretariat), four use VAX 780s and one Center (IITA) uses two VAX 750s. The CG Secretariat's VAX facility is available through the World Bank. IRRI and CIAT have IBM 4331 computers, and IBPGR can use the FAO's IBM facility. ILCA maintains and operates an HP 3000.

The largest number of microcomputers are the various types of Radio Shack TRS, with 39 machines reported in use at 5 Centers. The second largest number of micros consists of IBM computers, and that number may very well grow in the next few years. Six Centers also report having a total of 16 Apple computers.

Word processing applications are served most often by Wang multi-user systems and IBM Displaywriters. Two Centers use Micom and one Center uses CPT. Most of the word processors can communicate to computers, or can be modified to allow this capability.

Table 2-3. Communication Access Devices for the CG Centers

Category	Number of Devices	Number of Centers
Computer terminals	298	
Micro computers		
APPLE	16	6
DEC MICRO	6	4
HP MICRO	16	2
IBM PC or XT	22	7
MEMORY 7500	1	1
NORTHSTAR	2	2
OSBORNE/KAYPRO	13	3
TRS	39	5
Word processors (# systems)		
CPT	4	1
DISPLAYWRITER	38	3
MICOM	7	2
WANG	4	3
Network access devices (est.)	500	15

Taking into account the 298 computer terminals, combined with the microcomputers and word processors (many of which are multi-user systems), means that approximately 500 devices could be used to access a CGIAR data transfer network. This number is expected to grow, because 88 percent of the Centers report major equipment purchases in 1984.

The percentage (mean) of Centers reporting usage of the various communication channels by specific user groups, is shown in Table 2-4. The telephone is most used by administrative and scientific staff, whereas telex and cable are used largely by administrative personnel. Letters and documents are relied on heavily by scientific/technical personnel. As far as the Centers' own publications are concerned, we found that the average Center publishes (or submits for publication) about 113 scientific and technical papers in a two-year period.

Problems with various modes of communication were cited from administrative as well as scientific points of view, and are shown in Table 2-5. For both, administrators and scientists, the biggest problems with letters and documents were turnaround delays and lost items (see Table I-14 in Appendix I for a listing of transit times for international mail). For administrators, the biggest problem with telephone usage was the expense, whereas scientists cited: poor quality, unreliability and expense. Few problems were listed for administrative communication with regard to telex and cable, but for scientific communication, the Centers reported reliability problems for both, telex and cable, and expense problems for cable.

Table 2-4. Distribution of Communication Channels' Usage (%) by User Group

User group	Communication channels				
	Phone	Telex	Cable	Lettr	Doc
Administrative	38	57	57	39	21
Scientific/technical	37	34	28	41	55
Library	3	4	5	13	20
Other	22	5	10	7	4
Total	100	100	100	100	100

Table 2-5. Problems Related to Administrative and Scientific Communication (% of Centers reporting)

Problem	Communication medium				
	Lettr	Doc	Phone	Telex	Cable
ADMINISTRATIVE					
Cost allocation			25	14	13
Expense			63	29	38
Lost messages	38	38			
Reliability	25	25	25	29	38
Tampering	13	13			
Technical quality			25	29	13
Turnaround time	75	75	13		
SCIENTIFIC					
Expense		17	67	20	50
Lost messages	57	50			
No equipment				40	
Overload			17		
Reliability	14	17	50	60	50
Tampering	14				
Technical quality	14	17	50	40	25
Turnaround time	57	83	33		25

Centers reported that the most important scientific needs were (1) access to remote information (data bases), (2) international electronic messaging, (3) the ability to send facsimiles of documents or letters to international locations, (4) the ability to reduce international phone costs, and (5) statistical analysis.

For the administrative needs, the most important emerged as (1) the ability to manipulate financial information pertaining to the Center, (2) international electronic messaging, (3) the ability to send facsimiles to international locations, (4) word processing, and (5) the reduction of international phone costs. Access to remote databases and statistical analysis seemed of relatively minor importance.

We also asked the Centers to rate the areas in which they could use assistance in obtaining scientific and technical information (see Table I-18 in Appendix I). The top five rated needs were, (1) identifying scientific and technical publications relevant to Center research, (2) obtaining, in complete form, scientific and technical publications, (3) keeping aware of recent developments, (4) finding specific facts, and (5) locating information for others. Centers thus indicated strongest needs for hard facts and specific scientific data as opposed to needs for items of interpersonal nature. The cluster of the top five could be seen as an appeal for stronger library support, especially when considering that 55.6 percent of responding Centers listed their preference for a trained intermediary performing bibliographic database searches, rather than for direct access (44.4 percent).

We asked Centers to name particular "applications" for the new telecommunication opportunities, which would best exploit the potential of a CBMS and international data network. During our site visits (as well as from the questionnaire) we learned from Center staff which applications they considered possible and important (see also Table I-19 in Appendix I for a complete listing).

Applications most suggested by administrators were purchasing and order tracking, liaison with contractors, supply sharing, annual budgets and budget reviews, fiscal reporting from remote sites, improved liaison with remote offices, and liaison with donors, Center Board of Directors, TAC and the CG Secretariat.

Information officers wanted to see management of international VIP mailing lists (e.g., directors of national programs), CG-wide news releases and announcements, access to computer-based translation services, on-line newsletter(s), and public relations and communications officers user groups.

Library staff were mainly interested in utilizing on-line intermediary services for performing bibliographic database searches, inter-library loan and cooperation services for the CG Center libraries and national programs, coordinated cataloging/abstracting services among libraries, on-line information analysis centers within the CG system, and on-line bibliographic search, document retrieval and ordering.

Computer operations staff mostly needed liaison with computer center managers, access to current awareness services and consultants, on-line transfer of software, and shared libraries of mainframe and microcomputer software.

Of importance to scientists were programs such as joint research with remote locations, transfer of machine-readable data from remote sites, ongoing "conferences" among special interest groups, international nurseries, awareness of important conferences and meetings, and joint authorship of scientific papers and reports. In addition, they wanted specialized databases, such as germplasm databases, training materials and methods databases, trainee tracking databases, crop disease surveillance database, and quarantine databases. These databases could be maintained in-house and provided as services to outside organizations, or maintained at other sites for use by the entire CG system.

2.2 TECHNICAL ALTERNATIVES

The applications considered necessary by CGIAR staff (see Section 2.1), shaped the basis for the technical alternatives presented in this Section. In keeping with a streamlined presentation, we have moved much of the detailed material from the main body of the text; the reader interested in specific technical issues, is invited to read Appendix J," Telecommunication and Microcomputer Options for the CGIAR." The appendix discusses in detail (1) microcomputers, (2) electronic mail and computer conferencing, and (3) telecommunication options.

Technical issues of most interest for the CGIAR are: value-added network access; electronic message, document and data transfer; information services; system access devices and intra-center access, delivery and notification procedures.

2.2.1 VALUE-ADDED NETWORK ACCESS

The primary focus of this study has been to identify the means by which the different CG Centers may gain access to a host of Value-Added Network (VAN) services. VANs can be thought of as data networks with special network features. Many of these VAN features are transparent to the user and consist of rather mundane tasks such as network management, and speed, code, and protocol conversion. For example, the user of a VAN does not have to be concerned with the network implications of using a satellite link, a microwave circuit, or a voice telephone circuit, the VAN complies automatically. Other VAN features are more visible. Telenet, for example, is a VAN which offers the user the ability to gain access to a large number of host computers, as well as to other services such as telex and on-line databases. In addition, the service also features the use of GTE's Telemail CBMS, and the ability to interact with other VANs.

International access to VANs is accomplished via international gateways, which, as the name implies, serve as access points for a particular country to the VANs. These gateways typically use the same satellite links that provide international voice capability to the national telephone service (P&T). The users make a local phone call to the gateway and pay for this service to the local telephone authorities. The rates for this service vary from US$ 0.13 to 0.31 per minute. Most countries have the ability to offer such gateways, however, often gateway access does not rank highly among national priorities. In our discussions with officials in a number of African countries, for example, we were told that gateways were not offered because no "need" was perceived. For a list of countries with VAN access via gateways (or through interconnection of their domestic VANs) see Appendix K.

Nine of the Centers can access VAN services through gateways or by domestic VAN access. In fact, during the course of our parallel project, the CBMS pilot, all nine established such connections. To provide VAN access to the remaining Centers (ICARDA, ICRISAT, IITA, ILCA, ILRAD, and WARDA), we need to look at alternative approaches. These involve the use of (1) the worldwide telephone network, i.e., the Public Switched Telephone Network (PSTN); (2) the

Center's telex facility as an interface to VAN, and (3) a "relay" computer (in a location with VAN access) to transfer messages from the VAN to the Center's computer via the PSTN (and vice versa).

The PSTN is a viable access method if no gateway is available in a given country. The (off-net) Center can make an international call through the PSTN, using their own computer (mainframe or micro) to store up CBMS (and/or telex) traffic for transfer into the VAN. To effectively use the PSTN in this manner virtually requires that a Center has access to International Direct Dialing (IDD) without operator intervention. In 1985, Centers with IDD will include IITA, ILRAD, and WARDA. In almost all cases, using IDD for transferring messages via the CBMS will be less costly than telexing the same information.

The telex network can also be used instead of routing traffic via the PSTN, to establish a direct connection to the CBMS. In this case, the messages could be prepared on paper tape, or whatever medium (e.g., floppy disks) was available for interfacing with the telex network. This transmission method will be more costly than the PSTN, because telex transmits at a very low speed (10 characters per second). Also, telex has a more limited character set and cannot differentiate between upper- and lower-case letter. Finally, the telex preparation of messages would probably still require re-typing and would thus provide an unsuitable method for transferring documents. Nevertheless, using this medium, the remaining "off-net" Centers (ICARDA, ICRISAT, and ILCA) could have (albeit very expensive) access to VAN services. We do not, however, consider telex as a viable access method especially in light of the potential of CBMS-telex interworking described in Section 2.2.2.

The concept of a relay computer was developed during the course of the study. This method of VAN access would be beneficial to Centers without IDD or gateway access. The prerequisite for this operation would be the ability of the PSTN to provide IDD into a Center. For example, making international phone calls from ICRISAT is often difficult, the calls are of poor quality, and an operator is required. Dialing into ICRISAT, however, often produces a high-quality connection and can be done without an operator from many developed countries. Thus, one could log on to ICRISAT's computer via the PSTN from a "relay computer" located in a developed country. The relay would (1) collect CBMS messages for ICRISAT via the VAN, (2) log on to ICRISAT's computer via the PSTN (IDD), (3) deposit the messages (and/or telexes) in ICRISAT's machine and collect outgoing traffic, and (4) forward the outgoing traffic via the VAN. Not only do we feel that this concept is worth exploring, we are in fact testing it with ICRISAT. This method may turn out to be a very useful way of providing network services to many Center remote locations.

2.2.2 ELECTRONIC MESSAGE, DOCUMENT AND DATA TRANSFER

Major enhanced telecommunication services of immediate benefit to the CGIAR are () the CBMS, (2) CBMS-telex interworking, and (3) CBMS-physical delivery.

The CBMS provides a low-cost method of transferring information between scientists, administrators, and librarians of the CG, but is limited to CBMS users.

By adding CBMS-telex interworking, outbound CBMS messages can be routed through the international telex network. A single CBMS message can be sent to a number of recipients; some of the recipients can receive their copy via telex and others via the CBMS. (This has obvious cost implications since the message can travel much of its international route via the CBMS and then hop off at a lower telex rate.) Another major opportunity with CBMS interworking (under development but not yet announced by any of the major vendors) will be the ability, to send a telex to a particular telex address which is also part of the CBMS. For example, a particular telex address could be a CBMS distribution list which would automatically route the contents of the telex to everyone on the roster.

Finally, we believe that CBMS-physical delivery interworking will prove of great benefit. For this service, the CBMS supplier would print and deliver the message, thus, the recipient would need neither CBMS nor telex access.

Group Messaging and Shared File Services are our generic category for several types of services all of which involve creating computer files that can then be accessed by others. There are numerous opportunities which could be exploited by the CG.

Computer Conferencing allows an ongoing meeting to be conducted without the constraints of time or distance. A potential CG application would be for the Benefits Subcommittee, since everyone on the subcommittee has VAN access to the computer conferencing system.

Simple shared files are another opportunity. For example, if a Center keeps a computer file of its remote staff's telex numbers, it could let other Centers know the location of this file, so that they could access the information. Such shared files could be created for directories of phone numbers, visa requirements, telex numbers, Center staff, national program contacts, etc.

Electronic bulletin boards allow users to "post" notices on a system-wide or CGIAR-specific basis.

Electronic publishing allows access to a manuscript on a computer file. Service providers (or other Centers) can use this file for proofreading, translation, typesetting, printing, distribution, and so forth.

2.2.3 INFORMATION SERVICES

Information services offer a variety of benefits to Centers. Several of the CGNET Centers have already used the VAN to access available on-line databases. Private shared databases (e.g., mailing lists, germplasm information) can be developed for and with the CGIAR community on a computer host with VAN access by open or closed user groups. Newswires can be used either directly, or Centers can build electronic clipping services that search certain publications on an ongoing basis and forward the items to the Centers. Centers can also supply news items and news releases INTO news services. More and more vendors are allowing electronic purchasing. Centers can have more access to

their banking operations. The electronic version of the Official Airlines Guide (OAG) is much more current than the version published monthly. A new service, Travel Scan, allows international and domestic flight booking and ticketing. Obtaining computer software from on-line sources is currently being done for free in the public domain, and several vendors hope to offer this service commercially. This list of information services, several of which many of the Centers have used already, will grow considerably over the next 5-10 years.

2.2.4 SYSTEM ACCESS DEVICES

The simplest access to VAN services is a terminal and modem (the modem provides the interface between the phone line and the terminal). The disadvantage for using a simple terminal is that it has no local storage capacity, and messages have to be composed directly on the CBMS, which is costly and cumbersome. Also, after the completion of any computer session, the output is simply on paper (at best). It cannot be integrated with other computer files or data.

One step above the terminal/modem combination is a communicating word processor (a modem is still needed with all access devices). By using the word processor to access the VAN, messages and documents can be prepared in advance, and information from the VAN service can be transcribed into the word processor's memory.

Some added features can be obtained when using a microcomputer as an access device. The micro offers the benefits of the communicating word processor; in addition, special software packages can automate the log-on process, and certain specific procedures like forms-filling or database searching. Microcomputers can be desktop units, portables, or lap-sized units that fit into a briefcase and have built-in modems.

A Center can also use its mainframe computer as an access device by connecting a modem or modem pool to the mainframe. All of the terminals connected to the mainframe can then access VAN services (the number of simultaneous users will be limited by the number of modems). Or, in case of the CBMS, the Center's mainframe can store up CBMS messages for transfer to the system, providing reduced transmission and usage costs. All of these devices have been used by CG Centers in the course of the CBMS pilot project.

2.2.5 INTRA-CENTER ACCCESS, DELIVERY AND NOTIFICATION PROCEDURES

Just as Centers have used almost every conceivable method of access to VAN services, numerous methods of internal control are in use.

The least restrictive method is for each user to have a personal access device and modem. One advantage is that as messages arrive, they can be read and responded to immediately. The disadvantage is that the user has to check for messages, maintain files, learn how to operate the system, etc. A similar option is, to set up devices for the shared usage of groups of people.

When the "telex model" (using a trained operator to enter and receive messages) is copied for the CBMS set up, the end-user views the CBMS as being procedurally the same as telex, and there is little incentive to use CBMS instead of telex. Even though the telex model appears to be a natural first organizational approach to CBMS operation, we feel strongly that Centers will want to migrate to a less restrictive approach as they become familiar with the VAN services, and as equipment becomes available.

Using the Center's mainframe as a focal point creates a hybrid situation, where input from the Center's various word processors, input from attached terminals, handwritten input, etc., needs to be routed through this computer. When large number of terminals are located throughout a Center, the mainframe can act as an integrated messaging system for internal communication (local CBMS), VAN CBMS messages, and even telexes.

There is no reason why combinations of the all of the above procedures cannot be used. For example, an individual could access a message directly and at the same time a copy could be routed to the Centers "general mailroom" where it would be printed and delivered in due time.

Chapter 3

THE CGIAR "EXTENDED NETWORK"

From our initial site visits we learned that the majority of information sent from any given Center in the CGIAR was directed to individuals and organizations outside the CG's 15 major sites. The somewhat unexpected volume of this "traffic" meant that we needed to broaden our project to include this larger, or "extended" community. We asked for, and were granted, permission to study the implications of this potential traffic for the CGNET, and developed the concept of the "CGIAR Extended Network." We compiled information on (1) Center remote facilities, (2) organizations which were significantly involved with the CGIAR, and (3) countries with high CG communication traffic volume. This chapter contains our findings for these categories.

3.1 CENTER REMOTE FACILITIES

The ability to maintain effective communication with staff posted in distant locations, is a major concern among the Centers. A total of 805 professional personnel are employed in 131 locations worldwide. Figure 3-1 shows the 51 countries where Center remote staff is located. Appendix L provides detailed information for each Center with respect to (1) which countries host remote sites, (2) the locations of the remote sites, (3) the number of remote sites a Center has per country, (4) the number of staff per site, (5) the total number of CGIAR remote sites per country, (6) the total number of CGIAR remote staff per country, (7) the number of Centers represented in a given country (a Center may have four different sites in a country, but will only count as one representation in this category), and (8) the number of co-locations in a given city (there are cases where several Centers have remote facilities in the same location, in addition, a Center may actually be the host for these offices).

To provide these remote facilities with access to Value-Added Networks (VANs), is the only practical method for establishing data communication links between the Centers and their outposts. Furthermore, once VAN access is achieved, remote sites will be able to benefit from the services offered on the VANs (see Chapter 2). Currently, 21 remote offices are located in 11 countries with gateway or local VAN access (see Appendix K for a list of countries with international gateway access). These countries are: Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Philippines, Portugal, Taiwan, Thailand and the United States. Table 3-1 shows which Centers could establish VAN access for their remote facilities in these countries. Thus, CIAT could provide VAN access to four of its remote sites, CIMMYT to six, CIP to four, IBPGR to four, ICRISAT to one, and IRRI to two.

Figure 3-1. International locations of CGIAR Center staff.

Table 3-1. Center Remote Facilities
in Countries with VAN Access

	Centers					
Country	CIAT	CIMMYT	CIP	IBPGR	ICRISAT	IRRI
Brazil	1		1			
Chile		1				
Colombia		1	2	1		1
Costa Rica	1					
Mexico					1	
Peru	1	2				
Philippines			1			
Portugal		1				
Taiwan				1		
Thailand	1	1		1		1
United States				1		

To establish VAN services to the remaining remote locations (110), alternative access methods as described in Chapter 2 will have to be used, i.e., either International Direct Dialing (IDD) using the Public Switched Network (PSTN), or telex-CBMS interface, or the relay computer. Of the 40 countries where Center remote facilities are located but where gateway access is <u>not</u> available, 11 deserve special attention. Several Centers have "co-located" facilities there (New Delhi is the site for the remote offices of three Centers, for instance), and data network access would thus benefit multiple Centers. Table 3-2 shows these 11 countries and the Centers which have co-locations there.

If VAN connections (through international gateways or alternative methods) were made to the Center remote facilities listed in Tables 3-1 and 3-2, 61 of the 131 CG remote locations would be included in the CGNET. Obviously, each Center will decide on a case-by-case basis which of its remote sites to interconnect. It might be advantageous for a Center to establish VAN access for its remote sites even if the Center itself has no access to VAN services, because many of the remote staff's information needs include the ability to communicate not only with the home Center but with other Centers and relevant organizations.

Table 3-2. Co-Located Center Remote Facilities in Countries without VAN Access

	Centers										
Country	CIAT	CIMM	CIP	IBPG	ICAR	ICRI	IITA	ILCA	ILRA	IRRI	WARD
Bangladesh		1	1							1	
Egypt			1		1					1	
Ghana		1					1				1
India			1				1			1	
Kenya	1	1	1	1		1		1	1		
Niger						2		1			1
Nigeria		1				1	1	1		1	
Pakistan		1				1					
Syria		1		1	1	1					
Tunisia			1		1						
Upper Volta				1		1	1				1

3.2 SPECIFIC ORGANIZATIONS

The communication audit asked for locations which were the origin and/or destination of a high volume of communication traffic. Another question inquired as to the specific organizations with whom better communication was needed. During our site visits we asked for this information as well. The overwhelming response was that the Centers needed better contact with their remote sites. In addition, there was a strong need to establish network communication capabilities to the off-net Centers. General categories such as national programs and universities, were also mentioned. From the CBMS pilot users, however, we obtained some very specific suggestions. Organizations, whose inclusion into the CBMS pilot were requested by more than one Center were:

TAC (Technical Advisory Committee)	Paris, France
USAID (U.S. Agency for International Development)	Washington DC, USA
IIE (Institute for International Education)	New York, USA
ODA (Overseas Development Administration)	London, England
UNDP (United Nations Development Programme)	Washington DC, USA

Of course, many of these organizations have their own needs for data network access, and to "include" them on the CGNET is to merely "know their address", since they have their own CBMS accounts. IIE is expected to become an active user in November. We also established CBMS access for the Centers to USDA (U.S. Department of Agriculture), ACE (Agricultural Communicators in Education), Winrock International Research Center, IADS (International Agricultural Development Service), and several hundred related organizations such as Michigan State University and AgCanada (the Canadian Department of Agriculture). The CAB (Commonwealth Agricultural Bureau) in London, England, has agreed to have an account established.

3.3 COUNTRIES WITH A HIGH VOLUME OF COMMUNICATION TRAFFIC

Each Center was requested to provide a list of origin and destination of major traffic by country for communication channels such as telephone, telex, telegraph, letters and documents. For instance, we asked which countries were phoned most frequently, and from which countries most long distance calls were received. Tables listing the detailed breakdown of those responses are found in Appendix M.

In Table 3-3, we have combined the results of these detailed traffic matrices. We first list the country, then the total number of Centers which mention that country as a major point of communication for telex, telephone, telegraph, correspondence, or documents. (For instance, the "7" listed for Australia, could be several Centers mentioning Australia for both telex and letters, or seven Centers mentioning Australia for telephone.) Our intention was to show the total traffic for each country and to attract attention to those which should be examined in more detail, either because of a high traffic volume, or the number of remote sites, or a combination of either.

The data for each country also include the number of Centers reporting frequent travel, the number of Centers which report that improved contact is needed, the presence of international remote sites (i.e., foreign sites in which Centers have personnel), the number of domestic remote sites, and whether or not a given country has access to international data networks (Appendix K shows which countries have gateway or VAN access). Detailed information on Center remote sites is found in Appendix L, which lists, among other things, the specific cities where the sites are located, and the number of staff at each site.

Table N-1 in Appendix N is the expanded version of Table 3-3. It lists the same data, but includes all countries mentioned by the CG Centers.

Countries with the highest reported traffic volume were (in rank order): (1) USA, (2) England, (3) India, (4) Canada, (5) Italy, (6) Mexico and West Germany, (7) The Philippines, (8) Australia and Kenya, (9) France and Indonesia, (10) Japan, The Netherlands and Nigeria, (11) Bangladesh, and (12) Colombia.

In terms of the development and expansion of the CGNET, special arrangements should be made for communication forwarding and assistance in network access, in all of these countries. If the country is a CG host country, the Center located there could provide communication cooperation and assistance, if it is not, cooperative arrangements with relevant organizations would have to be made. When Center staff are travelling to these locations, these organizations could provide assistance in establishing data network connections by allowing use of terminals, modems, and telephone dial-up facilities.

Table 3-3. Countries with Major CGIAR Traffic

Country	Communication Orig	Communication Dest	Travel	Improved contact needs Scient	Improved contact needs Admin	CG remote sites Intl	CG remote sites Dom	Data network access
AUSTRALIA	7	6	1					Yes
BANGLADESH	4	6				3		No
BRAZIL	4	2	1			2		Yes
CANADA	9	8	1	1	1			Yes
CHILE		3				1		Yes
COLOMBIA	5	4		3	1	5	4	Yes
COSTA RICA	1	3				1		Yes
EGYPT		1				3		No
ENGLAND	19	21	1	1				Yes
ETHIOPIA	1	2			1		2	No
FRANCE	6	6	2					Yes
GHANA						3		No
INDIA	12	12				2	9	No
INDONESIA	5	7				1		No
ITALY	8	8	1	1	2			Yes
JAPAN	7	4						Yes
KENYA	5	8				6	2	No
MEXICO	7	8		4	2	1		Yes
NETHERLANDS	5	6		2				Yes
NIGER	2	1				4		No
NIGERIA	4	7		4	1	5	5	No
PAKISTAN	1	6				2		No
PERU	3	5		1		2	3	Yes
PHILIPPINES	6	8		3	2	2	8	Yes
PORTUGAL		2				1		Yes
SYRIA	1	5		2	1	3	2	No
TAIWAN	1	1				1		Yes
THAILAND	4	3				4		Yes
TUNISIA		1				2		No
UPPER VOLTA	2	2				4		No
USA	34	35	4	3	3	1		Yes
WEST GERMANY	7	8	1					Yes

Summing up our observations, we find that the "extended network" is definitely feasible. Data communication access (through the VANs) is a realistic possibility for the majority of CG remote sites. To provide such access will be difficult in many cases, and only possible if a Center assigns high priority to such access, and is dedicated and persistent in achieving it. Implementation has become even more desirable because of the recent adoption of a worldwide Message Handling Standard (MHS), which will provide a dramatic increase in the facilities available to participating CGNET sites, since this standard permits message exchange between different CBMS systems.

Chapter 4

THE CBMS PILOT PROJECT

Concurrent with the Data Transfer Network Study, a computer-based message system (CBMS) pilot project was conducted for the CGIAR. The original intent of this project was to provide CBMS services to seven sites: the TAC and CG Secretariats, CIMMYT, IBPGR, IFPRI, IRRI, and ISNAR. During the course of the study, however, we were able to add CIP and CIAT and several Center remote sites. By the conclusion of the project, Telematics International had interconnected 9 (10, if we include ICRISAT where access is in a testing stage) of the 15 CG sites. We are currently working with a number of Centers to add sites in Thailand, Portugal, Costa Rica, Chile, Brazil, Panama, France, Germany, Canada, and the United States.

We also attempted to establish methods for extending the CBMS pilot network to Centers located in areas where data network access is not possible. Most of our efforts have focused on a proof-of-concept test with ICRISAT, where we want to test the relay computer. We assisted in the selection and acquisition of the necessary data communication equipment, and supplied technical information allowing ICRISAT to obtain the required government license. At this writing, we have logged on to ICRISAT's VAX 780, and have successfully transferred messages to and from ICRISAT. Even though there are still some technical problems, the concept of a "relay computer" seems to be working.

At the conclusion of the pilot project, we conducted an informal survey of CBMS users to which all of the participating Centers responded.

This chapter presents first a brief chronology of the project, and explains usage and cost of the CBMS. A description of the survey of CBMS participants and its results follows. Our observations and conclusions for the pilot project are summarized in the last section.

4.1 CHRONOLOGY

After funding for the pilot project was approved in October 1983, Telematics identified potential vendors for the CBMS service, and prepared a detailed Request for Information (RFI). The RFI contained 94 questions arranged in 12 sections, and was mailed on October 17, 1983. Four vendors responded: BCI (Bell Canada International), I. P. Sharp, ITT Dialcom, and GTE Telenet. BCI declined to bid on the contract, but the other three provided detailed written responses and supporting documentation. Our evaluations of the responses along with our recommendations were submitted to the CG on November 15, and in December, a contract with ITT Dialcom was initiated. The vendor evaluation process was repeated informally in October 1984, with the conclusion that ITT Dialcom provided the most service at the lowest cost. This was partially due to the favorable contract we were able to negotiate with Dialcom.

In December and January, we telexed or phoned all potential participating Centers and supplied them with detailed information (contacts, addresses, te-

lex numbers, and rates) as to how to obtain telecommunication access in their host countries. In early February we mailed to all of the participants a document entitled "Computer-Based Message System: Guidelines for CGIAR CBMS Pilot Participants." This document briefly outlined major Dialcom services and their use; it listed the participating Centers and identified staff groups for whom CBMS usage would be most beneficial. In addition, it addressed training and equipment needs, and gave directions for telecommunication access. Users were also advised as to appropriate support documentation and regular operations and procedures.

The CG and TAC Secretariats and IFPRI were the first to use the CBMS. Both, the CG Secretariat and IFPRI, already had equipment in place, and the TAC Secretariat was able to use a nearby machine belonging to the FAO's Fisheries Information, Data, and Statistical Service.

ISNAR and IRRI had logged on by the end of February, but both Centers had trouble with regular access. The computer available to ISNAR was located too far away for regular use. Initially, IRRI's access was only possible through the Manila office, about an hour's drive from the Center. By March, however, IRRI was checking messages 2-3 times a week, and CIAT had begun to experiment with different access methods. CIMMYT had succeeded in getting its application to the Mexican Communication Ministry approved, and was on-line by the end of the month.

In April, we were contacted by the Institute for International Education (IIE), with whom several Centers wanted to communicated via CBMS. Rich Miller (Telematics International) met with IEE's Ron Wormser in New York on May 10, to discuss the possibility of participation on the network. It appears that by October the Institute will have the necessary equipment to access the system. We also advised the chairman of TAC, Professor Guy Camus, in Paris, about the availability of the service. In April, the International Development Research Centre (Ottawa) also established an account.

In June, CIAT's connection efforts were met with success thanks to upgraded equipment. Leslie Chapas (CIAT) and Jim Estes (ICRISAT) had stopped by Telematics International, to work out technical communication problems and to make appropriate equipment purchases. The CIMMYT regional office in Bangkok, Thailand, had managed to get through to Dialcom but licensing procedures delayed further access. We were told, however, that they were expected to be on-line by late October.

In July, we learned that domestic data network access was available in Peru and notified CIP; in early August, the Center made contact with the local authorities for the necessary modems and licenses. Also during that month, ISNAR became fully operational. Leslie Chapas (CIAT) accessed the system successfully from Britain, and was able to keep in touch with Cali, Colombia, while travelling in the USA, by using a lap-sized TRS 80 Model 100 microcomputer. Mailboxes for the Impact Study Team working in Washington D.C. were added at the request of the CG Secretariat.

By late September, CIP was making progress reading mail. At CIAT's request, we added the Winrock International Research Center, the U.S. Department of Agriculture's Office of Information, and Agricultural Communicators in Education (ACE) to the CG CBMS directory. Entries were also established for the

U.S. Agency for International Development (USAID) and the International Agricultural Development Service (IADS), at the request of the CG Secretariat. We were also able to supply names and network identification for several hundred persons at land-grant universities and other agricultural organizations (all non-CGIAR organizations have their own Dialcom accounts and are not funded by the CGIAR).

In October, IBPGR came on-line, their license having been granted and their dedicated telephone line having been installed by Italcable. October should also see the addition of the Bangkok offices of CIMMYT, CIAT and IRRI. Olivia Vent (CG Secretariat) successfully communicated via CBMS from Eschborn, West Germany, by making use of equipment at the Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ). This month we will also attempt to use the CBMS for sending telexes. CIAT will pilot the telex re-filing and is hoping for immediate savings in excess of $ 1000 per month.

4.2 SYSTEM USAGE AND COST

The CGIAR system usage is influenced to a large degree by the way each Center provides system access. At CIMMYT, for instance, a 1200 BPS (ca 120 characters per second) modem is attached to the VAX 780, so that any terminal connected to the VAX (there are 48) can also be used for CBMS access. Messages are stored on the VAX and sent in one large file, making cost-efficient use of the system. In addition, we are working with CIMMYT to obtain software to allow the direct transfer of documents from their 27 IBM Displaywriters to the VAX (and thus the CBMS). A number of remote CIMMYT facilities are being supplied with IBM PC XTs.

CIAT uses a Displaywriter for transmission of messages which have been prepared beforehand on Displaywriters within the Center. Travelling staff can use a briefcase-sized Radio Shack micro. IFPRI currently uses TI terminals, transmitting at 300 BPS with no ability to store messages. We are working with Center staff to allow their CPT word processors to be used for access. The CG Secretariat uses IBM PCs, MICOM word processors, and TAB terminals; most devices are equipped with 1200 BPS modems. For most of its accounts, instant and direct access is possible as well as the ability to prepare messages and documents prior to transmission. ISNAR funnels its previously prepared messages through one Wang system. IRRI currently uses one stand-alone computer terminal with a 300 BPS modem and no ability for storage; messages are input and printed through an operator. The Center is working to upgrade access to the system by adding microcomputers. TAC is still awaiting equipment and, at the moment, must use a TI terminal in the FAO's Fisheries Dept. CIP is using IBM, Radio Shack, and Apple micros. IBPGR will likely initially use their Wang system or an Apple microcomputer. The ICRISAT relay connection is made directly to their VAX 780.

The system usage is shown graphically in Figure 4-1. Initial CBMS usage was about 10 hours in January, but rose to 81 hours in September (an increase of 683 percent). Preliminary figures for October indicate that usage will be similar. The anomalies in the growth curve may be explained by varying work loads at Centers and the tendency of many CG personnel to take home leave during the summer months. Table 4-1 supports the graph by providing a breakdown of the monthly hours of usage for each site.

The data for the CG Secretariat are somewhat inflated since they include the time for CGI100, the general maintenance account. CGI100 is used to access and update the Dialcom CG Directory, open and close individual accounts, and to calculate usage statistics. The CG Secretariat actually uses 1 general account and 11 individual accounts for various CG Secretariat staff, visiting Center personnel, and for the Impact Study Team members. The IDRC figures include two accounts: one is the general IDRC address, and the second is the contract officer for the Data Transfer Network Study, David Balson.

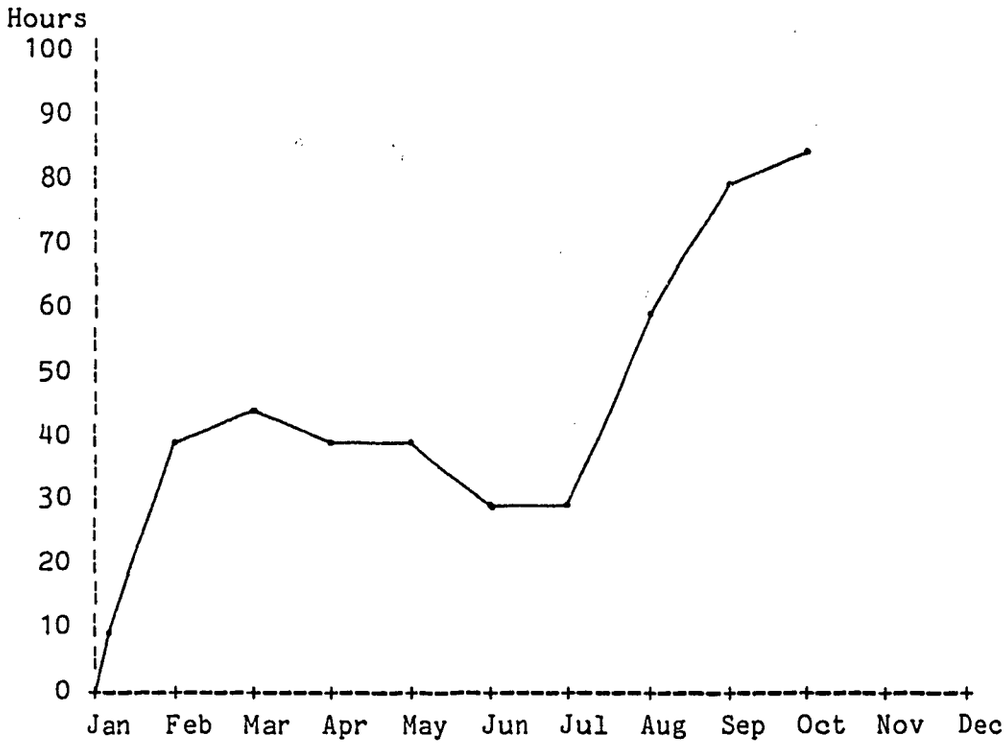

Figure 4-1. Monthly hours of CBMS usage for the CGNET Centers, the CG and TAC Secretariats, and the IDRC.

Table 4-1. Monthly Hours of CBMS Usage by Site

User	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
CIAT		0.35	0.40	0.78	0.80	6.58	5.10	5.70	4.67
CIMMYT		0.21	4.80	7.58	19.43	5.65	9.16	20.10	29.57
CIP								0.90	2.22
IFPRI		6.62	2.72	0.68	0.84	0.43	0.30	1.08	5.70
IRRI		3.73	11.72	4.66	2.05	2.05	1.85	2.87	5.48
ISNAR		0.78	0.48	0.01	0.03			2.73	2.82
CG Sec*	9.58	22.86	20.88	18.68	14.12	10.73	9.72	25.85	19.82
TAC Sec	0.65	3.15	2.45	0.45	0.94	0.61	0.05	0.28	2.13
IDRC**				4.52	3.02	1.12	1.60	2.62	7.72
Total	10.23	37.70	43.63	37.36	41.23	27.17	27.78	62.13	80.13

* Thirteen accounts.
** Two accounts.

The next two tables explain CBMS usage further. Table 4-2 lists the total number of times each Center logged on to the system for the months of June through September. The CGIAR totals indicate an increase of 92 percent, based on June versus September log-on times. The average session length, shown in Table 4-3, was calculated by dividing the number of minutes of usage by the number of log-on sessions. It is interesting to note that for the last three month, the grand mean figure has stabilized at seven minutes per session, which points to rather cost-efficient usage.

Table 4-2. Number of Times per Month Each Site Logged on to the CBMS

User	Jun	Jul	Aug	Sep
CIAT	59	40	43	40
CIMMYT	49	37	76	115
CIP			5	5
IFPRI	5	3	7	19
IRRI	34	23	32	36
ISNAR			27	38
CG Sec	174	127	344	350
TAC Sec	6	2	3	10
IDRC	22	16	26	57
Total	349	248	563	670

Table 4-3. Average Session Length: Mean CBMS Minutes of System Usage per Session

User	Jun	Jul	Aug	Sep
CIAT	6.76	7.65	7.95	7.00
CIMMYT	7.14	14.86	15.87	15.43
CIP			10.80	26.60
IFPRI	5.20	6.00	9.29	18.47
IRRI	4.29	5.48	5.38	9.14
ISNAR			6.07	4.45
CG Sec	4.06	4.83	4.51	3.40
TAC Sec	5.66	1.50	5.67	12.80
IDRC	4.09	6.94	6.04	8.07
Grand mean	4.67	6.72	6.62	7.18

Many of the sessions are, no doubt, just to check the mailbox for new messages. This "administrative overhead" is greatest when usage is low, since the results of a mail check are simply "no new mail", and the user logs off. When mail is in fact present, the overhead is nil. Holders of accounts where the mail volume is less than one message a week, may choose to have their mail sent to a general address. However, ultimately we expect that many individuals will want to have their own mailboxes to use while travelling, and to speed up the information transfer. For example, when one is reading one's own mail and wants to answer questions immediately, one can use the "reply" command. It is not necessary to enter any header information because the system knows the recipient and uses a modified subject for the reply. If an operator, on the other hand, receives the message, it must be printed, delivered, and a new session must be initiated for the response. Having someone regularly check and print messages, however, increases the certainty that the messages are actually received. (It is possible to modify the account structure such that a copy of the recipient's mail is sent to the general mailbox as well as to the individual.)

Table 4-4 lists how many times Centers logged on to the system each week. We find the information very positive, because most of the Centers are checking their mailboxes five days a week. On the average, Centers log on to the system about once a day, but the pattern varies widely and has ranged from several times a day to once in two weeks. This kind of unpredictable mail-checking initially caused some problems. When CBMS messages were sent, they often had to be followed by telexes to make sure the recipient had received the information. The problems have greatly diminished since most account holders are now checking their mail regularly. Each Center's consistent improvement in weekly access times is encouraging, because it indicates that the Centers understand the value of the CBMS; it can only be effective when used regularly.

Table 4-4. Average Number of Times per Week Each Site Accessed the System

User	Jun	Jul	Aug	Sep
CIAT	4.90	4.52	4.97	4.67
CIMMYT	4.20	5.42	5.19	5.13
CIP			0.45	0.45
IFPRI	0.70	0.68	0.90	2.57
IRRI	3.27	3.39	4.97	4.20
ISNAR			2.48	4.43
CG Sec*	4.90	5.42	5.65	4.69
TAC Sec	1.40	0.45	0.68	1.63
IDRC	2.57	2.03	3.16	3.97

*Does not include the CGI100 maintenance account.

Total monthly cost for CBMS usage is as follows (amounts were only available for the months shown, as invoices for the remainder had not been received at the date of this writing):

Month	Amount ($)
January	79.57
February	314.70
March	352.58
April	329.84
May	352.88
June	268.71
July	259.78
August	702.24

4.3 SURVEY

As part of Telematics International's contract with the CGIAR to provide an evaluation of the CBMS pilot, we conducted an informal survey of CBMS users. On September 8, 1984, a questionnaire was sent on-line to a selected user group totaling 39 individuals at the 8 pilot CBMS sites where the CBMS was in regular use. Included were the Director Generals, Communication Officers, and computer staff. By October 8, we had received responses from all of the Centers, from a total of 20 individuals. Following is a breakdown of how many questionnaires were sent to each Center, and the number of responses we received. In some cases, an indication was made that the questionnaire response represented the opinion of two people. In these cases, the count used was 2. In this chapter, the word "Centers" is used to include the CG and TAC Secretariats as well as the International Research Development Centre (IDRC).

	Questionnaires	
Center	Sent	Returned
CIAT	4	2
CIMMYT	9	5
IFPRI	5	2
IRRI	5	4
ISNAR	4	1
CG Sec	9	4
TAC Sec	2	1
IDRC	1	1
Total	39	20

Using the CBMS to conduct the survey proved to be very advantageous. By eliminating postal services (and standard transit times for deliveries), we were able to reduce turnaround time by two thirds. Ninety percent of the responses were received within two weeks! Another benefit was that the data arrived in machine-readable form.

4.3.1 RESULTS

Since the Centers are the focus of the study, we have used them as the primary unit of analysis. Thus, instead of calculating the percentage of actual respondents for each question, we report the percentage of Centers' responses. This process allowed for an equal weighing of the Centers; had we used the number of respondents, the analysis would have favored Centers with more people responding.

QUESTION 1: Taking everything into account, do you feel that the pilot application of the CBMS at the Center has been (a) very unsuccessful, (b) unsuccessful, (c) somewhat successful, (d) successful, or (e) completely successful?

We assigned a 5-point scale ranging from "1 - very unsuccessful" to "5 - completely successful". The mean response was 3.5, which meant that the Centers rated the CBMS pilot halfway between "3 - somewhat successful" and "4 - successful." Some of the Centers, which rated the CBMS as only "somewhat successful", commented that the system had not yet been used to its capacity, and that it was still too limited with too few locations (Centers) on the network.

QUESTION 2: What have been the major uses of the CBMS? What types of information are being sent and received (for example, financial information, administrative information, scientific data, travel information, requests for information about equipment, access to databases, meeting coordination, etc.)? Are there types of communication for which you have found the CBMS system to be NOT appropriate?

The major use (88 percent) of the CBMS was reported to be for administrative information. Travel information came second with 75 percent, and requests for information about meeting coordination were third with 63 percent. Fifty percent of the Centers reported financial information, especially for price quotes and purchasing purposes. Scientific data registered at 25 percent and consisted mainly of technical, computer-oriented information. Specific requests for information on equipment and on database access rated at 13 percent for each.

In addition, Centers mentioned various other kinds of usage, such as project management, coordination of inter-Center activities, proposal transmissions, setting up connections with other Centers, acquisition of software, transmission of briefing data, as a forum for scientific discussions, as a link to AgCanada, and coordination and communication in general.

Two of the Centers mentioned types of communication for which the CBMS was not considered to be appropriate. Those were confidential, and urgent communication requiring interactive conversations.

QUESTION 3: Do you feel that the CBMS should be continued? Expanded to more locations? Expanded in terms of adding more computer services on the network? Abandoned following the conclusion of the pilot? Could you elaborate on any suggestion you may have?

One hundred percent of the Centers felt that the CBMS should be continued. Comments ranged from "should and must" to "emphatic recommendations". One Center, however, made their support contingent on system accessibility through their word processing equipment.

Assuming continuation of the CBMS, 75 percent of the Centers felt that expansion to other locations was the highest priority. Centers not yet on-line were to be included, as well as collaborating institutions in developed and developing countries (the relay mode was to be used for difficult-to-reach locations); regional offices and remote experimental stations were to be reached; and connections were to be made with Centers' U.S. purchasing agents and commercial suppliers (at their cost).

Fifty percent of the Centers thought it necessary to expand the CBMS in terms of adding more computer services on the network. Specifically, they wished the following: telex-CBMS interface (e.g., XMail), CBMS-physical deliv-

ery interworking (e.g. MAILGRAM) with hard-copy deliver, a CBMS form feature for transmission of records, the possibility of transmitting volume data via CBMS from regional offices acting as collection and distribution centers for international testing data (this would include error-checking software), and automatic computer mail-checking.

Abandoning the CBMS following the conclusion of the pilot project, received no support.

QUESTION 4: What have been the major barriers to full utilization of the system (for example, lack of interface between word processors and the CBMS, lack of available terminals, lack of equipment such as modems, lack of training, lack of adequate documentation, and so on)?

Centers did not report a large number of "barriers" to CBMS usage, although individuals, who mentioned particular issues, often felt very strongly about them. The two obstacles mentioned most (38 percent) were (1) lack of training, and (2) hardware/software problems or shortages. For two of the Centers, the staff commented on the sore lack of direct access, due to either equipment unavailability or restrictive intra-Center CBMS procedures. Two of the Centers also felt that lack of CBMS coverage of the Centers constituted a barrier to usage.

QUESTION 5: What would be the most important ways in which benefits of the CBMS at the Center could be increased (for example, more training, in-house consulting support, more locations on the network, better awareness, more equipment, etc.)?

"More locations on the network" took first place with support from 75 percent of tne Centers. "More training" followed with 63 percent. Fifty percent of the Centers wanted more equipment, or at least upgraded equipment, in order to improve CBMS usage, and 38 percent felt that increased benefits of the CBMS would result from better awareness of the system. In-house consulting support was mentioned by 13 percent. However, the Centers volunteered additional suggestions such as, administrative procedures for handling CBMS mail, more direct personal and general access, and the telex/dialcom connection.

QUESTION 6: Have you used the CBMS to replace any telexes, courier packets, letters, or telephone calls? If yes, approximately what percent of your messages are a substitution for telex? For telephone? For courier? For letters?

All Centers reported that the CBMS had replaced some telex; 86 percent reported substitution for telephone, 71 percent reported substitution for letter and courier.

The second half of the question asked about the volume of the displacement. This question (percentage of traffic displaced) apparently was difficult to interpret, because most people reported the percentage of the various <u>media</u> which the CBMS had replaced, rather than the percentage of their <u>CBMS messages</u> that would have been sent by other means. We adjusted numbers for responses such as "replaced 90 percent of telexes for Centers on the network," by multiplying the proportion (0.6) of Centers on the network by the 90 per-

cent (90% x 0.6 = 54%). The data supplied by the Centers, are given in Table 4-5 along with the mean for each communication medium and an adjusted mean.

Strictly speaking, Centers reported a 19 percent reduction in telexes, 15 percent in courier packets, 16 percent in letters, and a 14 percent reduction in telephone calls. These numbers are very conservative because they include individuals within Centers who use the system very little, they also reflect estimates. There is a real danger here in being overly conservative when drawing conclusions from these data, since decisions might result which would miss significant cost saving opportunities. We have, therefore, provided an adjusted mean, which does not include low-usage Centers (these means do, however, include low-usage respondents within Centers).

Table 4-5. Estimated Media Displacement Percentages

	Communication media			
Centers	Telex	Courier	Letters	Phone
CIAT	35.0	20.0	20.0	35.0
CIMMYT	8.3	--	--	5.0
IFPRI	1.0	1.0	1.0	1.0
IRRI	21.5	--	10.5	1.0
CG Sec	46.3	21.5	33.3	27.5
TAC Sec	1.0	--	--	--
Mean	19.0	15.0	16.0	14.0
Adjusted mean	28.0	21.0	21.0	23.0

QUESTION 7: Are you aware of the Center's using the Dialcom mail features other than simply sending and reading electronic mail? If yes, which features (distribution lists, message forwarding, acknowledgment receipt, WPmail, filing and retrieval of messages on Dialcom, the editor with mail, spelling checker, message hold, delayed delivery)?

Four Centers responded to this question. They had been on the system the longest, and had solved hardware and procedural problems fairly quickly. Seventy five percent of these Centers had used message forwarding, acknowledgement receipt, and the editor with mail. All had used WPmail (the method for preparing messages beforehand and loading into the system), 50 percent had filed and retrieved messages, but only 25 percent had used the spelling checker, message hold feature, and the delayed delivery feature. None of them had made use of distribution lists.

QUESTION 8: Are you aware of the Center's using other Dialcom system features? If yes, which features: POST (Public Bulletin Board), PRPOST (Private Bulletin Board), CAL (Calendar System), NEWS (Electronic Newswires), NEWSTAB (Newswire Clipping), UNISTOX (UPI Stock Reports), ABI (ABI/INFORM), OAG (Official Airline Guide), INFOX (Database Management)?

The Centers responding here, fell into the same category as the ones that had addressed Question 7, except that only three reported. All three were familiar with the Official Airline Guide (OAG). The Public and Private Bulletin Board (POST and PRPOST), as well as Newswire Clipping (NEWS) had been used by two, and the OAG had been used by one Center.

QUESTION 9: How do you access the CBMS system [through your own personal device (microcomputer, terminal, or word processor), through a device within your immediate work area, through a device outside your immediate work area, or through someone else who accesses the system for you]?

Users at only two Centers had their own personal device (microcomputers and terminals), but five of the Centers had made devices within the immediate work area available for use (terminals). In four cases, the devices to be used were located outside the immediate work areas (terminals, word processors, and Displaywriters).

One Center provided a combination of personal, nearby and not immediately available devices. One Center had personal as well as nearby devices, and two provided only nearby and not immediately available devices. Half of the Centers used an operator at a central location to access the system (central switchboard, data processing service, radio room/secretary relay). An operator was used in addition to nearby devices at one Center, and at another in addition to devices outside immediate work areas.

QUESTION 10: Do you feel that the Dialcom documentation is clear and well written? Do you see a need for different documentation? If yes, what is needed (for example, simpler manuals, detailed log-on procedures specific to the Center, etc.)?

The Centers were divided 50/50 on the adequacy of the documentation, with comments ranging from "fine" to "verges on the unintelligible". Half of the Centers wanted different documentation: more user-oriented, oriented toward users not familiar with computers, covering all levels (from simple to highly technical), better organized and more clearly written, with more descriptions, better examples, cross-referenced and indexed. Centers also wanted the documentation to be geared toward the various devices available for access.

QUESTION 11: If additional training were needed, how would it best be done (for example, sending Center staff to a workshop? Training conducted on site by Center staff? On-site training by an outside expert? Sending a Center person for intensive training, who would then return and serve as the local expert)?

Opinions as to how training could best be accomplished, varied greatly among the Centers and their respondents. Sending Center staff to a workshop received no support, on the other hand, sending a Center person for intensive training to become the local expert was voted for by three Centers. Half of the Centers wanted training to be conducted on-site by Center staff, and half wanted it to be conducted by an outside expert. One Center, who wanted the training conducted by Center staff, wanted to send their person for intensive training. At two Centers, Center staff was divided over the local versus outside expert option.

QUESTION 12: Please list up to five sites of high priority to you that should be added to the network. Please be as specific as possible, for example, Guy Camus, Paris; IIE, New York; chairman of the Center's Board of Directors; a particular remote site, etc.

Seven Centers responded with suggestions to this question. In several cases, the Centers' responses were identical. A list of responses follows, rank-ordered by the highest percentage of Centers supporting the suggested addition. In some cases, specific individuals at certain institutions were also mentioned, and we have added these to the list.

71 Percent:

ICARDA, ICRISAT, IITA, ILCA, ILRAD, and WARDA

43 Percent:

TAC (Technical Advisory Committee) Paris, France

USAID (US Agency for International Development) Washington DC, USA

29 Percent:

Bangladesh (Dacca)
Kenya (Nairobi)

Thailand (Bangkok)

IIE (Institute for International Education) New York, USA
ODA (Overseas Development Administration) London, England

UNDP (United Nations Development Programme) Washington DC, USA

14 Percent:

Burma (Rangoon)
Chile (Santiago)
Ecuador (Quito)
Ghana (Kumasi)
Haiti (Port-au-Prince)
Indonesia (Bogor) (Jakarta)
Madagascar

Mexico (Obregon)
Pakistan (Islamabad)
Peru (Cuzco)
Portugal (Lisbon)
Rwanda (Rubona)
Swaziland (Mbabane)
Turkey (Ankara)

ACIAR, Canberra, Australia
CAB (Commonwealth Agricultural Bureau) London, England

Rockefeller Foundation New York, USA
Rutgers University

CIDA (Canadian International Development Agency)
FAO (Food and Agriculture Organization)
ICAR (Indian Council for Agricultural Research) India
New Brunswick, New Jersey
University of Minnesota St. Paul, USA
Software/Hardware suppliers

QUESTION 13: If the CBMS project were to be continued, do you have any suggestions as to what the major emphases should be?

The Centers responded with a wide variety of suggestions. In several cases, a Center's answer coincided with that of another. Major emphasis was placed on (1) getting the remaining Centers on-line, and expanding the network, (2) dedicating support and promotion for the CBMS and office automation in general, and (3) training to assure effective use of the system and the devices used for access.

An interesting array of suggestions followed and it is definitely worth listing each of them:

- experimenting with the CBMS and sharing the findings,
- getting most donors and institutions related to international agricultural development on-line,
- needing help in signing up more destinations, starting CBMS-based conferences, using potentially available features and services,
- linking regional offices,
- linking domestic remote sites,
- developing specific applications for the CBMS,
- making cheap, easy-to-use terminals with many more linkages available to all secretaries,
- enhancing/simplifying the technical requirements within the Centers,
- increasing direct available access,
- replacing telephone and telex,
- using an intermediary for on-line database searching.

One Center volunteered a pilot application for the last point on the list: that of an intermediary for on-line database searching. Since many Centers do not have access to data networks, the intermediary would carry out on-line searches, on Dialog for instance, for those Centers. The results could be sent via CBMS and transmitted to those particular Centers via the relay computer system. Due to the Center's central location, we envision it to be an intermediary in more ways than one, because it could also function as the relay for Centers located in Europe, Africa, and the Near East. The relay for Centers in the Pacific and the Far East should probably be located in the US.

4.4 OBSERVATIONS ON OPERATIONS AND LOGISTICS

Telematics International assumed the responsibilities of selecting the CBMS vendor, providing information to Centers on how to obtain VAN access to the CBMS in their particular countries, providing information on the methods of operation on the CBMS and certain "helpful hints," serving as a resource for technical information on appropriate equipment and software, and, whenever possible, provided assistance in on-site training activities. A great deal of our time was also spent solving specific problems, providing information on the various available services, and trying to encourage usage.

Another area we managed was the CBMS account itself. This task involved opening new accounts, maintaining the directory of CBMS users, collecting usage statistics, providing manuals to users, monitoring on a daily basis who was reading their mail and which Centers' mail remained unread, assisting with CBMS alternative delivery options and access methods, paying the bills, etc. These activities consumed a great deal of time at the start of the project, but had become fairly routine by Octer 1984.

Whenever a new site comes on-line on the CBMS, much time will be spent in answering specific questions, making suggestions on operations, and problem solving. For example, at this writing we are working to establish access for ICRISAT via the relay computer. Several days were spent earlier this year in discussions about the correct modem specifications for ICRISAT, in providing information for the Indian P&T, in assisting with the decisions-making needed to set the stage for the test, and so forth. Currently, 4-6 hours are spent each day trying to optimize modem settings, talking to engineers about the characteristics of the modems we are using and the alternatives, and simply trying to get the set-up to work. When it is working properly, we will need to update the CBMS directory with the appropriate ICRISAT staff. Updating the directory is not a difficult task, but if errors are made, one can inadvertently cut off all CBMS access, or perhaps worse, a Centers mail could arrive at the wrong Center.

Another area for which we have taken major responsibility is "motivating" the staff at the various sites to take advantage of the CBMS. This is a task which we vastly underestimated in terms of force-loadings (time consumed). Certainly it is true that once Center staff are aware of the options and their benefits available to them, they want to take advantage of the opportunities presented to them. But the initial convincing seems to take a great deal of time. Typically, our efforts were met with initial scepticism: "it has been tried before and it doesn't work here."

Eventually we isolate an interested party with enough technical expertise (or blind perseverence) to follow through on all the necessary preliminaries to obtain a license, to get a modem, to hook the modem to the computer, to get the communication software to work, etc. This motivation stage (from our perspective) can easily last several calendar months and can consume 15-20 percent of one senior staff's time during those months. The "selling job" is very stressful on the "local innovator," because that person still has all of his/her usual job responsibilities. (It helps to find a work-aholic.)

The next stage consists of getting everthing to work and making sure all the requisite documentation actually arrives at the Center (and is distributed to the proper people). Once everything is in place, making it work is not an overly difficult task; it requires perhaps two to three days. After that, the local innovator needs to take over and "spread the word."

At this point, the local innovator faces the same motivation problem task which we faced at the beginning of the project. But by this time, some of the innovator's initial enthusiasm has worn off, and he/she is behind in their "regular" work. So there is a lull of activity on the newly acquired CBMS capability. But soon some URGENT need arises, and the CBMS is exactly what is needed to relay the lengthy proposal or document to its destination. News of the success follows rapidly, and soon the innovator (now hero) is overloaded with requests to use the "new" service. People have additional ideas on uses and our innovator becomes swamped with requests. At this point, Telematics receives daily requests for information on how various facilities may be utilized. We also often receive a myriad of questions on software and hardware. It is at this point that the CBMS facility can be considered "installed." The time period from "getting the system going," to "urgent need," to "expansion", has often consumed over one month of time for one senior and one junior professional staff.

In all truth, we must report that, so far, the primary success stories have taken place in the administrative realm. We sincerely believe that once scientific staff discover the opportunities and possibilities of the CGNET, the applications (and usage) will increase exponentially.

Chapter 5

CGNET COST MODEL

The solution we have proposed for the CGNET, provides the Centers with enhanced communication capabilities at low cost; in fact, considerable cost savings will be made in comparison to the Present Mode of Operation (PMO). Furthermore, CGNET will not be subject to an early obsolescence because it relies on services rather than equipment acquisition; a clear migration to the newest services is possible with minimal effort.

Unlike the recommendations of previous studies, our proposed design for the CGNET requires no centralized equipment purchases, no major capital expenditures (i.e., less than US$ 2500 per Center is required), no centralized CG facility, and no additional central staffing. We have resisted basing the CGNET on strict cost benefit criteria, because we felt that that the real issue was effectiveness rather than efficiency. As stated appropriately by one Director General, "the basic mandate is to produce more food and feed more people. Anything that helps us do that, is worth trying."

From a decision making and planning viewpoint, it is desirable to have some basis for the understanding of the cost impact of the CGNET. This chapter is devoted exclusively to the presentation of a cost model for the network (with a 7-year time frame, from 1984 to 1990). We will present three scenarios (all based on the same model) for cost analysis: (1) Pessimistic Case, (2) Minimum Expected Case, (3) Optimistic Case. The basis for varying the three cases is related to two primary variables (1) the growth in expenditures for the PMO and (2) the potential impact of the CBMS.

The estimated annual increase in PMO expenditure used for the Pessimistic Case is, naturally, the least favorable to the adoption of the CGNET. It is based on an annual growth in communication costs within the CG of only 7 percent. (In fact, for several of the Centers, we were able to obtain comparative monthly traffic volumes for 1983 and 1984. The average percent increases for telex, telephone, and telegraph were 13, 33 and 46 percent.) Whereas the Pessimistic Case is based on a 7 percent annual increase (half of 13), our Minimum Expected and Optimistic Cases are based on 13 percent (which was the lowest reported increase for the Centers). This figure (13%) is consistent with other organizations' experience in telecommunication cost increases.

The other key variable for the three cases is the potential impact of the CBMS on reducing costs of the PMO. For the Pessimistic Case we use 13 percent as an estimate of displacement (cost savings from the other media gained by substitution of the CBMS for these media), and for the Minimum Expected and the Optimistic Cases we use 23, and 35 percent, respectively. The lowest of these numbers (13%) is the very conservative displacement estimate from Chapter 4, and includes the most pessimistic estimates, as well as no estimates for telegraph substitution. The Minimum Expected Case's substitution figure is based on the grand mean of the substitution percentages (Chapter 4, Table 4-1). The Optimistic Case uses 35 percent (which is a 50 percent increase of the Minimum Expected Case) based on the fact that many new features which have not been used by the Centers as of yet, e.g., CBMS-physical delivery and re-

filing of telex, telegram, phonegram, and lettergram, will surely have an impact.

The cost model is based on interconnecting all 15 sites: the 9 (which are already on the CGNET) via gateways, and the 6 Centers not currently on CGNET, via IDD in combination with other access alternatives. For those sites, we have included cost to utilize 10 hours of international phone calls per month (at US$ 2.50 per minute). We are assuming $ 2000 for equipment (high-quality modems) for 15 Centers, amortized over five years, and equipment replacement in 1989.

The Pessimistic Case is shown in Table 5-1, with the PMO cost at a 7 percent growth rate, and the CBMS displacing only 13 percent of the telecommunication costs. The first column (PMO) shows the costs for the PMO, the second column (DISP) shows the impact of the 13 percent displacement (cost saving) from the CBMS. Columns 3, 4, 5, and 6 give the costs for the CBMS usage for International phone calls (IDD) for Centers not on the net, for CBMS usage, for equipment, and for the charges which must be paid (based on seven Centers) to the P&T for international gateway access. (For Centers with no IDD, this money could be used for ten hours of telex access to the CBMS). The yearly increases in the CBMS costs (except equipment) are coupled with the PMO annual rate of increase. The total CBMS costs are given in Column 7. CBMS impact is given in Column 8. This impact is expressed as the cost impact of the CBMS on the PMO. Thus, in 1984, had all 15 sites used the CBMS, the cost impact of the CBMS on the PMO would have been $ -0.118. In other words, CBMS usage would have constituted a $ 118,000 savings in the PMO budget.

Table 5-1. CBMS Cost Impact in US$ (000,000)
Pessimistic Case
(PMO 7% Annual Growth, CBMS 13% Displacement)

	CBMS							
	Costs							
Year	PMO	DISP	IDD	Usage	Equip	P&T	Total	Impact
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1984	1.983	0.258	0.108	0.015	0.006	0.011	0.140	-0.118
1985	2.122	0.276	0.116	0.016	0.006	0.012	0.149	-0.127
1986	2.270	0.295	0.124	0.017	0.006	0.012	0.159	-0.136
1987	2.429	0.316	0.132	0.018	0.006	0.013	0.170	-0.146
1988	2.599	0.338	0.142	0.020	0.006	0.014	0.181	-0.157
1989	2.781	0.362	0.151	0.021	0.006	0.015	0.194	-0.168
1990	2.976	0.387	0.162	0.023	0.006	0.016	0.207	-0.180
Total	17.161	2.231	0.935	0.130	0.042	0.093	1.200	-1.031

Between 1984 and 1990 the CGIAR will spend some $ 17 million on telecommunication, $ 2.2 million of which can be displaced by the CBMS. The CBMS will cost $ 1.2 million, translating into a total savings of about $ 1 million by 1990. The biggest component of the CBMS cost is the IDD. No doubt, by 1990, most of the Centers will have access to data networks, and very significant costs can be avoided.

Table 5-2 presents what we consider to be the minimum savings, by using the CBMS for the same time period, based on the assumption that the PMO would increase at 13 percent and that the CBMS could displace 23 percent of this cost. In this case, the CG is saving several hundred thousand dollars each year, and will have a cumulative savings of over $ 3 million by 1990.

Table 5-2. CBMS Cost Impact in US$ (000,000)
Minimum Expected Case
(PMO 13% Annual Growth, CBMS 23% Displacement)

	CBMS							
	Costs							
Year	PMO	DISP	IDD	Usage	Equip	P&T	Total	Impact
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1984	1.983	0.456	0.108	0.015	0.006	0.011	0.140	-0.316
1985	2.241	0.515	0.122	0.017	0.006	0.012	0.157	-0.358
1986	2.532	0.582	0.138	0.019	0.006	0.014	0.177	-0.406
1987	2.861	0.658	0.156	0.022	0.006	0.016	0.199	-0.459
1988	3.233	0.744	0.176	0.024	0.006	0.018	0.224	-0.519
1989	3.654	0.840	0.199	0.028	0.006	0.020	0.253	-0.588
1990	4.129	0.950	0.225	0.031	0.006	0.022	0.285	-0.665
Total	20.632	4.745	1.124	0.156	0.042	0.112	1.434	-3.311

Making the same PMO increase assumption (13%) as in the Minimum Expected Case but with a 35 percent traffic displacement, Table 5-3 shows that the CGNET could save the CGIAR $ 6 million by 1990.

The bottom line of this exercise is that the CGIAR will save millions of dollars by using the CGNET. We might note that no mention has been made of travel. If a mere 5 percent of the travel could be avoided using computer conferencing, another $ 3.5 million could be saved for this same time period. We have not gone into specifics on the hardware and software required at each Center. We would like to note that in the current CGNET community, 10 of the 15 sites have the equipment in place (and are using it to access CGNET). Of the remaining five, all will need modems or computer/telex interface equipment.

We should also note that in all cases, the equipment used for CGNET access is used for other purposes as well. Therefore, assigning the modem costs to CGNET is quite generous. Finally, the modem requirements in most countries are dictated by the local P&Ts.

Table 5-3. CBMS Cost Impact in US$ (000,000)
Optimistic Case
(PMO 13% Annual Growth, CBMS 35% Displacement)

	CBMS							
	Costs							
Year	PMO	DISP	IDD	Usage	Equip	P&T	Total	Impact
	(1)	(3)	(3)	(4)	(5)	(6)	(7)	(8)
1984	1.983	0.694	0.108	0.015	0.006	0.011	0.140	-0.554
1985	2.241	0.784	0.122	0.017	0.006	0.012	0.157	-0.627
1986	2.532	0.886	0.138	0.019	0.006	0.014	0.177	-0.709
1987	2.861	1.001	0.156	0.022	0.006	0.016	0.199	-0.802
1988	3.233	1.132	0.176	0.024	0.006	0.018	0.224	-0.907
1989	3.654	1.279	0.199	0.028	0.006	0.020	0.253	-1.026
1990	4.129	1.445	0.225	0.031	0.006	0.022	0.285	-1.160
Total	20.632	7.221	1.124	0.156	0.042	0.112	1.434	-5.787

Any model is open to criticism and ours is no exception. It could be refined: for example, we could subtract IDD charges for particular Centers according to the date we estimate the host country to obtain gateway access. The savings to the CG would grow. If we were asking the CG to invest hundreds of thousand of dollars to obtain the CGNET capability, these refinements would have to be made. Instead, we are asking each Center to spend about $ 2000 for two high quality modems. We think of our model as dynamic, and would like to stress its value as a heuristic device.

The CGIAR has maintained a position of world excellence by exploiting appropriate technologies and seeking top-rate talent. The worldwide telex system is becoming an outmoded technology and is being replaced with newer, faster, and cheaper devices and techniques for communicating information. The CGIAR stands to save millions of dollars by keeping in step with the latest communication and computer technologies. The only real choice is whether to begin now or wait several years. The CBMS pilot participants were unanimous: 100 percent felt that the CBMS should be continued. Waiting will be quite costly, and we cannot forsee any possible reason to delay implementation.

Chapter 6

RECOMMENDATIONS AND PHASED ACTION PLAN

In Chapter 5 we looked at the "bottom line" in terms of CBMS costs; in this Chapter we will again look at the bottom line but from the point of view of what has to be done to make the CGNET operational. We will look at issues that face the CGIAR as a whole and not cover those details that are best handled by individual Centers (see Appendix O for Center-specific recommendations).

6.1 RECOMMENDATIONS

Nine of the Centers are on CGNET via gateway or direct access to the Value-Added Network (VAN). At this writing, a tenth (ICRISAT) is using CGNET via a relay computer operated by Telematics International. (We log on to ICRISAT's VAX twice a day, deposit messages from the CBMS, and pick up outbound messages.)

Of the six Centers without gateway access to the CGNET, four will likely have access via International Direct Dialing (IDD) in 1985: ICRISAT, IITA, ILRAD, WARDA. They will need to obtain modems (two of the four have done so already), and get the P&Ts' approval for their use.

The remaining two, ICARDA and ILCA (or any Center for that matter), can use the CBMS via a direct telex link to the VAN by using a particular telex number (telex gateway) which provides a connection to the VAN. We are not encouraging this method because of prohibitive costs. We would prefer to set up a group of telex numbers instead, which would deliver telexes directly to the intended CGNET users. The different telex numbers would represent different distribution lists. For example, one particular telex number could relay a message to all the Director Generals, etc.

ILCA could, as an alternative, use its HP3000 to store messages, and a phone call from a relay computer could pick up and deposit messages, which is exactly what we are doing in the ICRISAT test. We would, however, caution against beginning another relay operation until the results of the current test are clear. In general, we believe that the relay and/or IDD access hold much promise for connecting Centers' remote facilities, many of which are in countries with no VAN access. For example, we are told that IDD is available from Niamey, offering the opportunity for ICRISAT to connect an important remote site.

To bring the remaining six Centers on to CGNET, will probably require a level of effort equal to or greater than the one expended during the CBMS pilot project. However, in anticipation of their eventually joining the network, we are providing Dialcom documentation to all of these off-net Centers. Thus we will at least not face the delay of getting training materials to the Centers.

Each of the nine pilot CGNET Centers is actively involved in optimizing its use of the CGNET, and a brief summary of the status of each is provided in Appendix O. The most pressing remaining issue (since the current project has ended) is to work out the administration of the CGNET service. An organization needs to assume the responsibility of providing the CBMS billing back to the Centers. (If the CBMS provider were to perform this function, expenses would increase by $ 1800 per month, because separate accounts would mean additional subscription fees.) In addition to billing, the directory must be maintained, materials must be supplied, and so on. One solution is to use a CBMS re-seller. The re-seller would gladly perform the needed services, but there are additional usage-sensitive charges for the basic service categories. Using a re-seller would add about $ 1000 per month. By using a contractor rather than a re-seller (who has a large vested interset in his/her particular product), the CGNET community can easily continue to survey the array of commercially available offerings, and experiment with different providers. (GTE Telenet, for example, has offered one month of free usage for CGNET to try out Telemail.)

The second major issue facing the nine pilot Centers is the acquisition of new VAN services. Telex re-filing from the U.S., and physical delivery are two of the most promising services. Also, Centers expressed interest in using computer conferencing, and an electronic bulletin board. CIAT will be piloting the use of XMAIL which provides telex re-filing and will soon add physical delivery (the document is printed and delivered). One Director General suggested the use of computer conferencing for the Benefits Subcommittee as a good pilot. Another Director General suggested the use of a private electronic bulletin board (called PRPOST in the Dialcom system) to keep Centers' computer personnel posted on the latest experiences. Another good use of the PRPOST would be to keep Centers aware of the progress on CGNET additions and changes.

All of these capabilities (and many more) are currently available on CGNET. All that is needed is for someone to take the lead and commit to organizing the particular application. It would be best if one of the Centers would take the initiative, as CIAT has done in the case of telex refiling. The application could be piloted, the results shared with the CG community, and all would be accomplished within the CG, thus saving the expense of an outside contractor.

The final major issue facing the nine pilot CGNET Centers is the expansion of the network to additional locations and in particular to their remote sites. Several Centers have made progress in adding remote sites (of course each Center must decide whether or not to interconnect remote sites). However, the addition of several sets of potential users such as donors, the TAC, and Center Board chairmen, might benefit all of the CGNET participants. A systematic method for informing all of these various potential users needs to be developed and disseminated. In addition, there are numerous potential organizations which might supply communication facilities while CG staff are in their country (as has happened in the case of IDRC in Canada and GTZ in West Germany.)

We would like to reiterate a recommendation regarding telex, which was made to many of the Centers. We strongly encourage that Centers' telex operations begin to prepare telexes on the Centers' mainframe computers, microcomputers, and/or on the various types of word processors. The prepared telexes

can then be sent directly via a telex interface from one of the aforementioned devices, or via the telex re-filing facility on the CBMS.

In our draft of this report several recommendation were made with respect to Centers' libraries. Specific suggestions for libraries have been removed from this version, since they were considered to be too Center-specific. However, we would like to make one major observation: libraries accounted for a relatively small portion of the communication traffic, and made very little use of faster communication channels such as telex, phone, or cable. This is hardly surprising, given the smaller size of library operations in comparison to major scientific programs. However, a warning may be in order. If libraries are restricted to the use of traditional communication media, Centers will face the danger of seriously under-utilizing resources that, if equipped and versed in new technologies, could become the main support for scientific and technical research. We would like to see libraries take a more active role in the acquisition and dissemination of the new communication technologies. The most obvious opportunity for such impact is probably in the area of database access, but libraries can also serve as facilites where microcomputers are located for shared use, where documentation on CBMS and other facilities is provided, and so forth.

6.2 PHASED ACTION PLAN

This section concentrates on those actions that need to be taken from a CGIAR system-wide viewpoint (Center-specific recommendations are found in Appendix O). They are listed in terms of the order in which they need to occur not in order of importance.

1. Make the Current CGNET Operational. Operation needs to become routine with standard operating procedures and billing to Centers. An outside contractor with no vested interest in a particular CBMS product, should be retained for directory updating, problem solving, facilitation, and billback to Centers. (The cost of this contractor could be borne by adding a small fee to each account; this arrangement would also facilitate the addition of new participants.)

   All Centers need individual operating procedures as well, to cover eventualities such as, what an operator should do with an incoming CBMS message addressed to the Center's general mailbox.

2. Inform Potentially Interested CGNET Participants. An invitation for their participation on CGNET needs to be generated along with descriptive materials outlining how they may join the network. The appropriate parties for receiving this invitation is a policy decision, but suggestions have been made for donors, TAC, etc.

3. Establish CGNET Access to Off-Net Centers. This implies continuation of the ICRISAT relay pilot, providing telex gateway and IDD access information to off-net Centers, tracking changes in international gateway access capabilities, developing and piloting inbound telex access to CGNET distribution lists.

4. Implement Additional VAN Services and Applications. Telex, telegram, lettergram re-filing, and physical delivery should be explored and implemented immediately. Also, CGNET participants need to pilot and implement computer conferencing and electronic bulletin boards. Applications for the piloting of these services need to be identified and encouraged. Centers should be made aware of the variety of VAN services available to them, e.g., on-line databases, newswire services, electronic publishing, etc.

6.3 CONCLUSION

Having addressed the key issues for enhancing and expanding the communication capabilities for each Center, the CG System, and the CG community in this report, we would like to give brief consideration to the short-term, mid-term, and long-term perspectives of the CGNET.

Short-Term: To satisfy the enhanced communication needs of the CGIAR, the only reasonable method (at least for the next several years) is to use a centralized CBMS service with integrated messaging capabilities (telex, physical delivery). The centralized service provides a low cost and reliable method for obtaining the services the CG needs.

Mid-Term: As worldwide data network usage grows, countries will begin to add domestic data networks of their own and will begin to offer CBMS services on domestic computers. These computers will have the ability to interconnect, and exchange messages with other computers throughout the world. Once domestic CBMS with international access is established, Centers in those countries will likely find it more economical to use the domestic CBMS. Dialcom, for example, has computers in England and Canada. A user can access the local Dialcom computer and send messages to any Dialcom user. The computer takes care of the logistics of transferring the traffic.

Long-Term: There will probably come a point for the larger Centers where CBMS traffic is quite high. This high traffic volume may warrant purchasing in-house CBMS software with access through domestic and international gateways into publicly available CBMS services.

CGNET will place the CGIAR at the forefront of organizations utilizing advanced computer-based communication technologies. The system will improve scientific, administrative, and library communication, and will immediately provide substantial cost savings. By isolating improved communication as an important CGIAR-wide objective, a solution has been identified which will clearly advance the common objective--which is, of course, improvement in the quality of human life.

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APPENDIX A

Study Background

STUDY BACKGROUND

The first phase of the data transfer network study for the CGIAR was initiated in 1983 and concluded with:

1. A presentation of the study results to the CGIAR Director Generals' Meeting in Tunis on 1 July 1983.

2. A "Preliminary Report on the Feasibility of a Data Transfer Network for the CGIAR," dated 11 July 1983.

3. An annex entitled "Technical Alternatives for the Provision of a CGIAR Data Transfer System (Interim Report)," dated August 1983.

Following the July meeting in Tunis, Telematics International proposed that the GIAR study be broadened to include training of relevant personnel at seven Centers in the use of an internationally available computer-based messaging system (CBMS). Such a "pilot" was necessary to identify practical problems and issues facing a full implementation of the system, and to provide the participating Centers with first-hand experience on which to base decisions regarding a CGIAR-wide network.

We were also asked to broaden the parameters of the data transfer network study be broadened to include a study of sites of special interest in the CGIAR data transfer network, i.e., "an extended network." These sites were to include those Centers with particular problems regarding data communication access. In addition, we wanted to identify organizations which are not among the "primary" sites of the CGIAR study, but which are of particular significance to CG Centers, e.g., regional, and national programs.

The extended network study and the CBMS Pilot were funded in October 1983. The CBMS pilot is well established with nine Centers on-line, and has taken the CG network to an operational phase. Currently, data communication has been established between Canada, Colombia, Italy, Mexico, Netherland, Peru, Philippines, Thailand, and the United States.

APPENDIX B

The CGIAR and Its Centers

THE CGIAR AND ITS CENTERS

CIAT
Centro Internacional de Agricultura Tropical

Apartado Aero 6713
Cali
Colombia

CIAT concentrates on poor urban and rural food consumers in developing countries of the tropics, with primary focus on Latin America and the Caribbean.

The Center pursues two basic research and development strategies: (1) increasing food production on small farms using resource-efficient technology to allow reasonable and stable yields under low input conditions, and (2) the development of technologies that will bring vast, under-utilized areas on the South American continent into agricultural production.

CIAT focuses on four basic commodities: (1) dry beans, a staple food and principal protein source for people in Latin America, Eastern Africa, and the Middle East; (2) cassava, a major carbohydrate source throughout the tropics and sub-tropics of the world; (3) tropical pastures, the key to increased beef production and productivity in the acid soil regions of tropical Latin America; and (4) rice, a staple food of overriding importance throughout the tropical Western Hemisphere.

CIMMYT
Centro Internacional
de Mejoramiento de Maiz y Trigo

Londres 40
Mexico 06600, D.F.
Mexico

CIMMYT investigates worldwide improvement of the production of maize, wheat, barley and triticale. Cereals account for more than 50 percent of the world's diet. Wheat is relied on throughout the Middle East, North Africa and the Indian subcontinent. Maize is a staple for 500 million people in Latin America, Asia and Africa.

To improve world-wide cereal yields, CIMMYT operates several large breeding programs which produce thousands of new crosses each year. Selections are made with emphasis on high-yield potential, wide adaptation, disease and insect resistance, and nutritional superiority.

CIMMYT is the world's major repository for maize germplasm, and hundreds of international trials are coordinated each year. These trials allow performance evaluation of improved germplasm in diverse environments.

CIP
Centro Internacional de la Papa

Apartado 5969
Lima
Peru

CIP aims for the improvement of the potato in high-altitudes in the Andes, and the development of varieties for the lower tropical regions, where it has great potential as a low-cost, nutritious food for many areas of the developing world.

Because of adverse climatic and pest conditions of the lowland tropics and the subtropics, the potato is still a luxury food in most developing countries. To build a better potato for the tropics, CIP has established a world collection of potato germplasm, maintained in viable condition by annual replanting. It currently numbers some 15,000 genotypes. As a basis for further improvement, CIP is converting the tuber seeds in its collection to true botanical seed, which can be stored almost indefinitely, remaining viable without annual replantings.

CIP's breeding program is producing potato genotypes that are insensitive to day length, tolerant of heat, cold, drought and soil salinity, high in energy content and capable of high yields under the various agroclimatic and agronomic regimes, typical of the lowland tropics.

IBPGR
International Board for Plant Genetic Resources

Food and Agriculture
Organization of the
United Nations (FAO)
Via delle Terme di
Caracalla
Rome 00100
Italy

IBPGR works to preserve the germplasms of the world's crops before their genetic diversity is lost. The Center's function is to promote a worldwide network of genetic resource centers to improve the collection, conservation, documentation and use of plant germplasms.

In developed countries, intensive breeding programs are achieving major advances in yield and quality, yet are dependent on narrow gene bases. In developing countries, agricultural and industrial advances are wiping out wild relatives or local cultivars in their natural habitat. Genetic diversity is essential because wild relatives or weedy forms of crops contain genes that are often resistant to disease and insect pests, and to excessively dry or wet conditions. It is vital to have these genes available for future breeding. Consequently, IPBGR sponsors and encourages the collection of seeds and plant material and their long-term storage by a wide range of agricultural centers, governmental units and universities all over the world.

The Center is recognized as the world authority on germplasm collection, storage and data compilation.

ICARDA
International Center for Agricultural Research
in the Dry Areas

P.O. Box 5466
Aleppo
Syria

ICARDA addresses the needs of West Asia and North Africa. The overall objective is to increase agricultural productivity as well as availability and quality of food in both the rural and urban areas.

ICARDA is principally involved with rainfed agricultural systems in an area bounded by Morocco, Pakistan, Turkey and the northern provinces of the Sudan. This area includes Cyprus and Afghanistan and comprises 22 countries with a total population of more than 300 million people. Food shortages, intensified by political tensions, are a continuing fact of life throughout the region. In spite of considerable mineral wealth in a few of the countries, the region remains a major food deficit area.

ICARDA serves as an international center for research into and the improvement of barley, lentils and broad beans. It functions as a regional center, in cooperation with other international agricultural research centers, for wheat and chickpeas. ICARDA promotes and demonstrates improved systems of cropping, farming and livestock husbandry, and provides training for and supports cooperation among other national, regional and international institutions in the adaptation, testing and demonstration of such systems.

ICRISAT
International Crops Research Institute
for the Semi-Arid Tropics

ICRISAT Patancheru P.O.
Andhra Pradesh 502-324
India

ICRISAT carries out research on rain-fed farming in the semi-arid tropics. The semi-arid tropics include large parts of Africa, Asia, Latin America, India and the Middle East, with a combined population of some 700 million.

The Center's objective is to improve the cultivated varieties of major food crops and the management of soils and water. The Institute's efforts are focused on the conditions of the poor farmer with little land or other resources.

ICRISAT concentrates on five major rain-fed crops grown by resource-poor farmers: sorghum, pearl millet, chickpea, pigeonpea and groundnut or peanut. In addition to its work on improved cultivars and farming systems, the Institute maintains an economics program that conducts needs assessment and investigates factors that affect acceptance of improved technologies.

IFPRI
International Food Policy Research Institute

1776 Massachusetts Avenue, NW
Washington, D.C. 20036
United States of America

IFPRI was established to identify and analyze strategies for meeting world food needs, with particular emphasis on the poorer groups within low-income countries. The factors involved in a reduction of hunger and malnutrition, require analysis of underlying processes and extend beyond a narrowly defined food sector. The Institute's research program reflects world-wide interaction with policymakers, administrators, and others concerned with increasing food production and with improving the equity of its distribution.

The Institute focuses on four major programs: (1) food production, including production strategies, investment policies and the relationships among economic growth factors; (2) food distribution and consumption, encompassing distribution policies, consumption patterns and effects of food-price policies and technological change on income distribution, food consumption and nutrition; (3) food trade, with special emphasis on food security for food-deficient developing countries, and the potential of agricultural exports as a major source of foreign exchange to finance food imports; and (4) food trends and statistics, with an attempt to pinpoint future food problems and their likely magnitudes.

IITA
International Institute of Tropical Agriculture

P.O. Box 5320
Ibadan
Nigeria

The scope of IITA originally concentrated on the lowland tropics of Africa, its research, however, has expanded to other continents and to some sub-humid and even semi-arid environments. IITA has responsibility for the improvement of cowpea, yam, cocoyam and sweet potato on a worldwide basis, and regional responsibility for cassava, rice, maize, soybean, lima bean, winged bean, and pigeonpea. Major efforts are thus concentrated on basic food crop improvement programs, roots and tubers, cereals, and grain legumes.

Another major program is devoted to traditional farming systems to develop more productive and ecologically sound alternatives to the traditional systems of bush fallow and shifting cultivation. These traditional systems can no longer be used since the growing demand for more agricultural production does not allow for fallow periods between cropping seasons.

ILCA
International Livestock Center for Africa

P.O. Box 5689
Addis Ababa
Ethiopia

ILCA is devoted to livestock, specifically, to improved production and marketing systems, the training of livestock specialists, and relevant African livestock industry documentation. ILCA's field research covers the major ecological zones of tropical Africa, including arid and semi-arid, humid and sub-humid, as well as the highlands.

The majority of people in tropical Africa depend on the combination of livestock and agricultural products as their principal means of subsistence. The human population is growing rapidly, but livestock productivity has remained low. By adapting known technologies and animal farming systems to the needs of tropical Africa, livestock production could be increased at least fivefold.

Dealing with livestock, ILCA is more concerned with systems analysis and management approaches than with commodities. The Center encourages the adaptation of superior technologies, introducing appropriate innovations into traditional social, economic, and ecological systems.

ILCA's research work is subdivided into seven major programs: (1) smallholder mixed farming in the highlands, (2) village sheep and goat production in the humid zone, (3) cattle production in the subhumid zone, (4) pastoral systems in the arid and semi-arid zones of West Africa, (5) range livestock production in Ethiopia and Kenya, (6) the trypanotolerance project, and (7) central research at headquarters.

ILRAD
International Laboratory for Research
on Animal Diseases

P.O. Box 30709
Nairobi
Kenya

ILRAD has the mandate to develop control measures for two major livestock diseases: trypanosomiasis and theileriosis (East Coast fever). Both diseases are caused by parasites that are transmitted by insect vectors; the tsetse fly carries trypanosomes, while ticks transmit theileriosis. These two seriously limit livestock production in vast areas of some 50 developing countries in Africa, Central and South America, the Middle East, the Indian subcontinent, and Asia. The total loss in food, leather, textiles, fertilizer, animal power, and other animal by-products is incalculable.

Animal health problems are a particularly pressing problem in light of decreasing food production in Africa. To make matters worse, population growth figures are the highest in the world. More cultivation and improvements in farming technology have only limited impact. Millions of cattle, sheep and goats die each year from disease, and substantial productivity losses and treatment costs are incurred even when diseased animals survive.

ILRAD's research emphasizes the identification of disease-control methods based on the immunological responses of the host animals. Research on theileriosis has been organized in three projects. An ECF epidemiology project is based on the application of existing knowledge for improved disease control. Two other research projects pursue alternatives for the development of more acceptable vaccines. The trypanosomiasis research program has also been organized into three projects: (1) an epidemiology project, (2) a study of the productivity of trypanotolerant livestock at several sites in Central and West Africa, and (3) a project to develop methods to control the parasites themselves.

IRRI
International Rice Research Institute

P.O. Box 933
Manila
Philippines

IRRI focuses on the improvement of the quality and quantity of rice. For almost a third of the world's 4.5 billion people, an abundance of rice means survival, a scarcity of rice means hunger, malnutrition and starvation. Rice is a secondary staple for another 450 million people. IRRI has greatly transformed the traditional tropical rice plant by developing a semi-dwarf, stiff-strawed variety, that does not topple and and does permit denser planting. Although a considerable improvement over the existing species, technology was not appropriate for many farming conditions and the varieties were as susceptible to disease and pests as the old rices.

IRRI's Genetic Evaluation and Utilization Program is concentrated on six major areas: (1) the development of rices with built-in resistance; (2) the creation of crosses between drought-resistant and high-yielding rices which promise less risk for farmers; (3) the production of rices that combine high yield and acceptable grain quality without decreasing protein content; (4) the creation of rices that can tolerate saline, alkaline, acid and irontoxic soils, as well as soils deficient in phosphorus, zinc and other essential elements; (5) the combination of genes of high-yield varieties with desirable traits of others to produce rices that can elongate with rising floodwater or that can tolerate periodic submergence; and (6) the crossing of cold-tolerant rices with modern tropical varieties to produce high-yielding rices that thrive in cold climates, as well as the development of heat-tolerant varieties for irrigated areas in arid regions.

The International Rice Testing Program links national programs with IRRI's Genetic Evaluation and Utilization Program and the rice germplasm collection. The best germplasms from all countries are being tested uniformly and are coordinated internationally in nurseries.

The Cropping Systems Program focuses on the development of early-maturing plants, thus intensifying rice production.

ISNAR
International Service for
National Agricultural Research

Oranje Buitensingel 6
2511 VE The Hague
Netherlands

ISNAR has as its mission the strengthening of national agricultural research systems. National programs play a vital role in the identification and selection of needs and opportunities for the improvement of crops and livestock. These programs adapt new technologies to their specific conditions, release them to farmers, and promote their adoption. Many national programs, however, lack scientific and technical strength, organizational and managerial skills, and facilities and financial resources. These deficiencies inhibit their ability to collaborate effectively in research and development efforts.

ISNAR is also concerned with the social, cultural, and economic aspects of research, and concentrates on the problems of program planning, policy, organization, and management. The Center assists governments in the identification of research needs, the setting of priorities, and the planning of research strategies. In addition, the Center designs and installs research facilities, trains scientific and administrative staff and obtains technical or financial assistance from external sources.

Major activities include: (1) the specification of national goals and policies for agricultural development; (2) the improvement of the capacity of national systems to organize and manage research; (3) the linking of the research system with the producers in order to understand their problems and modify research to their conditions; (4) the communication of results to national policy-makers, scientists, farmers, and others; and (5) the use of grants, loans, and human expertise from appropriate organizations to assist agricultural research in developing countries.

WARDA
West Africa Rice Development Association

P.O. Box 1019
Monrovia
Liberia

WARDA is a cooperative inter-governmental organization aimed primarily at making the region self-sufficient in rice. Its members are: Benin, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta.

WARDA's effort to increase rice production in West Africa is based on the development of improved varieties adapted to the region's agroclimatic and social conditions. The effort also includes the development of improved farming systems.

Although WARDA has been able to identify several high yielding, stable rice varieties, there still remains the need to select those that are resistant to cold, and wind and bird damage, especially in the Sahelian zone. Also, in that region, the efficiency of water use is a crucial factor in rice production, considering the high rate of evaporation. Consequently a water-management program was initiated to determine ways of increasing the water use efficiency under farmers' field conditions.

Research work is in progress to improve the yield of upland rice through careful application of fertilizer, breeding for high yield, drought and disease resistance and improved cultural practices. Research on the appropriate farming system for the maintenance of soil fertility under upland rice cultivation is also under way.

In the mangrove rice ecology as well as in the deep-water floating-rice ecology, attempts are being made through hybridization to produce new varieties that can give higher yields. In addition, emphasis is placed on the improvement of agronomic practices for this ecology.

In the irrigated rice ecolcgy, efficiency of water use, use of Azolla as a source of nitrogen, and the control of new diseases and insect pests through selection of resistant varieties, is emphasized.

To insure the controlled introduction of pure, disease-free seed of new rice varieties for its research programs and for the region, WARDA serves as the sole importer and distributor of seed from outside West Africa. WARDA's activities extend also to the post-harvest aspects of rice production, including grain storage and processing, and the marketing of rice for both domestic consumption and export.

CG SEC
CGIAR Secretariat

1818 H Street, NW
Washington, D.C. 20433
United States of America

The CGIAR Secretariat has several main functions:

1. it is responsible for ensuring that the funding requirements of the Centers are submitted in an orderly way to the CGIAR, and for advising the Group on plans to meet future requirements,

2. it seeks to ensure that the system is provided with adequate resources (real growth in activities as well as inflation have required continually increased funding so the Chairman of the Group and Secretariat have needed to attract new donors onto the Group while encouraging existing donors to increase their support),

3. on behalf of the Group, and with the advice of the Technical Advisory Committee (TAC), it attempts to ensure that the resources provided to a Center are effectively used to fulfill its mandate in keeping with the Group's established policies,

4. it brings policy issues to the Group for decision and facilitates the implementation of the decisions,

5. it facilitates communication between the various elements in the CGIAR enterprise and provides information about it to those outside, and

6. it provides administrative support for the Group's meetings and other collective activities, acts as staff for the Co-sponsors and provides advice to the Centers on matters within its competence.

TAC SEC
TAC Secretariat

Food and Agriculture
Organization of the
United Nations (FAO)
Via delle Terme di
Carcalla
Rome 00100
Italy

The TAC Secretariat performs, in support of TAC, staff and administrative functions analogous to those of the CGIAR Secretariat. Responsibilities include the identification and analysis of scientific policy issues, recruitment of experts selected for Quinquennial Review Panels and other missions, documentation and administrative arrangements for TAC meetings and other operational activities, and participation in the annual process of reviewing the programs and budgets of the Centers.

APPENDIX C

TmI Communication Audit and Methodology

TMI COMMUNICATION AUDIT AND METHODOLOGY

To simultaneously assess end-user needs and technical feasibility, Telematics International developed the TmI Communication Audit. This audit provided a tool for each Center to summarize its own communication needs from a variety of perspectives. The audit as a working research tool required as much as two person-weeks of effort at each site, but we feel that this effort was easily justified since merely completing the document, gave participants valuable insight into their site's communication situation. The audit covered such areas as:

- Physical Plant, Communication Equipment, and Facilities
- Scientific and Administrative Communication Needs
- Scientific and Administrative Procedures
- Crisis Communication
- Legal Issues
- Previous Experience

Telematics International supplemented the information from the audit with visits to most of the Centers, to enrich these data with an in-depth understanding of the operation of each facility. The data-gathering effort resulted in an analysis with two major thrusts:

1. a management, user, and organizational survey; and
2. an information system, applications, and traffic survey.

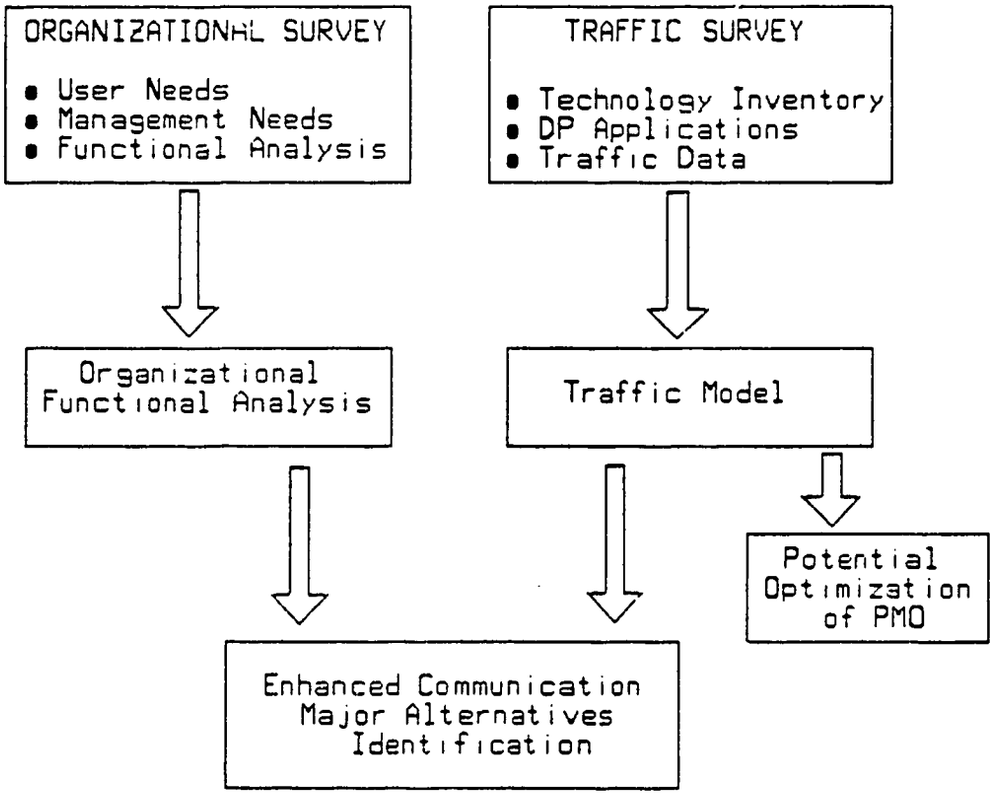
The organizational survey led to a functional analysis of the participating Centers. It allowed an understanding of major information flows in and out of the sites, an understanding of how these inputs and outputs are processed within the sites, and an organizational functional analysis.

The traffic survey looked at the sources and destinations of information, the channels that were used, the amount or volume of the information, and the technology involved in transferring or capturing the information.

We have taken a broader perspective than most telecommunication planning studies because, for example, we included travel as a technology associated with the face-to-face communication channel. The basis for configuring any network is a good model of the traffic demand that exists and is expected to exist in the future. A side benefit of the creation of this kind of traffic model construction is the potential for optimizing the already existing network.

Together, the output of the two streams of survey data, the organizational functional analysis, and the traffic model led to "the identification of major alternatives for enhanced communication." The resulting list of alter-

natives which were to satisfy the needs of the CGIAR, was the most important product of the communication audit. The communication audit methodology is shown diagrammatically in Figure C-1.



Note: DP = Data Processing
PMO = Present Mode of Operation

Figure C-1. Conceptual description of the TmI communication audit.

The communication audit (along with the site visits) was one of the three major elements of TmI's methodology. Concurrent with the processing of the audit data, we assessed the technical feasibility of various services (text messaging, database access, interworking), major equipment alternatives (microcomputers, terminals, storage devices), and network interconnections (leased lines, public networks, satellite links). We also summarized legal concerns and regulations. From the technical feasibility study we determined a set of technically feasible alternatives.

Once we had the major alternatives for enhanced communication from polling the organizational needs, the technically feasible major alternatives from reviewing the state-of-the art technology, and the legal constraints, we submitted these considerations to a network decision process. This consisted first of eliminating alternatives which did not meet all three constraints. We

also eliminated alternatives which were clearly too costly. For example, voice-grade telephone lines could be leased to each facility, but the combined cost would be about US$ 100,000 per month. Our understanding of the traffic volume suggests that 1.2 million dollars would be too much to spend on interconnections alone.

The next step in the decision process involved optimizing the combinations of alternatives which provided the most services at the lowest cost. We took into account equitable distribution of resources, system administration and maintenance, reliability, and anticipated technological trends.

The output of this decision process was a set of alternative scenarios for enhanced communication. Each of these scenarios was subjected to an in-depth evaluation in terms of costs, benefits, and evolution potential. The latter was extremely important since we had to design a network and service facility which could gracefully evolve as new services and technologies became available. The output of this methodology is ultimately a Phased Action Plan for 1984-1988 (see Chapter 6). The framework for the CG communication system design is shown in Figure C-2.

We should note at this point that looking only at the individual Centers is somewhat like the proverbial "tip of the iceberg". Many of the Centers have numerous remote locations, and a broader picture would be obtained, if the potential and existing traffic among these locations were taken into account.

An engineering study to design a network topology would consider local tandem switching placement, homing of remote nodes to tandem switches, bypass access groups, hop-off routes, and so forth. We are not performing such a study at this time; however, we hope that our current network design can provide the "backbone" of an eventual CG system network.

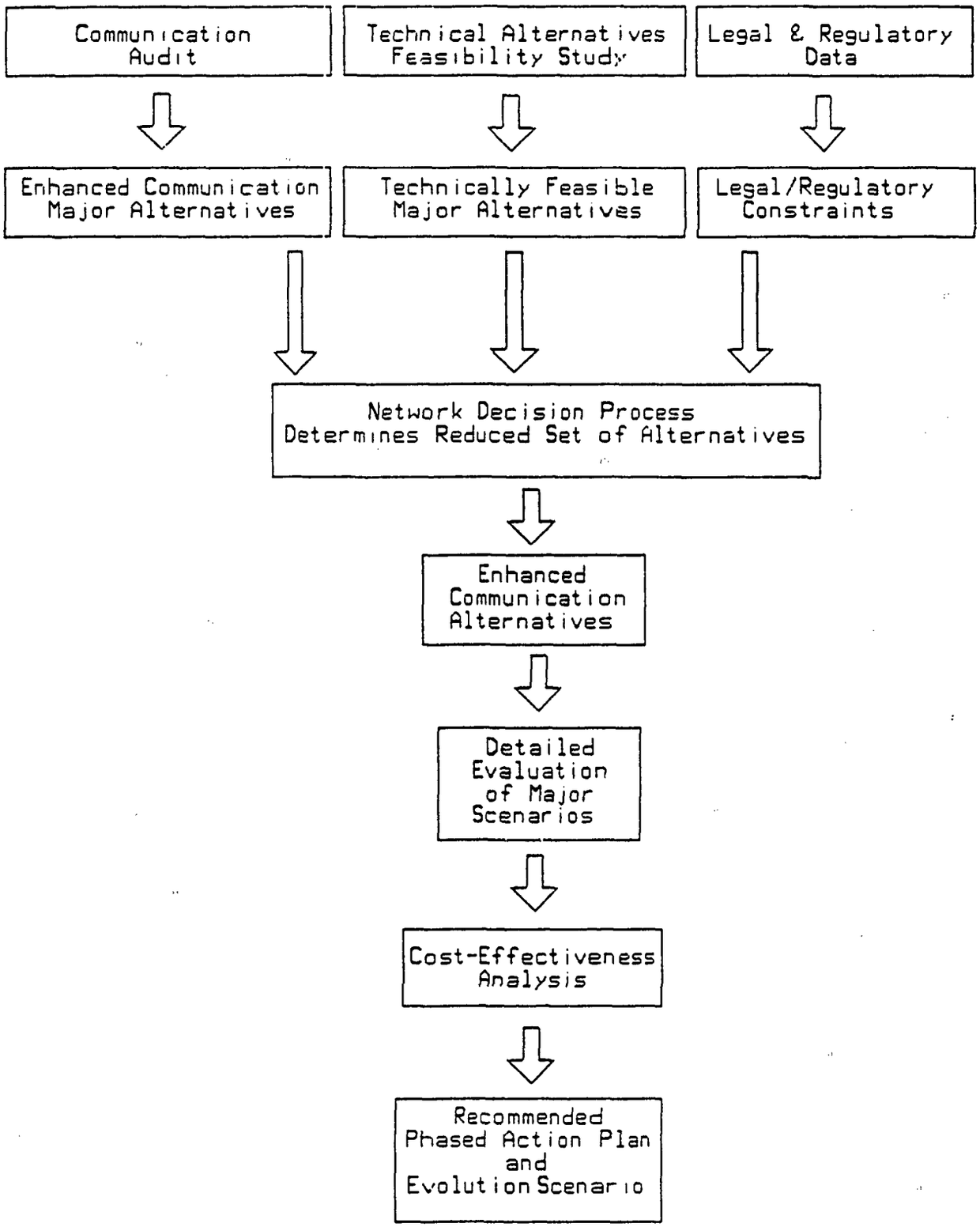


Figure C-2. Conceptual framework for the CG communication system design.

APPENDIX D

IDRC Guidelines

IDRC GUIDELINES

In 1982, the IDRC issued a document entitled "Guidelines for a Feasibility Study on the Implementation of a Data Transfer Network for the International Agricultural Research Centers." The document specified the four basic areas which a study should examine: (1) communication needs, (2) technical possibilities, (3) implementation feasibility (for each Center), and (4) conclusions and recommendations. These IDRC guidelines have been adhered to throughout the study. They request the collection and synthesis of the following information:

1. Communication Needs were to be determined for both the present and the future. The present situation was to be examined in terms of communication patterns, communication media (including travel, volume, and costs), and external database searching. Future communication needs were to be determined based on projections of the current situation, given reliance on traditional media.

2. Technical Possibilities were to cover microcomputers, electronic mail, computer conferencing, and telecommunication options.

   Microcomputers were to be considered with respect to: text preparation, store and forward, unattended nodes, error checking and retransmission, and interface between word processors and network.

   Electronic mail and computer conferencing options for the study were to include decisions as to whether a Center should (1) develop its own software, (2) purchase a turnkey system, (3) use a service bureau and pay-for-use, or (4) utilize host computer(s).

   Telecommunication options were to involve an investigation of: public-switched telephone networks (PSTN), packet-switched networks, microwave transmission, satellite communication, and short-wave radio.

3. Implementation Feasibility was to take into account the technical, legal/regulatory, administrative, and economic feasibility for each Center.

   Technical Feasibility was to be based on hardware requirements (terminals, printers, modems, microcomputers, minicomputers) and software requirements. Software consideration included items such as developing software in-house or purchasing off the shelf; microcomputer requirements; interface with existing computer conferencing networks; interface with TWX, international telex, and packet-switched networks; software support; file transfer capability; user friendliness; command language and degree of sophistication. The contractor was also to consider telecommunication options such as Direct Distance Dialing (DDD), line quality, operator intervention, short-haul microwave or cable, human intermediaries, satellite, short-wave radio, and access to packet-switched networks.

Legal/regulatory feasibility was to examine trans-border data flow policies, import regulations (hardware and software), interconnection standards and regulations, political barriers, and tariffs.

Administrative feasibility had to cover system management and implications, effects on operations, monitoring and evaluation, system expansion to other organizations, growth plans and enhancements, introduction of new technology, system training, training and technical documentation, and trouble-shooting.

Economic feasibility was to be based on cost/benefit analysis, cost sharing formula, and funding mechanisms.

4. Conclusions and Recommendations for the study were to include a system design and a plan of action. The system design had to cover timing, geographic extent, speed and capacity, costs, mix of technologies, role of microcomputers, location of host(s), and timing of implementation of other techniques (e.g., satellite).

APPENDIX E

Terms of Reference

TERMS OF REFERENCE

In proposing the CGIAR network project to IDRC, Telematics International produced a set of terms of reference which were later incorporated into our contract. These terms of reference are addressed in this report, and are as follows:

1. To study the technical, regulatory/administrative, economic and practicable aspects of establishing an information/communication system for the CGIAR Secretariat, the 13 Centers, and the TAC Secretariat.

2. To identify and analyze alternative short-term, mid-term, and long-term implementation programs for an information/communication system for the 15 sites.

3. To recommend, on the basis of those analyses, strategic plans for the provision of services and facilities comprising a CGIAR data transfer network.

4. To identify which Centers could immediately join the system and to develop interim measures for provision of information/communication to those Centers with no opportunity for immediate electronic access to such a system.

5. To specify type and cost of the hardware and software needed at each Center.

6. To specify the services required by the individual Centers and the central facilities.

7. To specify the hardware, software and staffing required at a central facility or facilities, as well as the associated costs.

8. To identify the types of information required for evaluation and on-going monitoring of the system at individual Centers as well as for the system as a whole.

9. To develop guidelines for the introduction and expansion of the CGIAR data network services at the 15 sites.

APPENDIX F

Design Objectives and Selection Criteria

DESIGN OBJECTIVES AND SELECTION CRITERIA

This appendix describes the design objectives for a CGIAR data transfer network, and the assumptions and guidelines for the identification and selection of the technical alternatives.

F1 DESIGN OBJECTIVES

In order to develop realistic scenarios for a CGIAR data transfer network, and select the technical alternatives accordingly, we established a set of general design objectives. A brief description is given for each of the key points.

Dependability. Communication and information processing systems are considered to be essential in the day-to-day operations of the Centers. Consequently, the CGIAR network architecture must provide the following:

1. A high probability of continuous availability.

2. Autonomous and, to the degree possible, automatic recovery from errors.

3. A systematic reporting of errors and status information for those cases where recovery is not achievable automatically.

Price and Performance. Continued emphasis will be placed on total cost and on performance in its broadest sense. System structures that help to reduce costs for systems development, operation and maintenance, will therefore be of particular importance.

Usability. The decreasing cost of computing power and the availability of numerous services for interpersonal communication, is quite promising for a CGIAR network. However, the acceptability of a system depends a great deal on whether it can be used by individuals with different skill levels. User interfaces ideally have command subsets for users with different levels of experience. The user of the system must be shielded from complexity that is irrelevant to his/her use of the system. To the degree possible, the use of the system should be completely independent of the local system configuration.

Of importance in the CGIAR network are services that (1) prompt the user (on request), (2) minimize the amount of information the user must have about the network and the services employed, and (3) accommodate the language the user is accustomed to.

Changeability. Data transfer and communications systems are characterized by growth and change. The CGIAR network structure must facilitate the tailoring of a system design that meets the evolving needs of the individual installations. Each major level of the systems structure should be amenable to modification without substantially affecting other pieces of the structure.

Diversity of Function. The different application areas of the CGIAR network (e.g., administrative communications, scientific and technical communications, messaging, conferencing, etc.), and different types of devices, will require increasingly diverse communications facilities. The large number of necessary options must be organized in a systematic hierarchy in order to avoid unnecessary proliferation of options. To promote more general communicability, common sets of options must be established.

Distributed Function. Lower hardware costs and advances in telecommunication services permit an increase in the amount of distributed function regarding computer power and data storage, in high-function terminals and in the local Center sub-systems. Huge centralized computers supporting hundreds of terminals are rapidly becoming a thing of the past. The distribution of computer power throughout the systems offers advantages in terms of performance, reliability, cost-efficiency, and in the ability to grow the system in an incremental fashion.

Multiple Domains. Different portions of the CGIAR network can be expected to grow autonomously for a time, with a subsequent integration. Even in a completely "united" network, there will always be justification for a degree of uniqueness within the sub-nets. The total CGIAR network must be prepared to accommodate different messaging domains (where simplified or specialized addressing may be appropriate for a sub-net) and multiple control domains (where resource control is regionalized and a coordination among peer system control points is required). For example, CIMMYT may wish to establish a local CBMS at El Batan for communication among staff at headquarters and Mexico City. This local CBMS should be interfaced with the international CBMS.

Diversity of Transmission Facilities. The structure of the CGIAR network must permit the use of different transmission services in different parts of the data transfer network. These various communication components of the CGIAR system must be amenable to change as the circumstances warrant it. The primary choices anticipated include:

1. Choice of communications carrier (for example, a terrestrial voice-grade carrier, a terrestrial digital service carrier, a satellite carrier, a packet carrier, etc.).

2. Choice of service from a particular carrier (for example, switched public service or non-switched leased-line service), and a particular band width depending on tariffs, geographic dispersion of destinations, and anticipated traffic.

3. Choice of private transmission systems, such as in-house systems (using local area networks or digital PBXs) and local/regional systems (using radio, microwave, special satellite services, etc.).

An important consideration here must be the development of a minimum number of common interfaces for physical connections to a variety of transmission services.

F2 IDENTIFICATION OF ALTERNATIVES: CRITERIA AND ASSUMPTIONS

The identification of technical alternatives was based on the initial IDRC guidelines for the feasibility study (see Appendix D), and was directed by our understanding of commercially available services and technologies. Publicly stated plans of various vendors and industry projections were the concrete basis on which the actual alternatives for a three- to five-year time frame were developed.

The selection of the most promising alternatives was based on the following assumptions:

1. The availability of services and technologies is changing at varying rates within the Center host countries.

2. A critical error at this point in time would be to limit all Centers to the solutions available at those sites that are most technically "disadvantaged" (i.e., choosing an alternative on the basis of a "least common denominator").

3. Since a uniform provision of technologies and services to all Centers is not possible, a primary consideration is the development of a system that allows all Centers to evolve more advanced and appropriate systems in a coherent and cost-efficient manner.

4. Despite the inability to provide a uniform set of services and technologies to every Center, all Centers should be capable of interconnection and interaction, though at different costs and with different capacities.

5. Data processing and communication networks typically evolve over a number of years. Equipment and telecommunication facilities available at the Centers, range from basic to quite advanced. It is inevitable, therefore, that the CGIAR network will consist of combinations of old and new equipment, with old services (e.g., telex) in concert with the new (e.g., computer-based messaging systems).

6. The goal of the data transfer network is an overall communications system which permits sharing of communication and information processing facilities. Moving from that system to a structure wherein all lines and terminals are capable of providing all data transfer services, could involve major re-design and expense if that move was not considered from the start.

7. The CGIAR network architecture must provide a more unified total structure to minimize unnecessary architectural proliferation. On the other hand, a degree of coexistence must be designed into the structure, in order to provide a practical set of migration paths toward the desired architectural integration.

APPENDIX G

Interviews: Locations and Logistics

INTERVIEWS: LOCATIONS AND LOGISTICS

As part of the communication audit, Telematics International conducted a number of site visits. Discussions and interviews took place at the following locations:

CG Secretariat	Washington D.C.
CIAT	Cali
CIAT	Palo Alto
CIMMYT	El Batan
CIP	Lima
IBPGR	Rome
ICARDA	Aleppo
ICARDA	Cairo
ICRISAT	Hyderabad, New Dehli
Indian Telecomm. Representatives	Bombay, New Delhi
ICRISAT	Palo Alto
IDRC	Ottawa
IDRC	Cairo
IFPRI	Washington D.C.
IITA	Ibadan, Lagos
Nigerian Telecomm. Representatives	Ibadan, Lagos
ILCA	Addis Ababa
Ethiopian Telecomm. Representatives	Addis Ababa
ILRAD	Nairobi
Kenyan Telecomm. Representatives	Nairobi
IRRI	Los Banos, Manila
Philippine Telecomm. Representatives	Manila
IRRI	Palo Alto
TAC Secretariat	Rome
FAO Staff	Rome
Data Committee: CIAT, CIMMYT, IBPGR, IITA, and IRRI	Ottawa
All Centers (TAC and DGs' meeting)	Tunis
All Centers (Information Officers)	Frankfurt
All Centers and World Bank Telecomm. Staff (Centers' Week)	Washington D.C.

Georg Lindsey conducted the first site visits in May 1983 to IFPRI and the CG Secretariat. During the same month he visited CIMMYT, CIAT, and CIP. At the end of June, he met in Tunis with staff from various Centers and presented preliminary findings. At that meeting, the Center Directors also asked Telematics International to undertake the operation and evaluation of a pilot Computer-Based Messaging System (CBMS). In October, Richard Miller attended the meeting of Information Officers in Frankfurt and visited ISNAR. Also in October, Georg Lindsey attended the Centers' Week meetings in Washington, and met with the computer staff of the World Bank. In November and December, he travelled (in the order given) to ICARDA and the Cairo offices of ICARDA and CIP, ILCA, ILRAD, IITA, the TAC Secretariat, and IBPGR. He also met with telecommunications experts and officials of the Post and Telephone ministries in Addis Ababa, Nairobi, Lagos and Ibadan.

In January 1984, Richard Miller met in Washington with World Bank telecommunication staff, as well as with TRT Communications, Inc., INTELSAT, IFPRI, and the CG Secretariat. In February and March 1984, he visited IRRI and ICRISAT, and met with telecommunication agencies in Manila, Bombay, Hyderabad, and New Dehli. His visit was to include a stop in Bangkok to meet with representatives of CIMMYT, IRRI, and IBPGR there; unfortunately, logistics prevented this meeting as Center staff were travelling during that time. In April, he met with the staff of the CG Secretariat in Washington D.C.

During April, the opportunity of a meeting with a number of Centers was presented in Ottawa, and the meetings were attended by Georg Lindsey. Following the Ottawa meeting, Leslie Chapas and Jim Estes (Computer Center managers of CIAT and ICRISAT respectively) visited the Palo Alto offices of Telematics International for two days to discuss technical communication problems and acquire appropriate equipment.

CIMMYT was visited a second time in May 1984, to (1) create an awareness for the potential of the CBMS, (2) identify application opportunities, and (3) provide support for the operation and utilization of the system. Seminars on potential uses of the CBMS were conducted, and "hands-on" training was provided for system operators. Finally, Bart Duff of IRRI's Agricultural Economics visited the office of Telematics International in July 1984.

APPENDIX H

Communication Audit: Description

COMMUNICATION AUDIT: DESCRIPTION

Quantitative data were collected by use of a detailed survey, the communication audit. This questionnaire was divided into 14 sections:

1. Physical Plant - sought information on the number of personnel working at the Center and their classifications, the number of remote facilities, and electrical power conditions.

2. Communication Equipment and Facilities - sought information on the telephone system, and the characteristics of the major communication media (telephone, telex, telegraph and mail).

3. International Travel - asked which countries were travelled to, the amount of money spent on travel, and the the distribution of travel by personnel category.

4. Scientific Communication Needs - sought information on technologies for which scientists perceived the greatest needs and asked for evaluation of the potential benefits of different types of communication improvements such as: faster communication between Centers, and faster communication between Centers and the CG Secretariat.

5. Administrative Communication Needs - sought information on technologies which administrators needed most, and asked for the potential benefits of different types of communication improvements.

6. Scientific Procedures - asked for particular sources and destinations of scientific information where better communication was needed. Section 6 also asked about problems with different modes of scientific communication.

7. Administrative Procedures - parallel to Section 6, this section asked for particular sources and destinations of administrative information where better communication was needed, and about problems with different modes of administrative communication.

8. Crisis - asked about the means of communication used in urgent situations.

9. Radio Communication - concerned the utilization of two-way radio.

10. Scientific and Technical Information Needs - consisted of rank-orderings of the five most important areas for which improvement was needed in information gathering.

11. Previous Experience - inquired about the amount of experience the Center had in communication technology, about knowledgeable persons at the Center, and about obstacles to the application of new technologies.

12. Legal Issues - sought information on regulatory and legal aspects of trans-border data flow.

13. Ideal Telecommunication - sought the respondents' view on the function attributes of an ideal telecommunications system for that particular Center.

14. Additional Sources of Information - provided a space for giving the names of persons/organizations in a Center host country who might be useful in our study.

It was not possible to obtain complete information for all variables. Our method of handling missing data was, to compute statistics based on the number of responding Centers. In cases where fewer than five Centers responded to a question, the variable was dropped. For most variables, nine or more Centers responded.

For total system estimates, we calculated the mean for the Centers responding, and multiplied that by 15 sites. For example, if 11 Centers reported telex traffic averaging 100 telexes per month, the total CG system estimate would be given as 100 times 15, or 1500 telexes per month.

APPENDIX I

Communication Audit: Results

COMMUNICATION AUDIT: RESULTS

This appendix presents the results of the two major methods of data collection, i.e., the questionnaire and the interviews. The data are not presented separately, by method, but are integrated into the findings for major content areas. Because the emphasis is on providing descriptive information, a minimum amount of interpretation is given.

CGIAR STAFF

Table I-1 shows the CGIAR staff distribution. Thirteen Centers along with the CG and TAC Secretariats report the employment of 1119 scientists and engineers, 110 administrators, and 68 library staff. The total staff, including all classifications (professional support, clerical, farm workers, guards, technicians, etc.) amount to 9400 people. Included in this total are Center staff located in 131 remote sites in 51 countries.

Table I-1. CGIAR Staff Distribution

Category	Total
Professional staff	
Scientists/Engineers	1,119
Administrators	110
Library staff	68
	1,297
Professional staff at remote sites (domestic and international)	805
Other	7,298
Entire staff (all classifications)	9,400

COMMUNICATION AND TRAVEL: EXPENSES AND VOLUME

Table I-2 shows the monthly and annual communication expenses and traffic volume for the CG system as a whole. The costs shown for each medium are those paid to the carriers, and do not include equipment costs, supplies, or labor.

Table I-2. Communication Expenses and Volume

Category	Monthly Average (per Center)	Monthly Total (15 Sites)	Annual total
COMMUNICATION EXPENSES (US$)			
Intl. phone calls	2,965	44,475	533,700
Telex	2,234	33,510	402,120
Telegraph	1,640	24,600	295,200
Letters	1,731	25,965	311,580
Documents	2,452	36,780	441,360
Subtotal	11,022	165,330	1,983,960
Travel expenses	55,394	830,912	9,970,944
Total expenses	66,416	996,242	11,954,904
COMMUNICATION VOLUME (#)			
Intl. phone calls	120	1,800	21,600
Telex	342	5,130	61,560
Telegraph	177	2,560	30,720
Letters	2,025	30,375	364,500
Documents	2,679	40,185	482,220

Some $2 million are spent yearly to make 21,600 international telephone calls, send 61,560 telexes and 30,720 telegrams, and post almost a million letters and documents. The length of an average call, telex, telegram and document is as follows:

Category	Length
Intl. phone call	9 minutes
Telex	138 words
Telegraph	74 words
Document	35 pages

It is worthwhile to look at international telephone and telex rates in order to better understand the composition of the expenses for those communication media. Table I-3 shows international phone costs for a 5-minute call and Table I-4 gives the telex rates for a 50-word telex.

Table I-3. International Telephone Costs for a 5-Minute Call (US$) (Center estimates)

From	To: Washington D.C.	London	Nairobi	Mexico City
Cali	10.50	12.30	16.80	11.60
Ibadan	29.00	21.75	18.00	29.00
Hyderabad	17.00	14.00	14.00	17.00
Lima	10.50	10.50	--	10.00
Mexico City	12.50	43.00	53.50	--
Nairobi	25.00	20.00	--	30.00
Washington D.C.	--	7.50	--	6.00

Table I-4. Telex Rates for a 50-Word Telex (US$) (Center estimates)

From	To: Washington D.C.	London	Nairobi	Mexico City
Cali	10.00	10.00	11.50	10.00
Ibadan	18.00	15.00	12.00	18.00
Hyderabad	8.50	7.00	7.00	8.50
Lima	8.00	8.00	14.00	8.00
Los Banos	9.00	12.00	12.00	9.00
Mexico City	6.00	8.00	10.00	--
Nairobi	13.00	9.00	--	16.00
Washington D.C.*	--	5.00	7.50	2.50

*Depends on carrier, i.e., RCA, WUI, WU, ITT.

A comparison of the above rates for telephone and telex with those currently charged for packet-switched networks (shown in Table I-5), points out immediately the advantage of a computer-based telecommunication system.

Table I-5 shows the charges (US$) for connect time (per minute) and for character transmission (per 1000 characters) for selected countries, where data network access is available (see Appendix Q for a list of international record carrier rates).

Table I-5. Representative Rates (US$)
for Packet-Switched Networks

Country	Carrier	Connect time (minute)	Character transmission (1000 char.)
Colombia	TELECOM	0.31	0.20
Italy	ITALCABLE	0.13	0.08
Mexico	CONACYT	0.18	0.10
Philippines	ETPI	0.20*	0.60
Thailand	IDAR	0.22	0.67

*For a minimum of 15 minutes.

International travel expenses amount to US$ 10 million annually for some 7125 trips. The number of trips for Center staff (by classification) is as follows:

Group	Trips (#)	Trips (%)
Scientists and engineers	221	47
Administrators	50	11
Professional support staff	26	5
Library staff	7	1
Students	99	21
Support staff	3	1
Other	68	14
Total	475	100

When asked if any electronic media could substitute for some of the international travel, 42.9 percent of the seven Centers responding, did so affirmatively, 57.1 percent responded negatively.

Electronic media were also not considered appropriate as substitutes for regularly scheduled international and national meetings. Of eight Centers, 12.5 percent responded positively and 87.5 percent negatively.

Documents account for a large amount of communication volume and expense, and it is interesting to see a breakdown of the types of documents a Center typically receives and sends (Table I-6).

Since the distribution of many of the variables is quite skewed, we are showing, in addition to the mean, the median and range for each type of document. For instance, for scientific and technical papers received, the mean

number per Center is 172, the median (the number above and below which 50 percent of the Centers fall) is 53. The disparity between mean and median can be readily seen from the range. The lowest number reported by a Center was 15, the highest 450.

Table I-6. Volume and Type of Documents Received and Sent*

	Volume							
	Received				Sent			
			Range				Range	
Type	Mean	Med	Min	Max	Mean	Med	Min	Max
Scientific journals	193	188	60	325	--	--	--	--
Books	86	83	15	200	--	--	--	--
Scientific/technical papers	172	53	15	450	865	375	4	3300
Research reports	68	53	5	200	1354	400	1	9000
Newspapers	87	28	2	250	--	--	--	--
Abstracts	45	30	5	100	--	--	--	--
Bibliographies	24	6	3	50	--	--	--	--
Government reports	17	15	1	40	1	1	0	10
Administrative documents and forms	165	58	5	500	110	60	0	500

*Blank spaces indicate that five or fewer Centers reported on this variable.

COMMUNICATION ACCESS FACILITIES AND EQUIPMENT

Access devices which can be used for a data network for the CG Centers, are shown in Table I-7.

Domestic access to international data networks is possible from nine of the Centers, and has been established for them. Mainframe computers in operation include VAX, IBM, and HP. Of the five Centers with VAX facilities (CIMMYT, ICARDA, ICRISAT, IITA and the CG Secretariat), four use VAX 780s and one Center (IITA) uses two VAX 750s. The CG Secretariat's VAX facility is available through the World Bank. IRRI and CIAT have IBM 4331 computers, and IBPGR uses FAO's IBM facility. ILCA maintains and operates an HP 3000.

The largest number of microcomputers are the various types of Radio Shack TRS with 39 machines reported in use at 5 Centers. The second largest number of micros consists of IBM computers, and that number may well grow in the next few years. Six Centers also report having a total of 16 Apple computers.

Table I-7. Communication Access Devices for the CG Centers

Category	Number of Devices	Number of Centers
Computer terminals	298	
Micro computers		
APPLE	16	6
DEC MICRO	6	4
HP MICRO	16	2
IBM PC or XT	22	7
MEMORY 7500	1	1
NORTHSTAR	2	2
OSBORNE/KAYPRO	13	3
TRS	39	5
Word processors (# systems)		
CPT	4	1
DISPLAYWRITER	38	3
MICOM	7	2
WANG	4	3
Network access devices (est.)	500	15

Word processing applications are served most often by Wang multi-user systems and IBM Displaywriters. Two Centers use Micom and one Center uses CPT. Most of the word processors can communicate to computers, or can be modified to allow this capability.

Taking into account the 298 computer terminals, combined with the microcomputers and word processors, means that approximately 500 devices could be used to access a CGIAR data transfer network. This number is expected to grow because 88 percent of the Centers report major equipment purchases in 1984.

A description of the electrical power conditions and selected equipment at the Centers is provided in Table I-8. All Centers reported that electricity was available 24 hours a day, and the largest group of Centers used 220 volts. Power fluctuations were experienced at 80 percent of the Centers, and 80 percent of those responding had provisions for generating their own electricity. Centers without electrical power generating facilities are generally located in countries with stable power situations.

Two-way radios are in use at 73 percent of the Centers, and PBXs were in place at 81 percent with a median of 250 internal lines and 20 trunks for external access. Only 30 percent used leased telephone circuits to specific locations and only 20 percent used leased telephone circuits for data communication.

All Centers report having their own telex machines, and most utilize paper tape punch/readers for input of messages, however, only one Center has facilities for facsimile transmission.

Table I-8. Electrical Power Conditions and Availability of Communication Equipment

Category	Availability	
	(% of Centers)	
Voltage/Frequency		
110/60 Hz	33.3	
220/60 Hz	11.1	
220/50 Hz	55.6	
	NO	YES
24 hours a day voltage	0.0	100.0
Generators	20.0	80.0
Switchboard	18.1	81.8
Leased lines	70.0	30.0
Special lines for data	80.0	20.0
Two-way radio	27.3	72.2
Fax	87.5	12.5
	(Median)	
Number of phones per Center	250	
Number of trunks per Center	20	

COMMUNICATION USAGE, DISTRIBUTION, AND PROBLEMS

In order to determine communication usage, the Centers were asked to identify the primary purposes for the use of individual communication channels. Table I-9 shows the percentage of Centers using various communication channels for these major purposes. For instance, telephone communication is distributed over a number of categories; telexes and cables are used heavily for travel arrangements, other logistics, and purchase arrangements; primary purposes for the usage of correspondence are reported as logistics (other than travel), scientific reporting, and purchasing. The data do not sum to 100 percent because multiple purposes could be mentioned for each channel.

Table I-9. Major Purposes for Center Usage* of Communication Channels

Purpose	Communication channel			
	Phone	Telex	Cabl	Lettr
Non-routine	25		13	
Travel arrangements	25	56	75	33
Other logistics	25	78	67	78
Scientific reports	13	11	13	68
Personal	13			11
Training information	13			11
Purchase arrangements		78	50	68
Money transfer		33		11
Library				11

*Expressed in the percentage of Centers reporting a purpose for a channel.

Usage of communication channels during a crisis situation was reported for two scenarios. When information was urgently needed from an international source:

1. telex was mentioned by 81.8 percent of the Centers,
2. telephone was the choice of 45.4 percent,
3. a courier was used by 9.1 percent,
4. telegraph was chosen by 9.1 percent, and
5. express mail was listed by 9.1 percent.

When information needed to be provided on an urgent basis to an international destination:

1. telex was chosen by 72.7 percent of the Centers,
2. telephone was mentioned by 45.4 percent,
3. a courier was used by 18.2 percent,
4. telegraph was listed by 9.1 percent, and
5. express mail was the choice of 9.1 percent.

The percentage (mean) of Centers reporting usage of the various communication channels by specific user groups, is shown in Table I-10. The telephone is most used by administrative and scientific staff, whereas telex and cable are used largely by administrative personnel. Letters and documents are relied on heavily by scientific/technical personnel.

As far as the Centers' own publications are concerned, we found that the average Center publishes, or submits for publication, about 113 scientific and technical papers in a two-year period.

Table I-10. Distribution of Communication Channels' Usage (%) by User Group

User group	Communication channels				
	Phone	Telex	Cable	Lettr	Doc
Administrative	38	57	57	39	21
Scientific/technical	37	34	28	41	55
Library staff	3	4	5	13	20
Other	22	5	10	7	4
Total	100	100	100	100	100

The percentage of Centers experiencing difficulties when using the phone, is shown in Table I-11. 56 percent of the Centers report problems making local calls, and 78 percent have trouble with long distance calls within their own country. In general, it takes 1 hour to make a long distance call.

Problems, when attempting to make international calls, are encountered at 60 percent of the Centers. 45 percent of the Centers must use an operator to make long distance calls within the country. International calls must be made through an operator at 60 percent of the Centers, with 45.5 percent reporting that international phone lines are very often not available.

Table I-11. Centers (%) Reporting Problems with Internal and External Phone Usage

Are there problems with:	NO	YES
Local calls?	44.4	55.6
Long distance calls within the country?	22.2	77.8
International calls?	36.4	63.6

Which access methods must be used for long distance calls?

	Operator	Dir dial	Both
Within the country	45.5	27.3	27.3
International	60.0	10.0	30.0

Problems with various modes of communication were cited from administrative as well as scientific points of view, and are shown in Tables I-12 and I-13 respectively. For both, administrators and scientists, the biggest problems with letters and documents were turnaround delays and lost items (see Table I-14 for a listing of transit times for international mail).

Table I-12. Problems Related to Administrative Communication (% of Centers reporting)

	Communication medium				
Problem	Lettr	Doc	Phone	Telex	Cable
Reliability	25	25	25	29	38
Turnaround time	75	75	13		
Tampering	13	13			
Lost messages	38	38			
Expense			63	29	38
Technical quality			25	29	13
Cost allocation			25	14	13

For administrators, the biggest problem with telephone usage was the expense. Telephone problems for scientists were: poor quality, unreliability and expense. Few problems were listed for administrative communication with regard to telex and cable, but for scientific communication, the Centers reported reliability problems for both, telex and cable, and expense problems for cable.

Table I-13. Problems Related to Scientific Communication (% of Centers reporting)

	Communication medium				
Problem	Lettr	Doc	Phone	Telex	Cable
Reliability	14	17	50	60	50
Turnaround time	57	83	33		25
Technical quality	14	17	50	40	25
Tampering	14				
Lost messages	57	50			
Expense		17	67	20	50
Overload			17		
No equipment				40	

Table I-14. Transit Times (Days)
for International Post
(as reported by the Centers)

	Washington D.C.	London	Nairobi	Mexico City
Columbia	5	4	7	4
India	7	7	10	13
Kenya	7	4	--	7
Mexico	7	7	15	--
Nigeria	20	7	5	23
Peru	7	10	15	7
Philippines	5	6	14	6
United States	--	5	10	3

The median unavailability and restoration times for power and the communication media are shown in Table I-15. Power outages are a major problem at many of the Centers with a median number of 105 failures per year. In addition, 80 percent of the Centers reported power fluctuations. Telephone, telex and telegraph failures are less frequent, averaging only a few times a year.

The lack of continuous power at many of the Centers has cost implications even when installing microcomputers. Centers will need to consider stand-alone uninterruptible power supplies (UPSs) to ensure proper operation of the equipment.

Table I-15. Unavailability and
Restoration Times (Median) for
Power and Communication Media

Medium	Unavailability (per year)	Restoration (hours)
Power	105	1
Internal telephone	1	1
External telephone	3	13
Telex	3	6
Telegraph	1	1

IMPROVED COMMUNICATION: NEEDS AND BENEFITS

The Centers were asked to rank a number of capabilities available on a computer-based telecommunication system, which would most support scientific, technical and administrative objectives. Table I-16 lists these capabilities as communication needs and shows the ranking given from the scientific/technical and administrative points of view.

Table I-16. Scientific and Administrative Communication Needs Ranked in Order of Importance

Communication need	Type: Scientific	Type: Administrative
Access to remote information (databases)	1	6
Intl. electronic messaging	2	2
Ability to send facsimiles of documents or letters to intl. locations	3	3
Ability to reduce intl. phone costs	4	5
Statistical analysis	5	7
Word processing	6	4
Electronic messaging within the country	6	9
Ability to manipulate Center financial information	7	1
Direct access to telex	8	9
Other	9	10
Electronic messaging within the Center	10	8

Centers reported that the most important scientific needs were (1) access to remote information (databases), (2) international electronic messaging, (3) the ability to send facsimiles of documents or letters to international locations, (4) the ability to reduce international phone costs, and (5) statistical analysis.

For the administrative needs, the most important emerged as (1) the ability to manipulate financial information pertaining to the Center, (2) international electronic messaging, (3) the ability to send facsimiles to internatio-

nal locations, (4) word processing, and (5) the reduction of international phone costs. Access to remote databases or statistical analysis seemed of relatively minor importance.

The communication audit querried the Centers about their estimation of the benefits of faster communication for scientists/engineers, administrators, library staff, and students. We asked the extent to which each group would benefit from faster communication to four types of destinations, (1) to other Centers, (2) from the Center to the CG Secretariat, (3) from the Center to its remote sites , and (4) from the Center to non-CG agencies. The results are shown in Table I-17.

Scientists estimated that they would benefit most from increased communication to remote Center sites and to other Centers. Administrators thought they would benefit from faster communication to all of the listed locations except non-CG agencies; librarians felt that connections with remote Center sites, other Centers, and non-CG agencies would be most beneficial. The strongest benefit to students and trainees was considered to be faster communication to other non-CG agencies.

Table I-17. Centers (%) Reporting Benefits of Faster Communication to Various Locations for Different User Groups

	User group			
Communication points	Scientists/ Engineers	Adminis- trators	Library staff	Students
Other Centers	55	55	64	9
Center and the CG	27	55	36	0
Center and its remote sites	64	55	55	18
Center and non-CG agencies	36	27	64	27
Center and the TAC	27	55	9	0

We also asked the Centers to rate the areas in which they could use assistance in obtaining scientific and technical information. The results are presented in Table I-18. The top five rated needs were, (1) identifying scientific and technical publications relevant to Center research, (2) obtaining, in complete form, scientific and technical publications, (3) keeping aware of recent developments, (4) finding specific facts, and (5) locating information for others. Centers thus indicated strongest needs for hard facts and specific scientific data as opposed to needs for items of interpersonal nature. The cluster of the top five could be seen as an appeal for stronger library support, especially when considering that 55.6 percent of responding Centers listed their preference for a trained intermediary performing bibliographic database searches, rather than for direct access (44.4 percent).

Table I-18. Scientific and Technical Information Needs Ranked in Order of Importance

Information need	Rank
Identify scientific and technical publications relevant to Center research	1
Obtain in complete form scientific and technical publications	2
Keep aware of recent developments	3
Find specific facts	4
Locate information for others	5
Find answers to specific questions	6
Identify new sources of information related to Center research	7
Identify new materials, methods, and procedures	8
Prepare reports, articles, and speeches	9
Keep aware of who is knowledgeable in particular areas	9
Evaluate new materials, methods, and procedures	10
Develop new problem-solving approaches	11
Maintain friendly relations	11
Resolve conflicts	11

We asked Centers to name particular "applications" for the new telecommunication opportunities which would best exploit the potential of a CBMS and international data network. During our site visits (as well as from the questionnaire) we learned from Center staff which applications they consider possible and important (see Table I-19).

Table I-19. Telecommunication Applications for the CG Centers

ADMINISTRATIVE APPLICATIONS

1. Travel and meetings database
2. Purchasing and order tracking
3. Supply sharing
4. Annual budgets and budget reviews
5. Periodic reviews (CG Secretariat and TAC)
6. Board nominations
7. Improved liaison with remote offices
8. Donor liaison
9. Center Directors liaison
10. Liaison with Center Board of Directors
11. General liaison, TAC
12. General liaison, CG Secretariat
13. Recruitment
14. Contractor liaison
15. Fiscal reporting from remote sites

Table I-19. Telecommunication Applications for the CG Centers (Continued)

INFORMATION SERVICES

1. Management of international VIP mailing lists (e.g., directors of national programs)
2. Remote printing/typesetting
3. News release and announcement
4. Access to computer-based translation service
5. On-line newsletter(s)
6. Public relations and communications officers user group
7. Press-clippings distribution/on-line press digest via CBMS
8. Internal CGIAR project description distribution
9. Coordination of "audience" directories
10. Joint authorship and conveyance of newsletter articles
11. Coordinated sales/order processing for Center publications

LIBRARY SERVICES

1. Librarian/information officers user group
2. On-line intermediary services for assistance in performing bibliographic database searches
3. Inter-library loan and cooperation services for the CG Center libraries and national programs
4. Coordinated cataloging/abstracting services among libraries
5. Establishment of on-line information analysis centers within the CG
6. On-line bibliographic search services
7. On-line document retrieval
8. On-line document ordering
9. Inter-library coordination
10. CG system publication awareness
11. Shared database coordination with other Centers
12. Provision of selective dissemination

SPECIALIZED DATABASE ACCESS

These databases might be maintained in-house and provided as services to outside organizations, or maintained at other sites for use by the entire CG system.

1. Germplasm database
2. Training materials and methods database
3. Trainee tracking database
4. Crop disease surveillance database
5. Quarantine database
6. Resume database (e.g., candidates for staff)
7. Funding sources database
8. On-line directories of CG personnel, national programs, board members and donors
9. Database on application software relevant to CG Centers

Table I-19. Telecommunication Applications for the CG Centers (Continued)

COMPUTER SERVICES

1. Liaison with computer center managers
2. Access to current awareness services and consultants
3. On-line transfer of software
4. Shared library of application software (mainframe and microcomputer)

SCIENTIFIC PROGRAMS

1. Joint research with remote locations
2. Transfer of machine-readable data from remote sites
3. On-going "conferences" among special interest groups
4. International nurseries
5. Awareness of important conferences and meetings
6. Access to specialized analysis services
7. Exchange of informal scientific information among scientific staff
8. Joint authorship of scientific papers and reports

APPENDIX J

Telecommunication and Microcomputer Options for the CGIAR

TELECOMMUNICATION AND MICROCOMPUTER OPTIONS FOR THE CGIAR

The guidelines of Appendix D, and our observations of Centers' needs, provided the basis for the organization of this appendix. We will examine in detail, and summarize, alternative technologies for microcomputers, electronic mail and computer conferencing, and telecommunication options.

The following presentation of options and technologies is intended to serve as a familiarization of different technical possibilities for the CG data network. We must point out that most of these technologies are changing at a rapid rate. Nevertheless, the array of products and services available to mid-size organizations has reached a level of maturity that allows one to make rational choices.

We found that for a number of Centers there is simply only one logical choice. This may be due to an existing policy at a Center to standardize, by using a particular vendor's equipment. Often, such decisions are based on practical concerns such as the availability of sales and service of only a particular product. Another limiting factor for many of the Centers is that certain equipment must be provided by governmental authorities of the host countries, and that those authorities select the vendors. In other cases, only certain vendors may be licensed to provide products in a particular country.

J1 MICROCOMPUTERS

With regard to changeability, the most volatile technologies discussed here are microcomputers. The changes are dramatic but positive. Microcomputers are becoming less expensive and more powerful. Waiting until the technology has stabilized, or arrived at an industrial standard, however, is not a viable option. These technologies are likely to continue their rapid evolution for another 5 years. The costs of waiting cannot be ignored. There is simply no excuse for failing to utilize resources which can further organizational objectives so powerfully. Besides which, a reduction in telecommunication costs could free money for re-allocation to scientific programs.

J1.1 GENERAL CONSIDERATIONS FOR THE CGIAR

In our site visits, we were questioned most often about issues of microcomputer selection, usage, proliferation, and standardization. While we were not mandated in this study to address some of these questions specifically, and not all questions (and answers) apply to all Centers, we thought it valuable to list them because these are questions that each Center will have to deal with one time or another. Appendix O gives detailed information about the Centers' individual equipment problems, conclusions and solutions.

Which Microcomputer Should We Buy?

Certainly the de facto standard is the IBM Personal Computer (PC), and it has, in fact, been the choice of CIMMYT, CIP, IFPRI, ILRAD, IRRI, the World Bank (and therefore the CG Secretariat). IBM's "de facto standard" status keeps IBM-compatible manufacturers in a vulnerable position. If it were a true standard, all of the information which other manufacturers needed to insure compatibility, would be released. This is not at all the case. Vendors of compatible machines must constantly anticipate IBM's next moves and IBM is not beyond surprises. Their June announcement of price cuts of up to 23 percent, for example, may have been a death blow to some IBM PC-compatible companies. No Center would be overjoyed with having a number of micros produced by a vendor which is out of business (some Centers have already encountered this problem). To make matters worse for competitors, IBM recently issued a new machine, the PC AT, which outperforms all of the IBM "look alikes", and in early 1985 the company expects to announce its own "lap" computer.

A word of caution is in order about vendors advertising that their machines are compatible with 95 percent (or some percentage) of the programs that run on the IBM PC. This percentage is useless if the program the Center wants to use, falls within the remaining 5 percent. In addition, there is often no way to determine beforehand, whether the software will work or not. The only thing one can do is buy it and try it.

Software is as big an issue, and Centers will need to think of software compatibility. Software standardization needs to be considered at two levels, (1) the operating system under which the software runs, and (2) the applications software that provides the service (word processing, statistical, etc). Most IBM PCs run under the MS-DOS operating system, and hence most software is provided to be excecuted under MS-DOS. In most CG applications, with micros in a stand-alone installation, MS-DOS will be the operating system of choice.

Another popular operating system is UNIX, which was developed at Bell Laboratories. UNIX is more than an operating system, it includes a word processing system, a text-formatter, a communication system, and compilers for executing programs written in C assembler, and others. UNIX has the ability to simultaneously execute multiple tasks. For example, it can print a document while a person is working on something else on the microcomputer. By attaching more terminals to the PC, it can also be used by more than one user at a time. UNIX is thus a "multi-tasking" and "multi-user" system.

UNIX is an inherently more powerful operating system than MS-DOS, and some speculate that it will become the predominant operating system on the PC. Its major drawback is that it is harder to learn than MS-DOS. Written initially for programmers, many of the commands are less than intuitively obvious. For example, "doc this >$lpt" means format the file "this" and print it on the line printer. (One could place these commands in a file called "print" and just issue the command "print this," but a person would have to know enough about UNIX to even be aware of the possibility).

We think that UNIX is a good package for the IBM PC, but would only recommend it for users, who are willing to take the time to learn the system, and thus make use of the features. If a multi-user, multi-task environment is prevalent, UNIX is a good choice.

A complaint voiced against IBM at some of the Centers was that its products were not based on the latest technology. IBM products up to now were based on Intel's 8088 chip, which is several years old, and cannot compete in performance with a number of other chips. (The 8088 is a combination of an 8- and a 16-bit chip; it processes data like a 16-bit chip, but it transfers data like an 8-bit chip. This slows down complex tasks considerably.) Some IBM-compatibles (e.g., Compaq and AT&T) use the 8086 which is a true 16-bit chip. In some applications, such as searching a large data base, the 8086 search time might be 15 seconds compared to 2 minutes for the 8088-based search. However, IBM's PC AT uses the next generation of the 8086 chip, the 80286. This chip performs far better than both the 8088 and the 8086 chip. The PC AT is available now but demand has exceeded supply, resulting in 2-months waiting periods and no discount prices.

We should also point out that a number of add-on boards can be purchased, which upgrade the capabiblity of any IBM PC or XT. For example, math co-processors such as the Intel 8087, can be added, which speed up some statistical programs by up to 8 times. On can also add boards based on Motorola's 68000 series chips.

We certainly have no vested interest in recommending IBM. In some cases, IBM PCs will not be the most appropriate. For example, the FAO has signed a large agreement with Digital Equipment Corporation (DEC). The TAC Secretariat and IBPGR, due to their location at the FAO, will likely be encouraged to use DEC micros. The main selection criterion regarding which microcomputer to use, will be based on sales and service support in a particular country. For example, ILCA has had good support from HP in Ethiopia, and the HP micro may well be the most logical choice for ILCA. Many Centers also find the TRS 80 Model 16 running under the XENIX operating system, to be a powerful and useful system.

In summary, in situations where a choice exists, the IBM PC is the most likely selection. If IBM is not an option, DEC, TRS, and HP are acceptable. For compatibility's sake we suggest the adoption of a well supported operating system.

Why Buy Microcomputers When We Have Compatibility Problems With the Word- and Data-Processing Equipment We Already Have?

This question has become less prevalent in recent years because manufacturers introduced new interface devices, such as speed, code and protocol converters allowing machines of different vendors to interwork. The answer to the question above is, to make sure that the proper hardware and software are purchased along with new equipment, in order to allow communication with the various other devices at the Center. The CBMS pilot has Centers communicating among each other with all sorts of devices ranging from "dumb" terminals to IBM PCs, Micom word processors, IBM Displaywriter word processors, and full-sized VAX computers. ISNAR accesses the system with the Wang, and IFPRI will access the system with the CPT word processors.

Be aware, however, that document exchange between different machines is at the "lowest common denominator" level. That is, the machines transfer only the characters and not the formatting codes, e.g., underlining, pagination. "Protocol converters" do exist and we strongly recommend for the future the

adoption of a "file transfer protocol" which will allow the exchange of formatting codes along with the text.

Can Microcomputers be Used for Concentrating Remote-Site Data and Forwarding Back to the Center?

Yes, ILCA already does it. Their remote staff inputs data on HP-125s and does some local statistical analysis. The researcher eventually comes back to Addis Ababa with his/her floppy disks and transfers the data to the main computer (HP3000). While the computer staff processes the data, the researcher has time to make use of the library facilities. CIMMYT staff will use an IBM PC XT in Bangkok for similar purposes, but the data will be transferred back to El Batan's VAX 780 via the data network. For the sake of accuracy and efficiency, the adoption of a file transfer protocol will be necessary.

Can We Use Microcomputers in lieu of Purchasing a Mainframe Computer?

Centers, which do not have a mainframe computer, can often get by without one. Mainframes will be needed only when the amount of data to be processed is very large, the number of simultaneous users is vast, or the complexity of the iask is great. Many speculate that the days of the mainframes are numbered except in very specialized applications (e.g., complex simulations, massive airline reservation systems). With the arrival of the "superchips", it is now reasonable to consider the use of microcomputers for the support of 4 to 6 users simultaneously.

Why Shouldn't We Get a Microcomputer for the (Library/Purchasing Department/Print Shop)?

In most cases, we do not understand why micros shouldn't be supplied for applications where there clearly is a perceived need. Libraries are probably the most neglected in this respect. Librarians at many of the Centers could use microcomputers for collection management, ordering, access to remote databases and other libraries, the preparation of documents, and word processing. The difficult issue to face here is micro software compatibility with existing mainframes. The integration of the micros is difficult, but this should not serve as a reason to prohibit their acquisition. Many organizations have successfully accomplished such integration.

J1.2 SPECIFIC CONSIDERATIONS

According to the project guidelines, microcomputers were to be considered specifically with respect to (1) text preparation, (2) store and forward, (3) unattended nodes, (4) error checking and re-transmission, (5) and interface between word processors and network. The following paragraphs address each explicitly.

Text Preparation

The distinction between word processors and data processing machines has virtually vanished. Almost all of the word processors at the Centers can be used as data terminals. Similarly, all of the major microcomputers have word-

processing software available. Of interest is the fact that a number of word-processing software packages "emulate" standard word processors such as Wang and the IBM Displaywriter. Thus, significant retraining of users is not needed. The price of an IBM self-correcting electric typewriter is close to the cost of a microcomputer. Clearly, the choice in most cases would be the microcomputer.

Store and Forward

There are three types of store and forward to consider, (1) microcomputer to mainframe computer (the CBMS), (2) microcomputer to microcomputer, and (3) microcomputer to telex.

1. Microcomputer to CBMS Mainframe. The primary cost of international data transfer is the time used on the telecommunication network. The cost to send or receive messages on most CBMSs is directly related to how long one is on the system, expressed in computer connect time and usage charges. Network costs vary from a low of US$ 6.00 per hour to as much as US$ 12.00 per hour, depending on the user's location. The time the user is logged on, is the key variable. Thus, it is quite beneficial to use a word processor or microcomputer to prepare messages beforehand in a "local" mode. Then, the messages can be transferred as a batch into the international network. Most CBMSs have additional charges for disk storage. Thus, storing and managing the messages "locally" on a micro can also save money, and can permit more personalized organization of long-term storage.

   Because connect time is directly related to the speed of data transfer, it is also advantageous to use a higher-speed modem for the network connection. Today's lower-speed modems transmit at 300 bits per second (BPS), higher-speed modems transmit at 1200 BPS. (A speed of 300 BPS is equal to 30 characters per second, and 1200 BPS is equivalent to 120 characters per second. BPS is also referred to as BAUD.) In most countries, the highest speed available over the public-switched telephone network (PSTN) is 1200 BPS. However, in some countries (e.g., Columbia) only 300 BPS access is available. As soon as higher speed becomes available, it should be used. The price of 1200 BPS modems has been falling steadily for some time and will likely continue to do so. Also, speeds of 2400 and even 4800 BPS are becoming possible over the PSTNs in the USA and Europe. This is a fast moving area which requires attention.

2. Microcomputer to Microcomputer. Store and forward between microcomputers works differently and is more cumbersome. Typically there is no automatic access, the micros need to be configured differently, costly equipment may be needed, and the computer must be available, i.e., not already in use and not turned off. We have not seen usage in the CG of micros or word processors in this scenario. Instead, diskettes are physically transported, as in the case of ILCA's remote sites. ILRAD sends its Wang diskettes to a typesetter.

   Error-free file transfer between micros using public or packet networks is definitely possible. Such usage will be highly case-specific and will primarily be useful within a country, e.g., to intercon-

nect ICRISAT's Dehli office with Hyderabad. Software is also available to allow unattended store and forward. This may be useful in cases where the main computer is shut down (most Centers turn off their computers each night).

3. Microcomputer to Telex. We have not seen microcomputers utilized in the CG for telex and yet, this is an important application. No new single-function telex machines should be added at the Centers. Microcomputers can do the job cheaper and more effectively. Initially, the micro can be used in addition to an already existing telex machine. A switch will be needed to allow changing the connection from the telex line to a modem which can access other services, e.g., the Centers' main computer, the CBMS, etc. As the telex machines become outdated, micros should be used exclusively.

Unattended Nodes

There is a hesitancy among CG Center computer directors to leave major computer equipment unattended. Typically, the major machines, e.g., VAX 780s and IBM 4331s, are protected from power surges and outages by power filters, uninterruptable power supplies (UPS) and backup generators. The problems arise when repairs are necessary; the procurement of replacement parts and service is so slow that the risk of leaving the machine on all night without an operator, is simply too great. Microcomputers can be left unattended for applications requiring 24-hour availability, but most of the Centers would need to provide the micro with its own UPS. Low-power models can be purchased for US$ 500.00 to 700.00.

Error Checking and Re-Transmission

For serious data transfer, for instance transmission of data from experiments, error checking and correction is absolutely essential. A number of software packages are available commercially, e.g., KERMIT and BLAST. To receive data from remote locations, error-checking file transfer protocols should be put into effect. KERMIT is public domain (and therefore free) and would be our recommendation for the PCs and the mainframe applications. KERMIT is available for many micros and for all the mainframe computers in use in the CG.

Interface Between Word Processors and Network

Any word processor in the CG system should have the ability to transfer files into the network, and most of the CG word processors can do that already. However, not necessarily all of a Center's word processors need telecommunication options. Communication boards and software for IBM Displaywriters are about US$ 1500.00. CIMMYT, which has 27 Displaywriters, does not need 27 boards, but at least two of the machines should have the communications options installed. In this way, floppy disks can be brought from the other Displaywriters to the communicating machines. While perhaps not the most convenient scenario, the ability to transmit previously "captured" information is well worth the price.

J2 ELECTRONIC MAIL AND COMPUTER CONFERENCING

J2.1 GENERAL CONSIDERATIONS FOR THE CGIAR

Electronic mail and computer conferencing options for the study included decisions as to whether Centers should (1) develop their own software, (2) purchase a turnkey system, (3) use a service bureau and pay-for-use, or (4) utilize host computer(s). We will discuss these issues in the paragraphs that follow. However, a major portion of this appendix will be devoted to an in-depth discussion of the computer-based messaging system (CBMS). We do so because a CBMS will be a mainstay in any CG network, and because access to and utilization of CBMSs present numerous alternative approaches.

Should the CG Develop Their Own Software?

Absolutely not. The amount of effort required in any such venture would be enormous. The software investments of many of the major CBMS vendors run into millions of dollars. This basically means that one can obtain a much better system than one could develop, at much lower cost.

Should the CG Purchase a Turnkey System?

Most of the Centers with in-house computers already have some sort of local mail facility, e.g., the VAX MAIL utility. It would be inappropriate for any of the Centers at present, to offer mail as a service to the rest of the CG, because (1) most Center computers are not available 24 hours a day, (2) rather extensive network interconnections would be required, and (3) in most cases it is not possible to log on to a Center's computer via international networks. The Centers can use the network to get into the international nets, but this doesn't mean that the network can be used to access a Center's computer. CIMMYT, for example, can access any computer on Telenet, Tymnet, Datapac, and so forth, by specifying a network address. However, CIMMYT does not have its own network address for others to access its machine. To obtain a network address is expensive and is not considered a viable alternative at this time.

The relevant questions, when considering if the CGIAR should run its own international CBMS, are traffic volume and cost: when the fee-for-services costs and traffic volume become high enough, the operation of a CGIAR message system may be re-considered.

What Host Computer Should Be Utilized?

Within the CG there are really only two possibilities: a World Bank machine in Washington or an FAO machine in Rome. The decision should be based on the criteria presented in Appendix F and on the same criteria as for the selection of an outside CBMS service, i.e., cost, performance, etc. For the present, the CG may encourage the World Bank or FAO to experiment with CBMS software, however, the CG should not rely on an experimental CBMS. Before shifting to a new system, the new system must be tried, tested, and proven.

Another consideration concerning host computers will be the vendors' offerings on those computers. CBMS vendors offer a wide variety of value-added

services, e.g., telex, gateways to other network services, specialized data bases, and forms systems. To duplicate all of these on a dedicated CG system would be quite expensive. In short, we feel that an in-house computer operation is not particularly attractive in the 2-3 year time frame.

Should the CG Use a Service Bureau and Pay-for-Use?

At present, the use of a service seems the only real alternative. With it one obtains 24 hour availability, sophisticated features and user interface, training materials and documentation, consulting support, access to other networks and database services like Dialog, and an array of ancillary services. Since the expenditures for this service have been under US$ 500.00 a month for the pilot, it is hard to imagine changing this set up. We expect that a service will still be the most logical option throughout 1985. By mid 1985, it may be worth re-evaluating purchase versus service, if costs have risen for the service but have become lower for the software.

How Does Computer Conferencing Relate to All of This?

With few exceptions, we have not found a great deal of enthusiasm nor many opportunities for computer conferences among the Centers. If computer conferences are to be used in the CGIAR, they will have to be organized in much the same way as any conference is organized. There will need to be leadership, the purpose of the conference must be clear, participants must be invited, and so forth. As such, the driving force behind the computer conference will have to be the organizer and the topic area. The network connections used in the CBMS will be the same as for a computer conference.

More likely than an internal CG computer conference is the possibility of CG participation in such a conference organized by an outside source, e.g., the IDRC. If organized outside the CG, the conferencing software might be supplied by someone other than the CBMS supplier. For a computer conference organized within the CG, however, the conferencing and CBMS software must be integrated. In fact, from the point of view of user acceptance, we consider such integration mandatory. We must stress here that the driving force must be the content not the technology. In a computer conference many of the participants may likely be outside the CBMS user group. Thus, special care must be taken to bring them on-line.

Computer conferencing will not be strongly utilized within the CG until someone highly interested in a content area sees the opportunity and organizes such an event. The most likely scenario is first a face-to-face conference with a computer conference follow-up. For example, the International Fava Bean Conference held in Cairo in 1981 (sponsored by ICARDA and IFAD) could have been continued via a computer conference. Special arrangements would have been necessary for participants which were not at CG Centers (in this case most of the participants). Similar examples could be cited for IBPGR's germ plasm gathering missions. By using the computer conferencing/CBMS network, additional benefits might accrue for publication, typesetting, and distribution of the proceedings.

J2.2 DESCRIPTION OF THE CBMS

Computer-based messaging systems (CBMS) evolved from simple programs used on a single computer system to exchange short messages by exchanging computer files. As computer networks became more prevalent in the late 1960s and 70s, these mailbox systems were expanded to allow users of different computers to send messages to one another. This was accomplished by creating a "message" as a distinct file on one computer and transmitting that file to another computer, whereby a program recognized the recipient's name and placed it in the other user's collection of files, or "mailbox." Typically, the program also announces to the recipient that a new message is waiting to be read.

"Computer mail" means that a message or file has been transferred to an "in-basket" or "mailbox" on the recipient's computer. A computer mail user must check his/her computer to determine if messages are waiting. This is extremely important, and is similar to checking for phone messages. If computer mail is not checked systematically, senders will resort to telex or phone, where they have reasonable assurance that the recipient will receive the message. This problem is common to new users of CBMSs: in the beginning they have few messages so they check the CBMS at irregular intervals. When messages are unanswered, the senders resort to other means, and the value of the CBMS is lost. Consequently, regular procedures must be established that insure the use of the CBMS.

CBMSs offer a means by which a user can send the same message to several individuals without having to retype, by either using an individualized address, or a distribution list. The sender or recipient of a message may use files (or databases) for saving these transactions or may delete the messages.

CBMS is not a "point-to-point" or terminal-to-terminal system like telex. Rather, it relies on the computer system to route and manage messages, protect them from unauthorized disclosure, and permit an individual to "call for" messages. Telematic services such as telex, transmit and deliver messages addressed to a particular terminal "address". Computer-based messaging systems are not based on the geographic location of a terminal or a registered network address. This permits access to the CBMS independent of the user's location. This is particularly important for the CG, where travel keeps many of the staff away from their home Centers much of the time.

For additional information on the operation of CBMSs, the reader is invited to read Appendix P, which provides information on CBMS typical operation and basic facilities, and CBMS options and capabilities. The CBMS currently in use by the CGIAR Pilot group is provided by ITT Dialcom.

J2.3 CONFIGURATIONS

The "configuration", or architecture, of a CBMS (or computer conferencing system) is a particular distribution of the "intelligence" (hardware and software). There are three major configuration choices: (1) centralized, (2) partially distributed, and (3) fully distributed. Combinations of the above exist as well.

1. The Centralized CBMS. Early CBMSs were centralized systems, and this is still the most prevalent service offered today. In centralized systems, a single computer facility (which may be several computers) acts as the processing location for message storage and processing. Access to the system is permitted by means of data networks and telephone lines.

2. Partially Distributed CBMS. Research on experimental packet-switched data networks (notably the ARPA NET funded by the U.S. Department of Defense) led to the development of partially distributed CBMSs. These evolved from a number of separate, non-communicating, centralized CBMSs, whereby collections of computers were set up to communicate to one another. In partially distributed CBMSs, computers send messages (through users' local machines) to "mailboxes" on remote computers. Though the software on each machine might be different, CBMS "protocols" (rules by which the two dissimilar CBMSs can communicate) are established. Thus, a user on computer A can exchange messages with users on computer B, C, and so forth.

3. Fully Distributed CBMS. In Configurations 1 and 2 above, computers acted as "concentrators," serving communities of users. Fully distributed systems allow the introduction of "intelligent" terminals (work stations) which are full-fledged "members" of the CBMS network. Users with appropriately equipped small business computers or microcomputers may act as nodes in the CBMS network. The microcomputer-based CBMS interacts with the CBMS mainframe computer as a peer. Messages are created, edited, stored, and retrieved on the user's work station. The use of telecommunication resources is reduced. Also, the individual may customize the CBMS to conform to his/her skill levels, language preference, and so forth. The fully distributed CBMS architecture allows a divergent group of devices to communicate.

J2.4 COMPUTER CONFERENCING

Computer conferencing is an application-dependent medium which finds optimal use by small and medium-sized groups (typically no more than 30 persons) who have a common interest. The geographic dispersion of the Centers could allow for beneficial computer conferencing usage. However, it should be kept in mind that the success of this medium is dependent upon the content of the computer conference. Computer conferences should be considered complementary to the basic interpersonal communication system embodied in computer mail.

Computer conferencing uses a centralized computer system and a communications network to support ongoing group interaction. Computer conferencing's most original contribution to improved interactions is its inherent ability to create a continuous record of "discussions." Participants always have access to this record. Because the messages are first organized into topic-oriented files (by the system), and are machine-readable, the record may be searched by keyword, date or source.

A second major feature of computer conferencing is that it does not necessarily operate in real-time; it operates asynchronously (as does CBMS). That is, all participants in the discussion need not be "present" at the same time. In the case where all or several participants are using the centralized system simultaneously, the computer conference permits all present to "have the floor" at the same time, since, when entering a message into the conference record, one need not wait for someone else to finish typing. The computer conference software itself keeps track of who has seen what message, and manages to prevent "collisions" (at least message collisions) or interruptions.

Typically, computer conferencing users (once authenticated) are presented with a list of the conferences (on-going discussions) in which they may participate (either as full members or as observers), and an indication as to which of these conferences contain entries created since their last session. The user may then enter a conference and view the entries which have been submitted, or enter new information. At any time, the user may search for an entry stored in a conference by specifying information (such as the date, author, key words, and so forth).

Unlike CBMS, the computer conference automatically allows the user to enter points of discussion which are available to anyone who has signed up to "attend" a conference.

Good computer conferencing systems generally allow for the following:

1. Many-to-many communications, with special "areas" for electronic meetings and discussions. These are accessed by people with the approval of a conference administrator or "chairman".

2. Personal notepad, memo, and work areas. Each user has private files or "scratchpads" that are kept on-line for ease of use. Notes or memos can be edited, re-formatted or modified in a number of ways, and subsequently sent to an individual, a group conference, or several conferences.

3. On-line bulletin board. As a special-purpose conference, a bulletin board may be established, which permits a community to "post" short messages that might be of general interest.

4. Computer-based messaging. Most computer conference systems allow the user to communicate with other users on a one-to-one basis, or in a "broadcast" mode, just as one would using a computer-based message system. However, the conference structure may be used to restrict the user as to such communication within a "closed user group", consisting only of those participants registered for a particular conference.

J3 TELECOMMUNICATION OPTIONS

The questions most often asked with regard to telecommunication were: how do we get good lines? and, what sort of PBX should we buy? While these questions were not within the range of topics to be addressed here, we did attempt to provide advice in these matters. Our recommendations are covered in Appendix O. In this section, we will address the questions posed by the project guidelines.

A discussion of telecommunication options had to involve an investigation of: (1) public-switched telephone networks (PSTN), (2) packet-switched networks, (3) microwave transmission, (4) satellite communication, and (5) shortwave radio.

Of these five, we can quickly dispense with satellite communication. First, the volume of traffic (or lack thereof) simply does not warrant serious consideration of this alternative. Second, licensing and operation of satellite facilities could only occur in joint arrangements with other international organizations, governmental facilities in each country involved, local telecommunication agencies, and a major sponsor. Such a project would require an earth station, or uplink, and an expensive leased circuit. An uplink is essentially out of the question, unless it were shared by a large number of users. Developing countries use these for international telephone calls so that the local P&T (telecommunication authority) can control them. The cost of leasing a channel on commercial satellites is typically greater than the cost of the equipment. There are now earth stations available for use with high-power satellites for as low as US$ 5000. However, we are talking about US$ 20 to 50 thousand a month for a satellite transponder circuit. This is the reason why the P&Ts lease the channel and then reallocate it to many different phone circuits, data circuits, video, et. They then resell the channel as smaller subchannels.

The P&Ts in most developing countries have at least one uplink, usually in the capital or in other large cities (this is the case in Kenya, Ethiopia, and Nigeria). Even if money were available, licensing would have to be obtained from the government and the P&T, and it is doubtful that they would grant it. A request might be interpreted as (1) evidence that they are not doing a good job, and (2) as competition for service. Exceptions occur, when experimental demonstration projects are offered by large organizations. The U.S. National Aeronautics and Space Administration (NASA) has provided free services and satellite usage for experimental purposes. IBI in Rome, for example, may pilot data base access to Africa, using INTELSAT. In those cases, we would naturally encourage participation.

Shortwave radio is used by most of the Centers in developing countries for local voice-communication to facilities within a particular country. As a means of enhancing capabilities at these remote sites, radio teletype (RTTY) could be used to exchange computer-resident information. The use of RTTY must be decided on a case-by-case basis and is presented as such in Appendix O. The use of RTTY for international data transfer is not a realistic possibility. While some success could be expected, it is highly unlikely that host countries would grant licenses for such use, since it would, in effect, bypass

state-controlled telecommunication facilities, depriving the telecommunication agency of both control and revenue.

Microwave transmission is used by many of the Centers as the final link between the Center and the nearest reliable telephone exchange. Again, this alternative does not follow a general pattern and must be considered on a case-by-case basis (see Appendix O). Microwave transmission is controlled, provided and tariffed by the state-run P&T. The use of microwave for international data transfer is not a possibility. As with satellite, such usage is reserved for the national post and telephone systems. As with shortwave, none of the countries in which Centers might make use of this technique, could be expected to grant licenses for international use. Such an operation would require the Center to maintain a private network link in competition with state-controlled telecommunication facilities.

Public-switched telephone networks (PSTN) and packet-switched networks. The public telephone network is simply the local system used by most subscribers to place calls. With the exception of Syria, none of the host CG countries prohibit the use of these facilities for domestic or international data transmission.

Packet-switched networks are much more efficient for data, because they save up information in groups of uniform size (or packets). A large number of devices (terminals) can be efficiently supported such that "logical" connections share the same physical medium. Thus, one line, which could be supporting only one voice conversation, can be used to support dozens of data communication devices. The net result is a much lower cost for the packet network. For example, the cost of a 5-minute phone call from Mexico City to London is US$ 43.00. The cost of a 5-minute usage of international packet-switched networks would be about US$ 3.00. Clearly, when communicating with a computer in London, the preferred medium would be the packet network. (Incidentally, the packet connection would probably result in the data being transmitted more accurately and possibly faster.)

Centers with access to such network services are CIMMYT, CIAT, CIP, ISNAR, IBPGR, IFPRI, IRRI, TAC SEC, and CG SEC. For the remaining Centers, the most reasonable possibility for getting data access to a remote computer is the international PSTN. Actually there are two choices, (1) an international phone call from the Center to a computer in the U.S. or (2) the phone call could be made from the United States to the Center computer (see Chapter 2, Section 2.2 for a description of the relay computer). It is preferable to locate the computer in the U.S. because of the many available service, the fact that it is the location of many desired communication points (people and organizations), and because the CG is well represented in the U.S.

This technique is discussed in detail for each Center (see Appendix O), but we should point out that if used efficiently, the cost of using the PSTN internationally may not be as high as one might think. If messages are prepared in advance on some storage medium, the telephone call can be quite short. In many cases, e.g., Nigeria, this method of transmission might still be cheaper than telex since a) the cost per minute is the same, and b) the data transmission will be at a faster rate.

J4 SUMMARY

Microcomputers will play an increasingly important role in any CGIAR network, for text preparation, store and forward, and, possibly, as unattended nodes. They will also be useful as data access devices to Centers' main computers and to remote databases. At remote sites, they can perform stand-alone functions for all of the above and for statistical analysis. We have pointed out that microcomputers will begin to replace standard telex terminals. With respect to network interface for the word processors and microcomputers, we feel that any new equipment should have communication capability. (This capability might not be purchased initially, but the devices should be upgradable.) We have suggested establishing file transfer protocols such as KERMIT for error checking and re-transmission.

For electronic mail and computer conferencing, Telematics International has urged Centers not to develop their own software, and not to purchase a turnkey system for a CGIAR-wide network, but rather to use a service bureau and pay-for-use.

The most immediate application recommended for the CGIAR is a CBMS. This is a centralized system, if we consider the Centers as the users. From a human-user perspective, we have proposed a partially-distributed system, since often people utilize their own local computer rather than directly accessing the CBMS. Users at CIMMYT for example, prepare their messages on CIMMYT's VAX; the VAX then transfers them into the CBMS network.

Telematics International does not expect computer conferencing to be strongly utilized within the CG in the next few years, unless some outside influence were exerted and a relevant content area were developed, organized, coordinated, and funded.

Our discussion of telecommunication options has centered on (1) the use of internationally available packet-switched networks (PSDN) whenever possible, (2) public-switched telephone networks (PSTN) in a relay mode whenver PSDN is not possibile, and (3) the use of telex, to send batches of messages to an entry point in the CBMS.

Microwave transmission, satellite communication, and shortwave radio have been ruled out for international telecommunication, except perhaps in experimental situations. However, Center-specific recommendations in Appendix O cover microwave and shortwave usage in detail for each individual Center or site. Recommendations applicable to a number of Centers or to the CGIAR-wide network, are found in Chapter 6.

APPENDIX K

Countries with International Gateway Access

COUNTRIES WITH INTERNATIONAL GATEWAY ACCESS

ALASKA
ARGENTINA
AUSTRALIA
AUSTRIA
BAHAMAS
BAHRAIN
BARBADOS
BELGIUM
BERMUDA
BRAZIL
CANADA
CAYMAN ISLANDS
CHILE
CHINA PEOPLE'S REPUBLIC OF
COLOMBIA
COSTA RICA
DENMARK
DOMINICAN REPUBLIC
FINLAND
FRANCE
GABON
GERMANY FEDERAL REPUBLIC OF
GREECE
GUAM
HAWAII
HONG KONG
HUNGARY
IRELAND
ISRAEL
ITALY
IVORY COAST
JAPAN
KUWAIT
LA REUNION
LA GUADELOUPE
LUXEMBOURG
MARTINIQUE
MEXICO
NETHERLANDS
NEW ZEALAND
NORWAY
PANAMA
PERU
PHILIPPINES
PORTUGAL
PUERTO RICO
QATAR
SAUDI ARABIA
SOUTH AFRICA
SOUTH KOREA
SPAIN
SWEDEN
SWITZERLAND
TAIWAN
THAILAND
TRINIDAD
UNITED ARAB EMIRATES
UNITED KINGDOM
UNITED STATES OF AMERICA
U.S. VIRGIN ISLANDS

APPENDIX L

CG Centers and Their Remote Sites

CG CENTERS AND THEIR REMOTE SITES

This appendix, Table L-1, provides detailed information each Center's remote sites. It lists the countries which host such sites, and gives the names of the cities where the sites are located. It shows the numbers of remote facilities a Center has per country, the number of staff per site, the total number of CGIAR remote staff per country, the number of Centers represented in a given country (a Center may have four different sites in a country but will only count as one representation in this category), and the number of co-locations in a given city (there are cases where several Centers have remote facilities in the same location, furthermore, a Center may actually be the host for these offices).

For example, the first entry in Table L-1 is Bangladesh, there are three "hits" for this country: CIMMYT, CIP, and IRRI, each have one remote site there. The city listed is Dacca because it is the location for all three sites. The "Dacca" row also shows the number of staff per site, two for CIMMYT, one for CIP, and four for IRRI. Thus, under the "Total" columns, we have three "Remote sites", seven "Staff", three "CG Representatives" (because three Centers are represented in this country), and, for the "Dacca" row, three "Co-locations", because three sites are present.

If Bangladesh were also the host country for a Center other than the ones which have remote sites there, the total "CG Representation" would have been four. Also, it could very well have been that the three remote sites would have been located in three different cities, in which case these cities would all have been listed with the number of staff there, and there would have been no "hit" for the "Total Co-location" column. Another possibility would be if a Center, CIMMYT for example, had two sites in Bangladesh instead of one. In this case, the entry for CIMMYT in the "Bangladesh" row would have been two, and the column underneath would have listed the number of staff for each site in the appropriate "City" row.

Table L-1. CG Centers and Their Remote Sites*

COUNTRY City	CG Centers** CIAT Cali	CIMMYT El Batan	CIP Lima	IBPGR Rome	ICARDA Aleppo	ICRISAT Hydera-bad	IITA Ibadan	ILCA Addis Ababa	ILRAD Nairobi	IRRI Los Banos	WARDA Monro-via	Totals Remote Sites	Staff	CG Repres.	Co-loc. (City)
BANGLADESH		1	1							1		3	7	3	
Dacca		2	1							4					3
BENIN							1					1	3	1	
Porto-Novo							3								
BHUTAN			1									1	1	1	
Thimpu			1												
BOTSWANA								1				1	5	1	
Gaborone								5							
BRAZIL	1		1									2	62	2	
Brasilia	1		1												2
BURMA										1		1	3	1	
Rangoon										3					
BURUNDI			1									1	1	1	
Bujumbura			1												
CAMEROON							1					1	10	1	
Yaounde							10								
CHILE		1										1	2	1	
Santiago		2													
COLOMBIA	4	1	2	1						1		9	64	5	
Bogota			1												
Cali		2		1						1					4
Carimagua	2														
Popayan	20														
Quilichao	35														
Rio Negro			1												
Villavicencio	15														
COSTA RICA	1											1	1	1	
San Jose	1														
CYPRUS				1								1	1	1	
Nicosia				1											
ECUADOR		1										1	3	1	
Quito		3													
EGYPT			1		1					1		3	11	3	
Cairo			2		8					1					3
ETHIOPIA								2				2	150	1	
Bamalo								50							
Niomo								100							
GAMBIA											1	1	1	1	
Banjul											1				
GHANA		1					1				1	3	4	3	
Accra							1				1				2
Kumasi		2													

Table L-1. CG Centers and Their Remote Sites* (Continued)

COUNTRY City	CG Centers** CIAT Cali	CIMMYT El Batan	CIP Lima	IBPGR Rome	ICARDA Aleppo	ICRISAT Hydera-bad	IITA Ibadan	ILCA Addis Ababa	ILRAD Nairobi	IRRI Los Banos	WARDA Monro-via	Totals Remote Sites	Staff	CG Repres.	Co-loc. (City)
GUATEMALA	1											1	1	1	
Guatemala City	1														
GUINEA											1	1	1	1	
Conakry											1				
HAITI		1										1	1	1	
Port-au-Prince		1													
INDIA			1			9				1		11	36	3	
Anantapur						1									
Aurepalle						1									
Bha Bhavanisagar						2									
Dharwar						1									
Gwalior						5									
Hissar						13									
Kanzara						1									
New Delhi			2			8				1					3
Shirapur						1									
INDONESIA										1		1	3	1	
Bogor										3					
ITALY														2	
Rome															2
IVORY COAST											1	1	8	1	
Bouake											8				
JORDAN					1							1	3	1	
Amman					3										
KENYA	1	1	1	1		1		1	2			8	91	7	
Kapiti Plains									20						
Kilifi									2						
Nairobi	1	4	2	1		1		60							7
LEBANON					2							2	28	1	
Beirut					9										
Terbol					17										
LIBERIA											2	2	10	1	
Fendall											8				
Suakoko											2				
MALAWI						1						1	2	1	
Lilongwe						2									
MALI						1					1	2	8	2	
Bamako						2									
Mopti											6				
MEXICO						1						1	2	2	
El Batan						2									2

Table L-1. CG Centers and Their Remote Sites* (Continued)

COUNTRY City	CG Centers** CIAT Cali	CIMMYT El Batan	CIP Lima	IBPGR Rome	ICARDA Aleppo	ICRISAT Hydera-bad	IITA Ibadan	ILCA Addis Ababa	ILRAD Nairobi	IRRI Los Banos	WARDA Monro-via	Totals Remote Sites	Staff	CG Repres.	Co-loc. (City)
NETHERLANDS														1	
The Hague															
NIGER						2		1			1	4	27	3	
Maradi						1									
Niamey						14		10			2				3
NIGERIA		1				1	5	2		1		10	129	5	
Ibadan		2						30		1					4
Ikeja							20								
Ikenne							3								
Kaduna								60							
Mokwa							2								
Onne							5								
Samaru						3									
Zaria							3								2
PAKISTAN		1				1						2	5	2	
Islamabad		4				1									2
PAPUA NEW GUINEA				1								1	1	1	
Port Moresby				1											
PERU	2	1	3									6	23	3	
Cuzco		1													
Huancayo			19												
Lima	1														2
San Ramon			?												
Tarapote	1														
Yurimaguas			1												
PHILIPPINES			2							8		10	71	2	
Banaue										3					
Bicol										15					
Cagayan										32					
Iloilo										5					
Malaybalay			1												
Manila			2												
Nueva Ecija										4					
Palawan										2					
South Cotabato										6					
Tarlac										1					
PORTUGAL		1										1	2	1	
Lisbon		2													
RWANDA	1		1				1					3	6	3	
Butare	1														
Kigali							3								
Ruhengeri			2												

Table L-1. CG Centers and Their Remote Sites* (Continued)

COUNTRY City	CG Centers** CIAT Cali	CIMMYT El Batan	CIP Lima	IBPGR Rome	ICARDA Aleppo	ICRISAT Hydera-bad	IITA Ibadan	ILCA Addis Ababa	ILRAD Nairobi	IRRI Los Banos	WARDA Monro-via	Totals Remote Sites	Staff	CG Repres.	Co-loc. (City)
SENEGAL						1					1	2	8	2	
Bambey						1									
Richard-Toll											7				
SIERRA LEONE							1				1	2	9	2	
Freetown							2								
Rokupr											7				
SUDAN						1						1	1	1	
El Obeid						1									
SWAZILAND		1										1	1	1	
Mbabane		1													
SYRIA		1		1	2	1						5	12	4	
Aleppo		2				2									3
Damascus				1	4										2
Lattakia					3										
TAIWAN				1								1	1	1	
Taipei				1											
TANZANIA							1					1	1	1	
Dar es Salaam							1								
THAILAND	1	1		1						1		4	11	4	
Bangkok	1	5		2						3					4
TOGO				1								1	1	1	
Lome				1											
TUNISIA			1		1							2	6	2	
Tunis			3		3										2
TURKEY		1										1	2	1	
Ankara		2													
UPPER VOLTA				1		1	1				1	4	12	4	
Bobo Dioulasso											2				
Kamboinse						6									
Ouagadougou				1			3								2
USA				1								1	3	3	
Washington				3											
ZAIRE							1					1	4	1	
Kinshasa							4								
ZIMBABWE						1						1	3	1	
Bulawayo						3									
TOTAL	12	15	16	10	7	22	13	7	2	16	11	131	805		

* The number of professional staff per remote site is shown by city.

** CG SEC, ISNAR and TAC SEC are not listed individually, as they have no remote sites. They are accounted for, however, under "CG Representation" in their respective countries.

APPENDIX M

Origin and Destination of Major Communication Traffic

Table M-1. Communication Origin

Country	Medium					
	Phone	Telex	Cable	Lettr	Doc	Total
ARGENTINA	1				1	2
AUSTRALIA				3	4	7
BANGLADESH			2	1	1	4
BELGIUM	1			1		2
BENIN						
BHUTAN						
BOTSWANA						
BRAZIL	1	1			2	4
BURMA		1				1
BURUNDI						
CAMEROON						
CANADA	2	2	1	1	3	9
CHILE						
CHINA			1	1	3	5
COLOMBIA		2	1	1	1	5
COSTA RICA	1					1
CUBA						
CYRPUS						
ECUADOR		1				1
EGYPT						
EL SALVADOR	1					1
ETHIOPIA		1				1
FRANCE	1	1		2	2	6
GAMBIA						
GHANA						
GREAT BRITAIN	2	4	2	4	7	19
GUATEMALA	1					1
GUINEA						
HAITI						
HONDURAS						
INDIA		2	4	1	5	12
INDONESIA		1	1	1	2	5
ITALY	1	4	2		1	8
IVORY COAST						
JAPAN		2		2	3	7
JORDAN						
KENYA	1	4				5
KOREA (SOUTH)				1	1	2
LEBANON						
LIBERIA		1	1			2
MALAWI						
MALAYSIA			1			1
MALI		2		1		3
MEXICO		3	1	1	2	7
NEPAL			1			1
NETHERLANDS	1	2	1		1	5

Table M-1. Communication Origin (Continued)

Country	Medium					
	Phone	Telex	Cable	Lettr	Doc	Total
NEW ZEALAND					1	1
NICARAGUA						
NIGER		1		1		2
NIGERIA		2		1	1	4
PAKISTAN			1			1
PANAMA	1					1
PAPUA NEW GUINEA						
PERU		2			1	3
PHILIPPINES		3	1		2	6
POLAND					1	1
PORTUGAL						
RWANDA						
SAUDI ARABIA	1					1
SENEGAL		1		1		2
SIERRA LEONE						
SRI LANKA			1	1	1	3
SUDAN				1		1
SWAZILAND						
SWITZERLAND						
SYRIA		1				1
TAIWAN				1		1
TANZANIA						
THAILAND		2	1		1	4
TOGO						
TUNISIA						
TURKEY						
UPPER VOLTA		2				2
USA	8	8	3	6	9	34
USSR					1	1
VENEZUELA					1	1
WEST GERMANY	1	1		2	3	7
ZAIRE						
ZIMBABWE						
Number of Center responses	11	10	7	6	9	

Table M-2. Communication Destination

Country	Medium					
	Phone	Telex	Cable	Lettr	Doc	Total
ARGENTINA	1					1
AUSTRALIA	2			2	2	6
BANGLADESH		1	2	2	1	6
BELGIUM	1					1
BENIN						
BHUTAN						
BOTSWANA						
BRAZIL	1	1				2
BURMA		1				1
BURUNDI						
CAMEROON						
CANADA	3	2	1	1	1	8
CHILE	1	1			1	3
CHINA				1	1	2
COLOMBIA			1	2	1	4
COSTA RICA	2				1	3
CUBA			1			1
CYRPUS						
ECUADOR		2				2
EGYPT		1				1
EL SALVADOR	1					1
ETHIOPIA		1		1		2
FRANCE	3			2	1	6
GAMBIA						
GHANA						
GREAT BRITAIN	5	5	4	2	5	21
GUATEMALA	1					1
GUINEA						
HAITI						
HONDURAS	1					1
INDIA		2	5	2	3	12
INDONESIA	1	2	2	1	1	7
ITALY	2	3	2	1		8
IVORY COAST						
JAPAN		2		1	1	4
JORDAN						
KENYA	1	4	1	2		8
KOREA (SOUTH)		1		1	1	3
LEBANON						
LIBERIA			1	2		3
MALAWI						
MALAYSIA	1		1			2
MALI		2				2
MEXICO	2	2	1	2	1	8
NEPAL			1			1
NETHERLANDS	1	3	1	1		6

Table M-2. Communication Destination (Continued)

Country	Medium					
	Phone	Telex	Cable	Lettr	Doc	Total
NEW ZEALAND						
NICARAGUA	1					1
NIGER		1				1
NIGERIA		4	2	1		7
PAKISTAN		1	2	2	1	6
PANAMA						
PAPUA NEW GUINEA						
PERU	1	3		1		5
PHILIPPINES		3	2	2	1	8
POLAND						
PORTUGAL		1		1		2
RWANDA			1			1
SAUDI ARABIA						
SENEGAL		1		1		2
SIERRA LEONE						
SRI LANKA				1	1	2
SUDAN		1				1
SWAZILAND						
SWITZERLAND		1				1
SYRIA		2	2	1		5
TAIWAN				1		1
TANZANIA		1				1
THAILAND		2	1			3
TOGO						
TUNISIA		1				1
TURKEY		2				2
UPPER VOLTA		2				2
USA	10	8	5	4	8	35
USSR			1			1
VENEZUELA						
WEST GERMANY	4	2		1	1	8
ZAIRE						
ZIMBABWE						
Number of Center responses	12	10	8	6	8	

APPENDIX N

Countries with Major Communication Traffic

COUNTRIES WITH MAJOR COMMUNICATION TRAFFIC

This appendix, Table N-1, combines the results of the detailed traffic matrices of Appendix M. We first list the country, then the total number of Centers which mention that country as major point of communication for telex, telephone, telegraph, correspondence, or documents. (For instance, the "7" listed for Australia, could be several Centers mentioning Australia for both telex and letters, or seven Centers mentioning Australia for telephone). The data for each country also include the number of Centers reporting frequent travel, the number of Centers which report that improved contact is needed, the presence of international remote sites (i.e, foreign sites in which Center have personnel), the number of domestic remote sites, and whether or not a given country has access to international data networks.

Table N-1. Countries with Major CGIAR Traffic

Country	Communication			Improved contact needs		CG remote sites		Data network access
	Orig	Dest	Travel	Scient	Admin	Intl	Dom	
ARGENTINA	2	1						Yes
AUSTRALIA	7	6	1					Yes
BANGLADESH	4	6				3		No
BELGIUM	2							Yes
BENIN						1		No
BHUTAN						1		No
BOTSWANA						1		No
BRAZIL	4	2	1			2		Yes
BURMA	1	1				1		No
BURUNDI						1		No
CAMEROON						1		No
CANADA	9	8	1	1	1			Yes
CHILE		3				1		Yes
CHINA	5	2						No
COLOMBIA	5	4		3	1	5	4	Yes
COSTA RICA	1	3				1		Yes
CUBA		1						No
CYRPUS						1		No
ECUADOR	1	2				1		No
EGYPT		1				3		No
EL SALVADOR	1	1						No
ENGLAND	19	21	1	1				Yes
ETHIOPIA	1	2			1		2	No
FRANCE	6	6	2					Yes
GAMBIA						1		No
GHANA						3		No
GUATEMALA	1	1				1		No
GUINEA						1		No
HAITI						1		No
HONDURAS		1						No
INDIA	12	12				2	9	No
INDONESIA	5	7				1		No
ITALY	8	8	1	1	2			Yes
IVORY COAST						1		No
JAPAN	7	4						Yes
JORDAN						1		No
KENYA	5	8				6	2	No
KOREA(SOUTH)	2	3						Yes
LEBANON						2		No
LIBERIA	2	3					2	No
MALAWI						1		No
MALAYSIA	1	2						No
MALI	3	2			2			No
MEXICO	7	8		4	2	1		Yes
NEPAL	1	1						No

Table N-1. Countries with Major CGIAR Traffic (Continued)

Country	Communication			Improved contact needs		CG remote sites		Data network access
	Orig	Dest	Travel	Scient	Admin	Intl	Dom	
NETHERLANDS	5	6		2				Yes
NEW ZEALAND	1							Yes
NICARAGUA		1						No
NIGER	2	1				4		No
NIGERIA	4	7		4	1	5	5	No
PAKISTAN	1	6				2		No
PANAMA	1							Yes
PAPUA(NG)						1		No
PERU	3	5		1		2	3	Yes
PHILIPPINES	6	8		3	2	2	8	Yes
POLAND	1							No
PORTUGAL		2				1		Yes
RWANDA		1				3		No
SAUDI ARABIA	1							Yes
SENEGAL	2	2				2		No
SIERRA LEONE						2		No
SRI LANKA	3	2						No
SUDAN	1	1				1		No
SWAZILAND						1		No
SWITZERLAND		1						Yes
SYRIA	1	5		2	1	3	2	No
TAIWAN	1	1				1		Yes
TANZANIA		1				1		No
THAILAND	4	3				4		Yes
TOGO						1		No
TUNISIA		1				2		No
TURKEY		2				1		No
UPPER VOLTA	2	2				4		No
USA	34	35	4	3	3	1		Yes
USSR	1	1						No
VENEZUELA	1							No
WEST GERMANY	7	8	1					Yes
ZAIRE						1		No
ZIMBABWE						1		No

APPENDIX O

Center-Specific Recommendations

CENTER-SPECIFIC RECOMMENDATIONS

This appendix gives detailed attention to the individual Centers as well as the CG and TAC Secretariats. A brief status description is provided for each, along with a technological inventory, a discussion of the most viable method of telecommunication access, and, when relevant, descriptions of technologies and service providers. Included are our observations and recommendations for each site. (See Appendix B for a description of the mandates and activities of the 15 sites.) Recommendations applicable to several Centers or to the CGIAR-wide network, are found in Chapter 6.

01 CIAT

The Center's headquarters are on a 522-hectare site about 35 km from Cali, in southwest Colombia. In addition to the operation of four substations inside Colombia, CIAT has research staff posted in Brasilia (Brasil), San Jose (Costa Rica), Guatemala City (Guatemala), Nairobi (Kenya), Tarapote and Lima (Peru), Butare (Rwanda), and Bangkok (Thailand).

CIAT has a telephone system (PBX) with 400 internal lines and 40 lines for access outside the Center. Specifically, a microwave system links the Center directly to a Cali telephone exchange, and land lines provide outside trunks to the nearby town of Palmira. CIAT has a special line for international direct dialing (IDD). Using regular lines to make long distance calls within the country is difficult. An operator must be used, and even then access is unpredictable and transmission often poor. The Center relies a great deal on cable for domestic purposes, since it is reliable and inexpensive. CIAT has its own telex and does not utilize a facsimile.

International data network access is available to the Center and as been established via TELECOM, a state-controlled company. Servicio DAPAQ is the data network service supplied by TELECOM. CIAT generally uses one of its Displaywriters for access to the CBMS, DIALOG information services, etc.

The Center has an IBM 4331 as its mainframe computer, and has recently acquired an IBM System/36 minicomputer. There are a total of 16 IBM 3278 terminals, 5 Radio Shack TRS 80 Model 16 microcomputers, 1 TRS 80 Model 100 micro, and 9 IBM Displaywriters.

CIAT is a current user of the ITT Dialcom CBMS through Colombia's DAPAQ service at 300 BPS. Presently, however, only one Displaywriter can access the network. Increased availability is possible by attaching modems to the IBM 4331, the System/36, or the microcomputers.

RECOMMENDATION 1: Purchase two additional modems. We suspect that it would be a good idea to obtain dual speed 300/1200 BPS modems on the premise that TELECOM is likely to upgrade its service to 1200 BPS in addition to the 300 BPS currently offered.

RECOMMENDATION 2: Establish a procedure for transferring files from the IBM 4331 into the network, preferably through a modem connected to the 4331, or by relay through the Displaywriter.

RECOMMENDATION 3: Establish a similar file transfer procedure for the IBM System/36.

RECOMMENDATION 4: Investigate whether any of the users of the TRS 80 Model 16s would like direct access to the international network. If there is a need, a method for these users to access the network should be implemented.

RECOMMENDATION 5: Conduct a series of classes, seminars, or workshops to determine the full potential of the CBMS at CIAT, and create greater staff awareness of the system.

RECOMMENDATION 6: Establish connections for CIAT staff in Bangkok, San Jose, Lima and Brasilia, and provide them with microcomputers equipped with appropriate communication software and modems.

RECOMMENDATION 7: Exchange information concerning hardware and software for the TRS 80 Model 16s with IRRI, which also has Model 16s, and is on the CBMS.

RECOMMENDATION 8: CIAT should consider enhancing the current radio system by adding text transmission features. Such utilization may require a separate license for private radio teletype (RTTY).

02 CIMMYT

CIMMYT headquarters are on a 78-hectare site at El Batan, Mexico, 45 km northeast of Mexico City; two additional offices are located in Mexico City. The Center manages four experimental stations in Mexico, and has additional staff stationed in Dacca (Bangladesh), Santiago (Chile), Cali (Colombia), Quito (Ecuador), Kumasi (Ghana), Port-au-Prince (Haiti), Nairobi (Kenya), Ibadan (Nigeria), Islamabad (Pakistan), Cuzco (Peru), Lisbon (Portugal), Mbabane (Swaziland), Aleppo (Syria), Bangkok (Thailand), and Ankara (Turkey).

The Center installed a new electronic PBX in 1983, with 25 outside lines, 10 of which are leased lines connected directly to Mexico City. International direct dialing by pass-number access is available to certain individuals and extensions, but operator intervention must be used by most users. Direct dialing within the country is available through the switchboard and from a restricted number of extensions within the Center. Domestic long distance calls are plagued by low accessibility and noise. CIMMYT operates a radio for communications with the experimental stations when and where telephone service is not available. The Center has a telex terminal which is connected via a leased line to Mexico City.

International data network access is available and has been established via TELEPAC, Mexico's data network. Access to the CBMS Pilot is via a 1200 BPS modem, connected to the main computer, a DEC VAX-11/780. This means that any of the VAX users can have international data network access. CIMMYT's 13 IBM Displaywriters (and another 14 on order) are used primarily for word processing. In terms of microcomputers, there are two TRS 80 Model 100s (lap-sized computers), one IBM PC XT, one Apple and one DEC Professional 350. There are 48 ASCII terminals hardwired to the VAX with a number of additional terminals planned for purchase.

CIMMYT's high level of interest in computer and communication technology led to a second visit by Telematics International in May 1984 in order to (1) increase awareness for the potential of the CBMS, (2) identify application opportunities for which the CBMS might be used, and (3) provide support for the operation and utilization of the system. A series of seminars on potential applications of the CBMS was conducted for the staff members. In June and July 1984, CIMMYT contracted with DEC Mexico to provide training on the use of the VAX machine to a large number of staff. CIMMYT is now in good shape to utilize the network. The following are our recommendations for further improvements.

RECOMMENDATION 1: CIMMYT's regional offices in Santiago, Lisbon, Bangkok, and Cali should be given access to CIMMYT headquarters (and other services) via international data networks. A close watch should be kept on Ankara, Quito, and Cuzco, because Turkey, Ecuador, and Peru, are supposed to obtain international data network access within a year. Port-au-Prince is less certain but may soon have data network access as negotiations are in progress with ITT Dialcom.

RECOMMENDATION 2: Regional staff in Ankara, Quito, Cuzco, and Port-au-Prince should be briefed on the possibilities of obtaining network access. The regional staff should establish a contact at the appropriate telecommunication ministry, and obtain projections of new offerings at regular intervals.

RECOMMENDATION 3: Much interest was expressed in providing a network connection to CIMMYT's office in Nairobi. The practicability of interconnecting CIMMYT/Nairobi, should be determined by using the relay technique, i.e., international calls to (or from) a microcomputer at ILRAD, or perhaps to IDRC's Micom word processor in IDRC's Nairobi office.

RECOMMENDATION 4: Connection should be established to international cooperators at EMBRAPA, CNPMS (Brazilia), IDIAP (Panama), and to related research activities at CIDA (Ottawa) and Agriculture Canada (Ottawa), by encouraging these organizations to obtain access to international data communication, and the CGIAR CBMS.

RECOMMENDATION 5: CIMMYT's banking and financial operations in Chicago should be added to the network. Since we understand that the Chicago bank is on the GEISCO CBMS, CIMMYT will probably need to establish a GEISCO account. This account can be obtained in Mexico City.

RECOMMENDATION 6: Two additional modems should be purchased for back-up and/or use on other machines, e.g., the Displaywriters.

RECOMMENDATION 7: The current interface for accessing the CBMS needs to be simplified. A VAX user should be prompted, and then be able to send mail to a local CIMMYT user, or an international CBMS user. The procedure used, should be the same for both cases.

RECOMMENDATION 8: Another telex line is needed <u>unless</u> the current line can be used primarily for incoming telex traffic. The outbound telex traffic would be dispatched using the CBMS-telex interworking described in Chapter 2.

RECOMMENDATION 9: <u>Without</u> the addition of another telex line, the preparation of telexes should take place on the VAX, on microcomputers, and/or on the Displaywriters. These prepared telexes should then be directly sent via the CGNET using telex re-filing.

RECOMMENDATION 10: With respect to interface between telex and the CBMS system, telex operators should be able to access both the CBMS and the telex systems. Also, it should be made possible to transfer received telexes into the CBMS, and CBMS messages into the telex system, without re-keying.

RECOMMENDATION 11: The IBM Displaywriters need to be integrated into the CBMS/telex system. Communication boards and software are needed.

RECOMMENDATION 12: The IBM Displaywriters should be able to access the CBMS system independently of the VAX.

RECOMMENDATION 13: CIMMYT should consider enhancing the current radio system by adding text transmission features. Such utilization may require a separate license for private radio teletype (RTTY).

03 CIP

Headquartered in Lima, Peru, CIP has four main experimental sites in Peru. In addition, it has representatives in Dacca (Bangladesh), Thimpu (Bhutan), Brasilia (Brazil), Bujumbura (Burundi), Bogota and Rio Negro (Colombia), Cairo (Egypt), New Delhi (India), Nairobi (Kenya), Manila and Malaybalay (Philippines), Ruhengeri (Rwanda), and Tunis (Tunisia).

CIP has a private branch exchange with 50 internal and 7 external lines. International direct dialing is available inbound as well as outbound. The Center has its own telex, and operates a high-frequency radio for communication to Peruvian substations. International data network access to Peru has recently become available. For telecommunications, 3 IBM PCs, 10 Apples and 1 Northstar can be used, as well as 7 Displaywriters.

RECOMMENDATION 1: International data network access needs to be investigated immediately through the recently announced domestic telephone data service.

RECOMMENDATION 2: CIP should investigate the possibility of interconnecting its programs in Brasilia (Brazil), Bogota and Rio Negro (Colombia), and Manila (Philippines).

RECOMMENDATION 3: Communication boards and related software should be obtained for the Displaywriters.

RECOMMENDATION 4: Communication software and modems should be provided for some of the PCs and Apples on a need basis.

RECOMMENDATION 5: A series of classes, seminars, or workshops needs to be conducted to create greater staff awareness of the CBMS, and to determine its full potential.

RECOMMENDATION 6: CIP should consider enhancing the current radio system by adding text transmission features. Such utilization may require a separate license for private radio teletype (RTTY).

04 IBPGR

IBPGR is headquartered at the Food and Agriculture Organization (FAO) of the United Nations in Rome, Italy. It has additional research staff placed in Cali (Colombia), Nicosia (Cyprus), Nairobi (Kenya), Port Moresby (New Guinea), Damascus (Syria), Taipei (Taiwan), Bangkok (Thailand), Lome (Togo), Ouagadougou (Upper Volta), and Washington D.C. (USA).

International direct dialing is available inbound, and international data network access is scheduled to be established in late September with the installation of a 1200 BPS communication modem by ITALCABLE, the state-owned telephone service. Computers available at the FAO are an IBM 370 mainframe and a PRIME 750. In addition, IBPGR operates its own WANG OIS and there are several microcomputers in use: one DEC MICRO, four Apple IIes and one Northstar Horizon.

RECOMMENDATION 1: IBPGR should make every effort to join other CG Centers on the CBMS Pilot as soon as the modem is installed in September.

RECOMMENDATION 2: IBPGR should interconnect with their staff in Cali (Colombia), Taipei (Taiwan), Bangkok (Thailand), and Washington D.C. (USA).

RECOMMENDATION 3: The various computer devices need to be able to transfer files to and from the CBMS. The highest priority should be the appropriate set up for the Wang.

RECOMMENDATION 4: With a stated mandate to provide a "network" among the world's germplasm banks, IBPGR should actively promote the establishment of an electronic network (CBMS) among the various locations.

RECOMMENDATION 5: IBPGR should query other germplasm banks with regard to interest in the network proposed in Recommendation 4.

05 ICARDA

Headquarters for the Center and its principal research station are located at Tel Hadya, Syria, about 30 km south of Aleppo, at a site of 948 hectares. However, until the completion of a new research complex at Tel Hadya, many ICARDA staff are located in several different sites in Aleppo. In addition to another principal station (totaling 50 hectares) in Lebanon, ICARDA has research staff in Cairo (Egypt), Amman (Jordan), and Tunis (Tunisia).

ICARDA has a 2 small PBXs with 4 and 5 lines, one at Tel Hadya and one at the main administrative offices in Aleppo, serving 120 phones. International direct dialing is available inbound, outbound calls can be placed through an operator. International data network access is not available in Syria.

The Center's main computer is a VAX 11/780 at Tel Hadya and a PDP 11/34A at the administrative center in Aleppo. A total of 24 ASCII terminals are connected. Most of these terminals are located in work stations placed in strategic areas on the farm and in Aleppo. They serve the collective needs of the teams assigned to these stations by providing internal computer services 24 hours a day to scientists and technicians.

RECOMMENDATION 1: ICARDA needs to stay in close touch with Syrian governmental agencies to determine if they can be persuaded to allow data communication to/from ICARDA on an experimental basis.

RECOMMENDATION 2: A new PBX and networking system for the terminals will be needed for the Tel Hadya complex. Planning for these facilities should begin at once.

RECOMMENDATION 3: Reliable communication from Tel Hadya to Aleppo is needed. Alternatives to the current overhead cable must be investigated. Perhaps the cable could be run underground at some of its most vulnerable points. A VHF link should be considered as an alternative.

RECOMMENDATION 4: With the addition of the main Tel Hadya building, ICARDA should establish a computerized central filing and notification system for telexes, messages, letters and administrative documents.

RECOMMENDATION 5: Exploitation of microcomputers should be considered to a greater degree. They could be used to computerize inventories, purchase orders, genetic resources data bases, etc.

RECOMMENDATION 6: Computer resources could possibly be used more by ICARDA's Communication Department to facilitate editorial and printing operations.

RECOMMENDATION 7: Additional seminars or series of workshops should be set up to explore improved ways of using the computer power available within ICARDA.

RECOMMENDATION 8: Machine-aided translation should be explored. Software for the VAX could save up to 70 percent of the effort for French translation. The addition of a laser or ink-jet printer to the VAX for direct printing of Arabic should be considered.

RECOMMENDATION 9: ICARDA can participate in the CBMS by telexing CBMS traffic to a relay node (the least expensive would probably be ISNAR). The relay node should telex responses to ICARDA.

06 ICRISAT

ICRISAT's headquarters are at Patancheru, India, 26 km northwest of Hyderabad. It also has scientific staff posted at nine additional research stations in the country. The Institute's international remote operations are in Nairobi (Kenya), Lilongwe (Malawi), Bamako (Mali), El Batan (Mexico), Niamey and Maradi (Niger), Samaru (Nigeria), Islamabad (Pakistan), Bambey (Senegal), El Obeid (Sudan), Aleppo (Syria), Kamboinse (Upper Volta) and Bulawayo (Zimbabwe).

The Institute is currently served by a Private Branch Exchange (PBX) with a capacity to connect 540 internal telephone lines and 20 trunk exchange lines. The Center has a special 4-wire link to the Hyderabad telephone exchange by means of a 30-channel Pulse-Code Modulation (PCM) system. Of these channels, 23 are in use and are interfaced directly to the Center's PBX, such that 20 trunks are available to the Center for both in-bound and out-bound calls to Hyderabad, to the national telephone system and for international telephony.

The Hyderabad exchange which serves ICRISAT, currently provides direct long-distance dialing for telephone numbers within India. International calls must be established by an operator at the Hyderabad exchange. The Center has two telex connections equipped with perforated tape/automatic punch feeder units. At this point, international data network access is not available.

The ICRISAT computer system is a DEC VAX 11/780 with 87 ASCII terminals connected. Microcomputers are available in the form of 2 DEC MICROs and 11 Osbornes.

RECOMMENDATION 1: ICRISAT could participate in the pilot CBMS by using their VAX to store messages. Once or twice a day the messages would be transferred to the CBMS computer in Silver Spring, Maryland by means of a relay node. A proof-of-concept test should be the first action taken, before making significant investment in equipment or software development.

RECOMMENDATION 2: Given a positive result of the initial tests, the relay computer operation should be enhanced to provide a completely automated (i.e., software-controlled) operation, and implement an error-correcting file transfer mechanism to improve the reliability of the data transfer.

RECOMMENDATION 3: Inquiries should be made to the Hyderabad P&T regarding the means by which outgoing international direct dialing (IDD) could be provided. This may involve having the P&T install special metering equipment at Patancheru or at the Hyderabad telephone exchange.

RECOMMENDATION 4: ICRISAT should survey available computer-telex interface packages to determine the cost and comparative cost advantages. This recommendation is made in light of the fact that ICRISAT presently has microcomputers in-house and will likely acquire more systems in the near future. At least two such packages

are good candidates. One is provided by Braid Communications (USA and UK) based on equipment manufactured by Hasler. The other is provided by BetaCom (USA).

RECOMMENDATION 5: ICRISAT should inform both the INDONET project and the P&T of its interest in and support for the provision of domestic CBMS services by a private organization. We believe that such an argument can be made convincingly, and that this might allow the speedy implementation of such services in India.

RECOMMENDATION 6: Details regarding international telephone service should be obtained from team members presently at ICRISAT remote sites (particularly Niger). This should include details on costs, reliability, availability of IDD.

RECOMMENDATION 7: Based on the outcome of Recommendation 6 and a successful demonstration of the relay concept at headquarters, we suggest that a relay mode be piloted for Niger.

RECOMMENDATION 8: Arrange with the Indian P&T to dedicate one of the unused channels on the PCM system running between Patancheru and Hyderabad to a subscriber telephone line, which will <u>not</u> be directed into the ICRISAT PBX. (This will be used as the data communications line to the VAX.)

RECOMMENDATION 9: Identify modem equipment available within India, or available quickly from overseas sources, which conforms to the P&T specifications.

RECOMMENDATION 10: Identify modem equipment available within India, or available quickly from overseas sources, which meets the standards set out in CCITT Recommendation V.22.

RECOMMENDATION 11: Obtain waivers from the P&T regarding the use of the HTL modems (or other CCITT V.23 devices) in favor of CCITT V.22. The waiver should be based on the fact that the device will be directly interconnected with the PCM system and owned by ICRISAT.

RECOMMENDATION 12: Acquire at least two 1200 BPS full-duplex modems, one to be installed at ICRISAT as soon as possible.

07 IFPRI

IFPRI is located in Washington D.C., USA. It does not operate any international remote sites but its regional projects are collaborative efforts with institutions in Indonesia, Malaysia, the Philippines, Thailand, Bangladesh and the Sahel (Niger, Mali, Chad, Upper Volta, Mauritania and Senegal).

IFPRI has 90 Centrex lines for access outside the Center, with 6 dedicated lines for data communication. International direct dialing is available and so is international data network access. The Center has 5 IBM PCs planned for 1984, 11 ASCII terminals, and 4 CPT word processor systems.

RECOMMENDATION 1: IFPRI may wish to re-evaluate the potential of the CBMS for its operation in light of recent enhancements such as direct telex interface, CBMS-physical delivery interworking, etc. If, for example, IFPRI used the CGNET CBMS for telex, the "administrative overhead" of checking for CBMS mail would be eliminated, since every time a telex is sent, the operator will be made aware of new CBMS messages. Also, batches of messages (some telex, some CBMS) could be prepared in advance and transmitted in one session.

RECOMMENDATION 2: Several of the CPT word processors are capable of accessing the CGNET (they are equipped with the appropriate communication board), but they need modems for CBMS interface. Currently, only one CPT has a modem. Training is also needed, and some assistance should be requested from CPT and the CBMS service provider.

RECOMMENDATION 3: IFPRI should explore alternatives to the use of the 90 Centex lines. We recommend that an RFP or RFI be prepared at once to major vendors of PABXs (ROLM, Northern Telecom, AT&T). We further recommend that a PBX be obtained that can be upgraded to allow for connection of microcomputers and data terminals.

RECOMMENDATION 4: IFPRI should consider using a part-time employee or research assistant, to facilitate dissemination of information about the CBMS within the Center.

08 IITA

IITA's headquarters are located on a 1000-hectare experimental farm outside Ibadan, Nigeria, roughly 150 km north of Lagos. The Center has five substations in Nigeria, and has additional staff posted in Porto-Novo (Benin), Yaounde (Cameroon), Accra (Ghana), Kigali (Rwanda), Freetown (Sierra Leone), Dar es Salaam (Tanzania), Ouagadougou (Upper Volta), and Kinshasa (Zaire).

IITA has an internal phone system which supports 400 internal lines. Presently, the Center has 10 assigned numbers at the Ibadan Central P&T exchange. Since the cable (through which these assigned numbers are provided) works only intermittently, IITA has two Very High Frequency (VHF) radio lines to serve two of these assigned numbers (DNs or "directory numbers"). Thus, two DNs are on VHF, the remaining eight DNs are on the cable. One of these eight DNs is used for telex, leaving only seven DNs for voice.

Of the cable's seven DNs for voice, no more than three are operational at any given time. The problem is compounded by a lack of automatic switching to the next line if the accessed DN is not working or busy. In addition, the two VHF DNs are part of a shared VHF system, such that if other VHF customers are using the VHF, IITA will be blocked from using its VHF DNs.

In summary, during much of the day, IITA is blocked on the VHF DNs by other VHF customers; leaving only the three operational cable DNs. These will be busy if anyone is phoning Lagos, Ibadan, or internationally. If someone is phoning from the outside, they won't get through if three IITA persons are phoning off-campus. The situation is worsened by the fact that any three lines on the cable may operate at random and any four not. Since there is no roll-over from a busy or non-working to an available line, the person dialing from the outside will only get through if by chance he or she dialed a working line and if that line were not engaged.

Domestic long distance communication has to be achieved through the operator at the Ibadan exchange and is severely hampered by recurring unavailability of lines to Ibadan. International calls are even more restricted. They must to be made first through the exchange in Ibadan, and second, through another in Lagos, both operator-assisted. International calls from the outside, have to go through the reverse procedure. The net result is that making an international call can take literally three or four days. There is no international data network access in Nigeria.

The Center's mainframe computers are 2 DEC VAX 750s with 48 ASCII terminals connected. In addition, there are several microcomputers in form of 8 IBM PCs scheduled for 1984, 15 TRS, 2 DEC MICROs and 1 Apple.

The primary problem at IITA is access to ANY reliable communication. Several options have been discussed in a report submitted directly to IITA including establishing international direct dialing (IDD) for IITA. This would involve installing private microwave equipment or leasing lines from the Nigerian P&T.

RECOMMENDATION 1: The IITA-Ibadan trunk situation should be given critical priority. A minimum of two dedicated VHF systems should be obtained. Traffic volume, however, may demand a larger capacity microwave system. This decision can only be made through a traffic study.

RECOMMENDATION 2: A traffic model must be created to estimate the effects of reliable off-campus service. This is the only way of establishing a rationale basis for the decision of how many inbound and outbound trunks to obtain.

RECOMMENDATION 3: IITA should relieve inbound access problems by designating "inbound" and "outbound" DNs (or trunks). (With IITA's severe shortage of trunks, this is probably impractical; however, when new trunks are established, some should be reserved for inbound calls).

RECOMMENDATION 4: The local P&T should put IITA's numbers in a "hunt group" such that if a DN is busy or not working, the call would go to the next available number.

RECOMMENDATION 5: Before IDD is established, the only method for connecting IITA to the data transfer network, is to transfer magnetic media to a microcomputer in Lagos Island and then use IDD. When IDD is available to IITA, the VAX 750s can be used to store messages and relay them to the CBMS.

RECOMMENDATION 6: Achieving international telephone access should be given urgent priority, with emphasis on IDD. Since the only exchanges in Nigeria with IDD are in Lagos Island, IITA must obtain DNs from this exchange. IITA could lease circuits directly to Nigerian External Telecommunication (NET) but this would be a very restrictive use of the circuits; they could not be used to phone Lagos or elsewhere within Nigeria, ONLY for international calls. The two methods for achieving IDD from IITA are: (1) leased circuits to a Lagos Island exchange, and (2) a VHF link to Lagos Island.

RECOMMENDATION 7: IITA should immediately apply for two leased circuits to a Lagos Island exchange. Making the application for the service is apparently the only method for determining the cost.

RECOMMENDATION 8: In the interim, IITA should investigate the cost, availability, and licensing of a private VHF link to Lagos Island. This dedicated circuit (whether leased line or VHF) should be an "extension" of a Lagos Island number rather than a direct connection to NET. The line could then be used to call Lagos (no long-distance charge) or elsewhere within Nigeria (through Lagos). This approach may be somewhat unusual with regard to local custom but it certainly is possible.

RECOMMENDATION 9: IITA should consider enhancing the current radio system by adding text transmission features. Such utilization may require a separate license for private radio teletype (RTTY).

RECOMMENDATION 10: When IDD is obtained all the way to the IITA campus, one of the VAXs can be used to obtain international access to the CBMS via the PSTN and VAN services.

RECOMMENDATION 11: For the relay test, IITA will need to obtain at least one modem. We suggest the Racal-Vadic VA1222 PX, because it incorporates CCITT V.22 and Bell 212A compatibility. It can be used at 0-300 or 1200 BPS.

09 ILCA

ILCA's headquarters are just outside Addis Ababa, Ethiopia. In addition to two large field operations in Ethiopia, ILCA staff manages stations in Gaborone (Botswana), Nairobi (Kenya), Niamey (Niger), and Ibadan and Kaduna (Nigeria).

ILCA has a PBX with 17 external lines. Domestic long distance calls can be done automatically or through an operator. International calls are available only with operator assistance. The Center has its own telex.

International data network access is not available; ILCA's computer unit, an HP 3000/III services headquarters and all field operations. 20 ASCII terminals and 15 HP MICROs are in operation, and an upgrade of the HP 3000 is in process. ILCA provides and services HP-125 microcomputers for their remote staff. Data are physically transported by bringing floppy disks to headquarters for sophisticated statistical analysis on the HP 3000.

RECOMMENDATION 1: ILCA should investigate the use of a relay computer approach to provide CBMS services to the Addis Ababa site.

RECOMMENDATION 2: For the relay test, ILCA will need to obtain at least one modem. We suggest the Racal-Vadic VA 1222 PX, because it incorporates CCITT V.22 and Bell 212A compatibility. It can be used at 0-300 or 1200 BPS.

RECOMMENDATION 3: Access to ILCA staff in Ibadan and Nairobi should be established when IITA and ILRAD come on line.

RECOMMENDATION 4: The Telecommunication Ministry should be encouraged to provide international data access for Ethiopia.

RECOMMENDATION 5: Telephone traffic, problems, deficiencies, etc., need to be documented, to make a convincing case for the Ethiopian Telecommunication Ministry to upgrade ILCA's PBX, and increase the number of external trunks serving the Center.

RECOMMENDATION 6: ILCA should consider enhancing the current radio system by adding text transmission features. Such utilization may require a separate license for private radio teletype (RTTY).

010 ILRAD

ILRAD is located on the outskirts of Nairobi, Kenya. In addition to headquarters, it operates a 13,000 hectare cattle ranch.

The Center has a Private Branch Exchange with 100 internal and 12 external lines. In addition, it has two direct leased lines to the Center's administration. Domestic long distance calls have to be made through an operator, and the same holds true for international calls. The Center has its own telex. International data network access is not available in Kenya. The Center's main computer service is a MEMORY 7500, and a great deal of use is made of a WANG OIS system. The Center also has an IBM PC.

RECOMMENDATION 1: When IDD becomes available in 1985, ILRAD should access VAN services via the PSTN, using IDD.

RECOMMENDATION 2: For the IDD access, ILRAD will need to use at least one modem. We suggest the Racal-Vadic VA 1222 PX, because it incorporates CCITT V.22 and Bell 212A compatibility. It can be used at 0-300 and 1200 BPS.

RECOMMENDATION 3: A policy for the provision and acquisition of different types of microcomputers is needed. As ILRAD has no mainframe computer, microcomputers will be used for all sorts of applications.

RECOMMENDATION 4: A method of interfacing the various microcomputers, the Wang and the Memory 7500, must be provided, to allow efficient use of peripherals, e.g., printers. This could be accomplished through the use of speed, code, and protocol converters, or through a media conversion unit which changes floppy disk formats to the desired interface. It is advisable to wait with these kinds of acquisitions until general planning for the computer operations is complete.

RECOMMENDATION 5: A survey or study of potential computing needs ought to be undertaken. While it was beyond the scope of the current study, we observed numerous applications for which straightforward data-processing capabilities could be of significant benefit.

011 IRRI

IRRI is located at Los Banos, Philippines, 65 km southeast of Manila. It operates eight domestic research stations; however, about one third of its staff is stationed outside the Philippines. The Center's remote sites are Dacca (Bangladesh), Rangoon (Burma), Cali (Colombia), Cairo (Egypt), New Delhi (India), Bogor (Indonesia), Ibadan (Nigeria), and Bangkok (Thailand).

The Center has its own switchboard with 236 internal and 16 external lines plus 5 WATS lines. It also has 2 pairs of data communication lines, connecting a research building to the off-campus computing center. A microwave link to IRRI's Manila office not only permits speedier (though operator-assisted) domestic and international calls, it also allows international data network access.

IRRI's computer facilities include a mainframe computer, an IBM 4331, a WANG 2200, 33 computer terminals, 1 IBM PC, 16 TRS 80s Models II, 12 and 16, 1 HP MICRO, 1 Apple and 1 Northstar. There are also nine Displaywriters available for use.

RECOMMENDATION 1: Two additional modems need to be made available, (1) for back-up, and (2) to allow additional devices onto the network.

RECOMMENDATION 2: A procedure should to be set up such that IBM 4331 users can access the data transfer network and send/receive mail.

RECOMMENDATION 3: Procedures should be established and modems provided such that selected microcomputer users can access the data transfer network and send and receive mail.

RECOMMENDATION 4: IRRI should conduct a series of classes, seminar, or workshops to create greater staff awareness of the CBMS, and determine its full potential for the Center.

RECOMMENDATION 5: Connections with IRRI staff in Cali and Bangkok should be made.

RECOMMENDATION 6: Once VAN access is established for IITA and ILRAD, microcomputers should be provided for staff there and connections should be established on the data network.

012 ISNAR

ISNAR's headquarters are in The Hague, Netherlands. The Center does not operate actual remote sites but has a working relationship with more than 20 countries and regional groups in Africa, Asia, Latin America and the Middle East.

ISNAR has a Private Branch Exchange serving 56 internal and 5 external lines. International direct dialing is available inbound and outbound.

The Center has a special telephone line connecting two separate word processors. Currently, a telecommunications line is being installed to permit international data network access. The Center's main computer is a WANG OIS-140, and it has one TRS 80 and one KAYPRO as microcomputers.

RECOMMENDATION 1: A procedure should be established such that any of the Wang system consoles can transmit messages into the network. This can be done through the communicating device, or through a separate modem.

RECOMMENDATION 2: A series of classes, seminars, or workshops should be conducted for the ISNAR staff to create greater awareness of the CBMS, and determine the system's potential for the Center.

RECOMMENDATION 3: ISNAR, as a Center committed to improved communication, should consider playing a central role in the data transfer network and application of the CBMS, by providing training materials, seminars, and so forth.

RECOMMENDATION 4: With respect to Recommendation 3, ISNAR could very well become an important relay point for the entry of non-CBMS communication traffic into the CBMS data net and, likewise, for the extraction and forwarding of CBMS messages to non-participating Centers.

RECOMMENDATION 5: Should ISNAR decide to relay messages from Centers with no current VAN access, e.g., ILCA, ICRISAT, another modem will be needed, preferably an exact match to the one used at the off-net Centers. We are suggesting that Centers use the Racal-Vadic VA 1200 PX (cost ca US$ 900.00).

013 WARDA

WARDA has its headquarters in Monrovia, Liberia. Its seed storage and processing laboratory is at Fendall and a nursery farm at Suakoko. WARDA has additional research installations in Banjul (Gambia), Accra (Ghana), Conakry (Guinea), Bouake (Ivory Coast), Mopti (Mali), Niamey (Niger), Richard Toll (Senegal), Rokupr (Sierra Leone), and Bobo Dioulasso (Upper Volta).

Even though there is no international data network access in Liberia, WARDA does have international direct dialing inbound as well as outbound. The Center's computer is a WANG 2200 MVP with seven terminals.

The primary communication flow in the WARDA organization appears to be between its member institutions. The usefulness of interconnecting WARDA to other Centers is not clear, however, the learning value of such a venture will be high. We recommend therefore, that WARDA join the network of Centers even though traffic volume may be low. Once the technical problems have been ironed out, a WARDA-wide network could be established.

RECOMMENDATION 1: WARDA should investigate the use of IDD and the PSTN to provide CBMS services to the Monrovia site by using the Wang. If this is not possible, a microcomputer should be used.

RECOMMENDATION 2: The Center should obtain communication hardware and software for the Wang system.

RECOMMENDATION 3: A modem needs to be acquired for access to the relay computer. Assuming that Liberia will provide data network access within the next 12 to 24 months, we suggest obtaining a modem which can be switched to conform to national or U.S. standards. We suggest the Racal-Vadic VA 1222 PX because it incorporates CCITT V.22 and Bell 212A compatibility. It can be used at 0-300 or 1200 BPS.

RECOMMENDATION 4: WARDA should investigate the possibility of forming a CBMS sub-net by interconnecting with its member countries, one of them has gateway access to the VAN already (i.e., Ivory Coast).

014 CG SEC

The CG Secretariat is located in the offices of the World Bank, in Washington D.C., USA. It has 14 Centrex lines available for internal and external use. International direct dialing is available and so is international data network access. As far as computer services are concerned, the Secretariat uses six IBM PCs, one Apple, and three ASCII terminals. In addition, it has five Micom word processors. The CG Secretariat can also access the World Bank's VAX 780s.

RECOMMENDATION 1: A temporary employee should be obtained (either from the World Bank's IRMD or hired) with the express purpose of customizing the various computer resources to function as needed by the staff. This person should also prepare quick reference sheets, so that any staff member will be able to perform various procedures such as sending mail, accessing the resume system, etc. We must emphasize here that a full-time temporary staff person is needed, NOT a consulting study.

RECOMMENDATION 2: In preparation for Recommendation 1, the CG Secretariat staff needs a list of all the applications which are needed and desired. This list needs to be prioritized.

RECOMMENDATION 3: The Tab terminals should be targeted for replacement with microcomputers. If economically feasible, the Micom word processors should be replaced with PCs, or, at a minimum, if new word processing power is required, the systems should provide more functionality than mere word processing.

RECOMMENDATION 4: If standardization of the equipment is not desired or possible, methods for transferring data between the various systems must be developed.

RECOMMENDATION 5: Initially, the PCs will function individually as terminals for access to World Bank computers, as microcomputers for spreadsheets, as word processors, and so forth. Sharing data will be in the form of physically trading floppy disks. By 1985, a strong need will exist for a local area network (LAN) between the PCs. This LAN will allow for the sharing of peripherals (printers, modems, back-up storage) and the transferring of information between the PCs. LAN products should be explored.

RECOMMENDATION 6: The professional staff of the CG Secretariat will benefit tremendously from direct usage of microcomputers. Senior staff should be provided with such equipment.

015 TAC SEC

The TAC Secretariat is located in the offices of the Food and Agriculture Organization (FAO) of the United Nations in Rome, Italy. International data network access is available but has not yet been established directly to the Secretariat. International access is available through the Fisheries Department located nearby in the same FAO building as the TAC Secretariat.

RECOMMENDATION 1: A license for data network access needs to be obtained as soon as possible from ITALCABLE, the state-owned network. A direct connection for 1200 BPS communication is needed from S.I.P. Should the 1200 BPS line be delayed, 300 BPS direct dial should be used through the existing phone system of the FAO.

RECOMMENDATION 2: Two microcomputers, most likely DEC as designated by FAO, should be obtained, equipped with communication software and modems.

RECOMMENDATION 3: A temporary employee should be hired with the express purpose of making all the computer device work on the network. This person should also be capable of customizing the software according to the needs of the staff.

RECOMMENDATION 4: At TAC Secretariat, we see a good opportunity for the direct utilization of microcomputers by professionals. At least one of the microcomputers should be placed in the office of senior staff (probably Dr. Roberts-Pichette).

RECOMMENDATION 5: Communication opportunities between TAC members should be explored, and relevant TAC members should be added to the CBMS, e.g., Dr. E. Alvarez-Luna (Mexico), Prof. G. Camus (France), Dr. L. T. Evans (Australia), Dr. O. Heide (Norway), Dr. E. Q. Javier (Philippines), Dr. G. E. Joandet (Argentina), Dr. A. McCalla (USA), Dr. J. Mortelmans (Belgium), Dr. A. Tanaka (Japan), Prof. C. C. Thomsen (Denmark), Dr. W. von Urff (Fed. Rep. of Germany), and Dr. E. T. York (USA).

APPENDIX P

CBMS: Operation and Basic Facilities

CBMS: OPERATION AND BASIC FACILITIES

Typically, the user of a computer-based messaging system (CBMS) will need a terminal device and a telecommunication service (such as the public-switched telephone network or a public data network) to connect to the computer where his "mailbox" resides. Before using the CBMS, the user must identify himself by providing an account number or name, and a unique password or security code. Once authenticated, the user is presented with a notification of the messages that have been received since his last session, or a list of messages which require his attention.

The user may elect to see the messages in the order in which they arrived, or may select individual messages to be displayed. After displaying the message, the CBMS marks it as "received", and permits the user to dispose of it in a number of ways. The message may be deleted, forwarded to another user (perhaps with annotations), or filed in a "message folder". At any time, the user may search for and/or retrieve a message stored in a folder, by specifying various kinds of information, such as the date on which the message was received, the author of the message, key words associated with the message, or character strings contained within the body of the message.

If the user wishes to send a message, the CBMS will elicit the name(s) of the recipient(s) from the user. If a name is not recognized, the CBMS will often allow the user to search a "directory" of valid user names. The user may also designate a pre-defined distribution list as the "recipient" of the message, relying on the CBMS to expand the list into a set of valid names for the recipients. The user is then allowed to type in the text of the message directly from a keyboard device, or to submit a previously prepared message from a computer file. (The file may reside on the CBMS computer, or on the user's terminal device if it has storage capacity.)

Table P-1 gives a brief overview of features and facilities that are typical for a CBMS, with detailed explanations following as text.

Table P-1. CBMS Facilities and Features

SYSTEM USERS	Maximum Number of Mailboxes
	Number of Concurrent Users
	Multiple User Groups
	Directory of Users
	Alternative User Names
	Distribution Lists
	Multiple Host (Distributed Messaging
SECURITY	Password Access Control
	Private Message Password
	User-Changeable Password
	Encryption

Table P-1. CBMS Facilities and Features (Continued)

MESSAGE SENDING	Date and Time Stamp Registered Delivery Reply Requested Courtesy/Blind Copies Maximum Message Length Priority Send Delayed Delivery Status Inquiry of Sent Message Storage of Unsent Messages
RECEIPT OF MESSAGES	Scan of Messages Message Length Indicator Reply Express Indicator Forwarding Message Recovery
MESSAGE STORAGE	User Files Maximum Number of Files per User Header Addressable Retrieval Content Addressable Retrieval
OTHER FACILITIES	Text Editor Forms Spelling Checker Active Messages Interfaces with Other Systems Usage Statistics Accounting System On-Line Help Facility Language Options
ADHERENCE TO STANDARDS	CCITT Message Handling System (MHS) NBS Message Interchange Standards ISO Message-Oriented Text Interchange System (MOTIS) ECMA Message Interchange Distributed Application (MIDA)
INTERNATIONAL SERVICE OPERATION	Private Network Access
INTERNATIONAL SERVICE ACCESS	International Access by Value-Added Network International Connection of Domestic CBMS Services

SYSTEM USERS

Maximum Number of Mailboxes. This number indicates the total "mailbox" capacity of the system, i.e., usually the number of addressable users. (Each user is assigned an individual mailbox, in which messages are stored.)

Number of Concurrent Users. The number of subscribers that use the system at the same time.

Multiple User Groups. The user directory is structured in such a way that users can be clustered into groups. Communications can be restricted within one group (a closed group) or permitted across some or all group boundaries.

Directory of Users. The system maintains a directory of users which can be searched in a variety of ways.

Alternative User Names. The system permits the creation of entries with several alternative names, "aliases" or nicknames, for each directory.

Distribution Lists. Standard lists are maintained for the distribution of a message to multiple recipients. These may be set up by the user or by the system administrator. Each list is normally addressed by a single "key word."

Multiple Host (Distributed Messaging). The system is capable of operating on multiple host computers which can be interconnected. The multiple hosts may be at a single site or at several sites. Users may send messages to mailboxes at other hosts through an addressing feature within the system.

SECURITY

Password Access Control. When accessing the system, the user must provide an identification name and the password associated with the user identification.

Private Message Password. The system has a facility that allows a second level of password to be used when the sender identifies a message as private.

User-Changeable Password. The user can change his password without intervention by the system administrator.

Encryption. The system provides the capability of encrypting messages or storing messages in an encrypted form.

MESSAGE SENDING

Date and Time Stamp. The system automatically includes the date and time when a message was sent.

Registered Delivery. The sender can request that the system provide automatic acknowledgement when the recipient reads a message.

Reply Requested. The sender can "force" the recipient to send a reply to the message.

Courtesy/Blind Copies. The system allows multiple copies of the message to be sent to designated recipients. "Courtesy" copies show the names of other recipient. "Blind" copies do not.

Maximum Message Length. A maximum length in words, lines or characters that the system permits for any one message.

Priority Send. The sender can request that the message be sent "express" or "urgent". The system will process the item as a priority message and identify the priority messages to the recipient when the end-user logs on to the CBMS.

Delayed Delivery. The sender can state the time and date when, or time delay after which, the message should be delivered to the recipient.

Status Inquiry of Sent Message. The sender can request information to find out whether a sent message has been received. He can specify for all messages or for only urgent or registered messages.

Storage of Unsent Messages. The user can create a message in full or partially, and then store it in some form of work space or file for later transmission to the recipients.

RECEIPT OF MESSAGES

Scan of Messages. The user, upon logging on to the CBMS, can scan messages in the "in box" before deciding which messages to read.

Message Length Indicator. When a scan of messages is carried out, or messages are retrieved from files, the CBMS indicates the length of each message.

Reply. The receiver can elect to reply immediately to the message. This implies that it will not be necessary to re-enter addressing information.

Express Indicator. The recipient is advised by the system that the message or messages waiting are "express" or "urgent".

Forwarding. The receiver can request that the system forward the message to others. It may also be possible to add comments before forwarding.

Message Recovery. The recipient of a message can delete the message. It may be possible to "retrieve" or reinstate a deleted message for some specified length of time, ranging from the length of the current session to some pre-set date at which time the message is expunged from the system.

MESSAGE STORAGE

User Files. The user can name files to be used for storage and subsequent search and retrieval.

Maximum Number of Files per User. The maximum number of files any one user is permitted to have.

Header Addressable Retrieval. The user can retrieve messages by a variety of search keys. However, the search keys relate only to the header information in the message, such as addressing information, the message title, and any system-requested "key words" (subject).

Content Addressable Retrieval. The user is able to retrieve messages by accessing information in both the header of the message and in the text, for example, by using character string search.

OTHER FACILITIES

Text Editor. The system contains the capability of editing and correcting messages prior to sending them.

Forms. The system allows users, or system administrators, to set up preformatted forms or documents. The user is able to call these forms up and fill them out.

Spelling Checker. The system contains the ability to check the spelling of words within a message before sending the message. This may include the capability to check against both standard English and a special vocabulary.

Active Messages. The system permits a message to contain "instructions" or a program which is activated upon receipt by the intended recipient.

Interfaces with Other Systems. The CBMS provides a general capability to link with certain other facilities, such as:

1. Word processing
2. Data processing and programming
3. Data base management systems
4. Telex/TWX
5. Teletex
6. Facsimile
7. Voice-messaging systems
8. Other public or private CBMS systems.

Usage Statistics. The CBMS produces a range of usage statistics. These usage statistics may be designed individually but should reflect specific variables of usage of the CBMS.

Accounting System. Linked to, or separate from the usage statistics, the CBMS can generate invoicing and billing information for users or groups of users.

On-line Help Facility. When in doubt, the user can request on-line help to determine the options available at any level in the CBMS.

Language Options. The CBMS user interface is available in a language or languages in addition to English. A system is defined as bilingual (or multilingual) if it allows part of the user community to interact with the system in languages other than English.

ADHERENCE TO STANDARDS

Note: Since all of the standards established for computer-based message systems are still in the process of formulation and ratification, evaluation can proceed only on the basis of stated intentions to adhere to one or more of the following sets of standards.

CCITT Message Handling System (MHS). The CBMS provides the Interpersonal Messaging Service (IPMS) specified by the CCITT recommendations X.MHS0 - X.MHS7.

NBS Message Interchange Standards. The CBMS adheres to the U.S. National Bureau of Standards (NBS) Federal Information Processing Standard (FIPS) recommendations.

ISO Message-Oriented Text Interchange System (MOTIS). The CBMS adheres to the International Organization for Standardization (ISO) MOTIS standard.

ECMA Message Interchange Distributed Application (MIDA). The CBMS adheres to the European Computer Manufacturers Association (ECMA) MIDA standard.

INTERNATIONAL SERVICE OPERATION/INTERNATIONAL SERVICE ACCESS

Note: This category of evaluation criteria applies to the service bureau offerings of Registered Private Operating Agencies (RPOAs), Postal Telephone and Telegraph administrations (PTTs), and private service bureaus.

Private Network Access. The CBMS service provides terminal access to users outside the national boundaries of the host country (in which the CBMS operates) by means of a private network.

International Access by Value-Added Network. The CBMS service provides terminal access to users outside the national boundaries of the host country (in which the CBMS operates) by means of interconnected (public) national data networks or publically available data network services operated by international record carriers (IRCs).

International Connection of Domestic CBMS Services. The CBMS services offered to the public in two (or more) countries are interconnected, such that the subscriber of a domestic CBMS in one country may send messages to a subscriber of a different CBMS operating in a different country.

APPENDIX Q

International Record Carrier (IRC) Rates

9/11/84 STANDARD IRC RATES

COUNTRY	AREA CODE	TELEX RATES*	CABLEGR RATE	LETTERG RATE
ABU DHABI	949	2.9200	0.340	0.170
ABU DHABI (UAE)	949	2.9200	0.340	0.170
AFGHANISTAN**	930	2.9200	0.340	0.170
AJMAN	958	2.9200	0.340	0.170
AJMAN (UAE)	958	2.9200	0.340	0.170
ALASKA***	314	1.3900	0.000	0.000
ALBANIA	101	0.0000	0.265	0.132
ALGERIA	936	2.9200	0.340	0.170
ANDORRA**	833	1.9200	0.265	0.132
ANGOLA	998	2.9200	0.340	0.170
ANGUILLA (WI)	317	2.3100	0.230	0.115
ANTIGUA (WI)	306	2.3100	0.230	0.115
ARGENTINA	390	2.3100	0.310	0.155
ARUBA (NETH ANT)	384	2.3100	0.230	0.115
ASCENSION ISL**	920	2.9200	0.280	0.140
AUSTRALIA	790	2.2100	0.280	0.140
AUSTRIA	847	1.9200	0.265	0.132
AZORES	835	1.9200	0.265	0.132
BAHAMAS**	382	1.4300	0.230	0.115
BAHRAIN (STATE OF)	955	2.9200	0.340	0.170
BANGLADESH	950	2.2100	0.280	0.140
BARBADOS (WI)	386	2.3100	0.230	0.115
BELGIUM	846	1.9200	0.265	0.132
BELIZE (BRITISH HONDURAS)	310	2.3100	0.280	0.140
BENIN (PEOPLE'S REP)	979	2.9200	0.340	0.170
BERMUDA	380	1.4300	0.230	0.115
BOLIVIA (ENTEL)	355	2.3100	0.310	0.155
BOLIVIA (ENTEL)	356	2.3100	0.310	0.155
BONAIRE (NETH ANT)	384	2.3100	0.230	0.115
BOPHUTHATSWANA**	932	1.9200	0.280	0.140
BOTSWANA	991	2.2700	0.280	0.140
BRAZIL	391	2.3100	0.310	0.155
BRUNEI	799	2.2100	0.280	0.140
BULGARIA	865	2.2700	0.265	0.132
BURMA**	713	2.2100	0.340	0.170
BURUNDI**	977	2.9200	0.340	0.170
CAMBODIA (DEM KAMPUCHEA)	102	0.0000	0.340	0.170
CAMEROON REP	973	2.9200	0.340	0.170
CANADA	389	0.6950	0.000	0.000
CANARY ISL	966	1.9200	0.340	0.170
CAPE VERDE ISL	938	2.9200	0.340	0.170
CAROLINE ISL	103	0.0000	0.340	0.170
CARRIACOU (WI)	104	0.0000	0.230	0.115
CAYMAN ISLANDS (WI)	309	1.9300	0.230	0.115
CENTRAL AFRICA REP	980	2.9200	0.340	0.170
CEYLON (SRI LANKA)	954	2.2100	0.280	0.140
CHAD REP**	984	2.9200	0.340	0.170
CHATHAM ISL	105	0.0000	0.280	0.140

9/11/84 STANDARD IRC RATES

COUNTRY	AREA CODE	TELEX RATES*	CABLEGR RATE	LETTERG RATE
CHILE (ITT)	352	2.3100	0.310	0.155
CHILE (TELEX CHILE)	392	2.3100	0.310	0.155
CHILE (TEXCOM)	359	2.3100	0.310	0.155
CHILE (TRANSRADIO)	332	2.3100	0.310	0.155
CHINA (PEOPLE'S REP OF)	716	2.2100	0.340	0.170
CHINA (REP OF--TAIWAN)	785	2.2100	0.340	0.170
CHRISTMAS ISL (MALAYSIA)	107	0.0000	0.280	0.140
CHRISTMAS ISL (PACIFIC)	106	0.0000	0.280	0.140
COCOS ISL	108	0.0000	0.280	0.140
COLOMBIA	396	2.3100	0.310	0.155
COMOROS (FED & ISLAMIC REP OF)**	942	2.2700	0.340	0.170
CONGO (PEOPLE'S REP OF)**	971	2.9200	0.340	0.170
COOK ISL**	717	2.9000	0.280	0.140
CORSICA (FRANCE)	109	0.0000	0.265	0.132
COSTA RICA	303	2.3100	0.310	0.155
CUBA	307	2.3100	0.230	0.115
CURACAO (NETH ANT)	384	2.3100	0.230	0.115
CYPRUS	826	1.9200	0.265	0.132
CZECHOSLOVAKIA	849	2.2700	0.265	0.132
DENMARK	855	1.9200	0.265	0.132
DJIBOUTI	994	2.9200	0.340	0.170
DJIBOUTI (REP OF)	994	2.9200	0.340	0.170
DOMINICA (WI)	304	2.3100	0.230	0.115
DOMINICAN REP	326	1.9300	0.230	0.115
DOMINICAN REP	346	1.9300	0.230	0.115
DUBAI	958	2.9200	0.340	0.170
DUBAI (UAE)	958	2.9200	0.340	0.170
ECUADOR	393	2.3100	0.310	0.155
EGYPT (ARAB REP OF)	927	2.2700	0.340	0.170
EL SALVADOR	301	2.3100	0.310	0.155
ETHIOPIA	976	2.9200	0.340	0.170
FALKLAND ISL**	319	2.9200	0.280	0.140
FAROE ISL	853	1.9200	0.265	0.132
FIJI (SUVA)	792	2.9000	0.280	0.140
FINLAND	857	1.9200	0.265	0.132
FRANCE	842	1.9200	0.265	0.132
FRENCH GUIANA	313	2.3100	0.310	0.155
FRENCH POLYNESIA (TAHITI)	711	2.2100	0.340	0.170
FUJAIRAH	958	2.9200	0.340	0.170
FUJAIRAH (UAE)	958	2.9200	0.340	0.170
GABON	981	2.9200	0.340	0.170
GAMBIA**	992	2.9200	0.280	0.140
GERMANY (EAST)	840	2.2700	0.265	0.132
GERMANY (WEST)	841	1.9200	0.265	0.132
GHANA**	974	2.9200	0.280	0.140
GIBRALTAR**	837	2.2700	0.265	0.132
GRAND CAYMAN (WI)	309	1.9300	0.230	0.115
GREAT BRITAIN & N IRELAND (UK)	851	1.4100	0.230	0.115

COUNTRY	AREA CODE	TELEX RATES*	CABLEGR RATE	LETTERG RATE
GREECE	863	1.9200	0.265	0.132
GREENLAND	859	1.9200	0.265	0.132
GRENADA (WI)	320	2.3100	0.230	0.115
GUADELOUPE (FR ANT)	340	2.3100	0.230	0.115
GUAM***	721	2.2100	0.340	0.170
GUATEMALA	305	2.3100	0.310	0.155
GUINEA (BISSAU)	931	2.9200	0.340	0.170
GUINEA (EQUATORIAL)	110	0.0000	0.340	0.170
GUINEA (REP OF)**	995	2.9200	0.340	0.170
GUYANA	312	2.3100	0.280	0.140
HAITI	349	1.9300	0.230	0.115
HAWAII***	723	0.4775	0.210	0.105
HAWAII***	743	0.3475	0.210	0.105
HAWAII (WU)***	709	0.7275	0.210	0.105
HAWAII-DATATEL***	708	0.4775	0.210	0.105
HONDURAS (REP OF)**	311	2.3100	0.310	0.155
HONG KONG	780	2.2100	0.280	0.140
HUNGARY	861	1.9200	0.265	0.132
ICELAND	858	2.2700	0.265	0.132
INDIA	953	2.2100	0.280	0.140
INDONESIA	796	2.2100	0.340	0.170
IRAN	951	2.2700	0.340	0.170
IRAQ	943	2.2700	0.340	0.170
IRELAND (EIRE)	852	1.9200	0.230	0.115
ISRAEL	922	2.2700	0.340	0.170
ITALY	843	1.9200	0.265	0.132
IVORY COAST (REP OF)	969	2.2700	0.340	0.170
JAMAICA (WI)	381	1.9300	0.230	0.115
JAPAN	781	2.2100	0.340	0.170
JORDAN	925	2.2700	0.340	0.170
KAMARAN ISL	956	0.0000	0.280	0.140
KENYA	963	2.2700	0.280	0.140
KOREA (REP OF SOUTH)	787	2.2100	0.340	0.170
KUWAIT	959	2.2700	0.340	0.170
LAOS (PEOPLE'S DEM REP)**	715	2.9000	0.340	0.170
LEBANON	923	1.9200	0.340	0.170
LESOTHO	990	2.2700	0.280	0.140
LIBERIA	937	2.2700	0.250	0.125
LIBYA	929	2.2700	0.340	0.170
LICHTENSTEIN	845	1.9200	0.265	0.132
LUXEMBOURG	848	1.9200	0.265	0.132
MACAO**	797	2.2100	0.340	0.170
MADAGASCAR**	983	2.9200	0.340	0.170
MADEIRA ISL	834	1.9200	0.340	0.170
MALAWAI	988	2.2700	0.280	0.140
MALAYSIA	784	2.2100	0.280	0.140
MALDIVES ISL	940	2.9200	0.340	0.170
MALI (REP OF)	972	2.9200	0.340	0.170

9/11/84 STANDARD IRC RATES

COUNTRY	AREA CODE	TELEX RATES*	CABLEGR RATE	LETTERG RATE
MALTA	838	2.2700	0.265	0.132
MARSHALL ISL	111	2.9200	0.340	0.170
MARTINIQUE (FR ANT)	300	2.3100	0.230	0.115
MAURITANIA**	935	2.9200	0.340	0.170
MAURITIUS ISL	996	2.9200	0.280	0.140
MAYOTTE (COMOROS)	942	2.2700	0.340	0.170
MEXICO	383	0.7800	0.000	0.000
MIDWAY ISL	112	0.0000	0.210	0.105
MONACO	842	1.9200	0.265	0.132
MONGOLIAN PEOPLE'S REP	113	0.0000	0.340	0.170
MONTSERRAT (WI)	360	2.3100	0.230	0.115
MORROCO	933	2.2700	0.340	0.170
MOZAMBIQUE (PORT E AFR)	946	2.9200	0.340	0.170
MUSCAT (OMAN)	926	2.9200	0.340	0.170
NAMIBIA(S W AFRICA)	964	1.9200	0.280	0.140
NAURU ISL	739	2.2100	0.280	0.140
NEPAL	947	2.2100	0.340	0.170
NETH ANT(ARUBA BONAIRE CURACAO)	384	2.3100	0.230	0.115
NETHERLANDS	844	1.9200	0.265	0.132
NEW CALEDONIA**	714	2.9000	0.340	0.170
NEW GUINEA (BR)	795	2.9000	0.280	0.140
NEW ZEALAND	791	2.2100	0.280	0.140
NICARAGUA	302	2.3100	0.310	0.155
NIGER (REPUBLIC OF)	982	2.9200	0.340	0.170
NIGERIA (FEDERAL REP OF)	961	2.2700	0.280	0.140
NORFOLK ISL	114	0.0000	0.280	0.140
NORWAY	856	1.9200	0.265	0.132
OKINAWA (RYUKYU ISL)	781	2.2100	0.340	0.170
OMAN SULTANATE	926	2.9200	0.340	0.170
PAKISTAN	952	1.9200	0.280	0.140
PANAMA	328	2.3100	0.310	0.155
PANAMA	368	2.3100	0.310	0.155
PAPUA	794	2.9000	0.280	0.140
PARAGUAY	399	2.3100	0.310	0.155
PERU	394	2.3100	0.310	0.155
PHILIPPINES (CAP WIRELESS)	732	2.2100	0.340	0.170
PHILIPPINES (ETPI)	762	2.2100	0.340	0.170
PHILIPPINES (ITT)	742	2.2100	0.340	0.170
PHILIPPINES (PHIL GLOBCOM)	722	2.2100	0.340	0.170
PHILIPPINES (PTT)	712	2.2100	0.340	0.170
PITCAIRN ISL	115	0.0000	0.280	0.140
POLAND (PEOPLES REP OF)	867	1.9200	0.265	0.132
PORTUGAL	832	1.9200	0.265	0.132
PRINCIPE**	916	2.9200	0.340	0.170
PUERTO RICO***	325	1.1000	0.210	0.105
PUERTO RICO***	365	1.1000	0.210	0.105
PUERTO RICO (ITT)***	345	1.1000	0.210	0.105
PUERTO RICO (PRCA-NAT'L)***	385	1.1000	0.210	0.105

9/11/84 STANDARD IRC RATES

COUNTRY	AREA CODE	TELEX RATES*	CABLEGR RATE	LETTERG RATE
QATAR**	957	2.9200	0.340	0.170
RAS AL KHAIMAH	944	2.9200	0.340	0.170
RAS AL KHAIMAH (UAE)	944	2.9200	0.340	0.170
REUNION ISL	941	2.9200	0.340	0.170
RHODESIA (ZIMBABWE)	987	2.2700	0.280	0.140
RODRIQUEZ ISL	116	0.0000	0.280	0.140
ROMANIA (SOC REP OF)	864	1.9200	0.265	0.132
RWANDA**	967	2.9200	0.340	0.170
RYUKYU ISL (OKINAWA)	781	2.2100	0.340	0.170
S W AFRICA (NAMIBIA)	964	1.9200	0.280	0.140
SAIPAN (MARIANAS)	724	2.2100	0.340	0.170
SAIPAN (MARIANAS)	783	2.2100	0.340	0.170
SAKHALIN ISL (USSR)	117	0.0000	0.265	0.132
SAMOA (AMERICAN)***	782	2.9000	0.270	0.135
SAMOA (WESTERN)	793	2.9000	0.280	0.140
SARDINIA (ITALY)	118	0.0000	0.265	0.132
SAUDI ARABIA	928	2.9200	0.340	0.170
SENEGAL (REPUBLIC OF)	962	2.9200	0.340	0.170
SEYCHELLES			0	0.170
SRI LANKA DEM SOC REP OF	954	2.2100	0.280	0.140
ST BARTHELEMY (FR ANT)	120	0.0000	0.230	0.115
ST HELENA**	921	2.9200	0.280	0.140
ST KITTS (WI)	361	2.3100	0.230	0.115
ST LUCIA (WI)	341	2.3100	0.230	0.115
ST MAARTEN**	308	2.3100	0.230	0.115
ST THOME ISL (PORT W AFR)**	916	2.9200	0.340	0.170
ST VINCENT (WI)	321	2.3100	0.230	0.115
SUDAN (REP OF)	970	2.9200	0.340	0.170
SURINAM (REP OF)	397	2.3100	0.310	0.155
SWAZILAND	993	2.2700	0.280	0.140
SWEDEN	854	1.9200	0.265	0.132
SWITZERLAND	845	1.9200	0.265	0.132
SYRIAN ARAB REPUBLIC	924	2.9200	0.340	0.170
TAHITI (FR POLYNESIA)	711	2.2100	0.340	0.170
TAIWAN (CHINA-REP OF)	785	2.2100	0.340	0.170
TANZANIA	975	2.2700	0.280	0.140
THAILAND	788	2.9000	0.340	0.170
TIBET	121	0.0000	0.340	0.170
TOGOLESE REP OF	986	2.9200	0.340	0.170

9/11/84 STANDARD IRC RATES

COUNTRY	AREA CODE	TELEX RATES*	CABLEGR RATE	LETTERG RATE
TONGA ISL**	765	2.9000	0.280	0.140
TORTOLA	318	2.3100	0.230	0.115
TRANSKEI**	915	1.9200	0.280	0.140
TRINIDAD & TOBAGO-DEM REP OF (WI)	387	2.3100	0.230	0.115
TUNISIA	934	2.2700	0.340	0.170
TURKEY	821	1.9200	0.265	0.132
TURKS & CAICOS ISLANDS	315	1.9300	0.230	0.115
UGANDA	973	2.2700	0.280	0.140
UMM AL QAIWAN (UAE)	958	2.9200	0.340	0.170
UMMM AL QAIWAIN	958	2.9200	0.340	0.170
UNITED ARAB EMIRATES	944	2.9200	0.340	0.170
UNITED KINGDOM (G BRITAIN/N IRELAND)	851	1.4100	0.230	0.115
UPPER VOLTA (REP OF)**	985	2.9200	0.340	0.170
URUGUAY	398	2.3100	0.310	0.155
USSR	871	1.9200	0.265	0.132
VANUATU**	718	2.9000	0.340	0.170
VATICAN CITY	803	1.9200	0.265	0.132
VENEZUELA	395	2.3100	0.310	0.155
VIETNAM**	798	2.9000	0.340	0.170
VIRGIN ISL (BR)**	318	2.3100	0.230	0.115
VIRGIN ISL US***	367	1.1000	0.210	0.105
VIRGIN ISL US (ITT)***	347	1.1000	0.210	0.105
WAKE ISL	122	0.0000	0.210	0.105
WALLIS & FUTUNA ISIS	123	0.0000	0.340	0.170
YEMEN ARAB REP**	948	2.9200	0.340	0.170
YEMEN-PEOPLE'S DEM REP OF**	956	2.9200	0.280	0.140
YUGOSLAVIA	862	1.9200	0.265	0.132
ZAIRE (REPUBLIC OF)	968	2.2700	0.340	0.170
ZAMBIA	965	2.2700	0.280	0.140
ZIMBABWE (RHODESIA)	987	2.2700	0.280	0.140

* The Telex Rate is normally a per minute charge that includes a domestic component charge. The domestic component for ITT is $0.384.

** Minimum Charge is three minutes. Additional minutes or fractions thereof are rounded up to the next minute for charging purposes, except where noted. A one minute minimum applies to all other countries.

*** Domestic telex service, additional usage in excess of one minute is charged in increments of one-tenth of a minute, except for calls to WUT TWX, additional usage in excess of one minute is rounded up to the nearest minute. For full rate telegrams to Hawaii, Puerto Rico and the U.S. Virgin Islands, the rate is $.21 per word for 1 to 50 words; $.10 per word for each additional word over 50.