DESIDOC Bulletin of Information Technology, Vol. 18, No. 2, March 1998, pp. 5-12

Agricultural Research Information System (ARIS) of ICAR

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Abstract

The Indian National Agricultural Research System (NARS) with its nationwide network of educational and research institutions consisting of state agricultural universities, zonal research stations, ICAR institutes with regional stations established Agricultural Research Information System in 1995 to strengthen its research information base with funds from National Agicultural Research Project. It has two main components: creation of infrastructure for providing electronic connectivity and creation of MIS and computerised/electronic databases of Indian research findings of NARS in various fields of agriculture and allied fields. Basic hardware to create e-mail and Internet connectivity has already been provided. Local Area Networks are being created at all sites. Programme to strengthen the connectivity using VSATs and creation of databases has been worked out for the ninth Five Year Plan period.

1. INTRODUCTION

As a consequence of rapid development in science and technology, there is a virtual information explosion the world over. For achieving an optimal utilization of these developments, it is essential that scientists in the Indian National Agricultural Research System (NARS) have a quick access to and free exchange of information at local, national and international levels. NARS through its vast network of 30,000 scientists working at ICAR's 49 Central Institutes, 10 Project Directorates (PDs), 27 National Research Centres (NRCs), 86 All India Coordinated Research Projects (AICRPs), 261 *Krishi Vigyan Kendras* (KVKs), 29 State Agricultural Universities (SAUs), 120 Zonal Research Stations (ZRS), one Central Agricultural University (CAU), numerous (1000 plus) regional stations and other research centres has been catering to the agricultural research and information needs of the farming community. The ICAR during eighth Five Year Plan embarked upon a project called Agricultural Research Information System (ARIS) to bring the power of information technology to the NARS. Its implementation started with the financial aid from World Bank (WB) under National Agricultural Research Project (NARP). The coverage of the project is being extended during ninth Five Year Plan under National Agricultural Technology Project (NATP).

In India, direct application of computerized information systems to the farmers perhaps is not feasible in the present conditions. However, information management by the research managers and the use of expert systems and other microprocessor based systems by the progressive farmers in commercial horticulture and aquaculture is very much within the reach. Utilization of information system has been

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demonstrated by Annon[1] and graphically presented in Fig. 1.

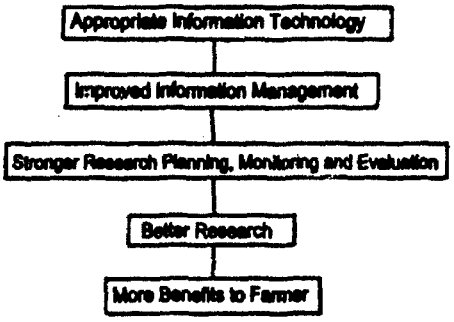

Figure 1: Flow Diagram of Information System utilization

2. INFORMATION REQUIREMENTS

For developing agricultural and rural sectors, the following three levels of users of information system are identified: managers, scientists and farmers.

2.1 Managers

Managers include research managers at ICAR headquarters and directors of its central institutes, vice-chancellors, deans and directors of SAUs, secretaries and other decision-making authorities of Agriculture and Rural Development Departments of States and NGOs. For effective decision making, they may require information on human & physical resources; research, extension and development projects; budgeting; and physical targets.

2.2 Scientists

Scientists include personnel working in NARS, extension, and development departments. Their information requirement can be related to research and extension trends in various disciplines: plant, animal & fisheries genetic resources, soil profiles, natural resources; agro-climate; economic and social indicators; feedback from fields; and results of previous research at both national and international levels.

2.3 Farmers

The farmers may require information on input/output prices, market information, location specific improved varieties, farm machinery, cattle breed, fish, etc., improved techniques and methods, complete package of practices, value additions (post harvest), and information about input supply system.

3. PROPOSED INFORMATION SYSTEM

Keeping in view the total agricultural and rural development system, constraints and limitations, and information requirements at different levels, following objectives are proposed in formulating a comprehensive information system (Fig. 2) for effective agricultural and rural development.

- ☐ Improved research and planning
- ☐ Checking the duplication of research and extension projects and programming
- ☐ Dissemination of research findings
- ☐ Improvement in feedback mechanism
- ☐ Better coordination and linkage between and among different rural development agencies and banking institutions like Department of Agriculture (DA), Department of Rural Development (DRD), NABARD, lead banks, NGOs, and private sector
- ☐ Evolving effective information sharing mechanisms
- ☐ Electronic interface among scientists, development agents and farmers.

However, it is very difficult to develop and maintain the proposed information system by any single organisation. The decentralised and step-up process is suggested in order to involve mainly three key organisations, viz., ICAR, SAUs and state departments. The three components of the proposed model will be independent in their structure and functioning.

4. ARIS

To exploit the potential of modern computing power in planning and management of agricultural research and scientific

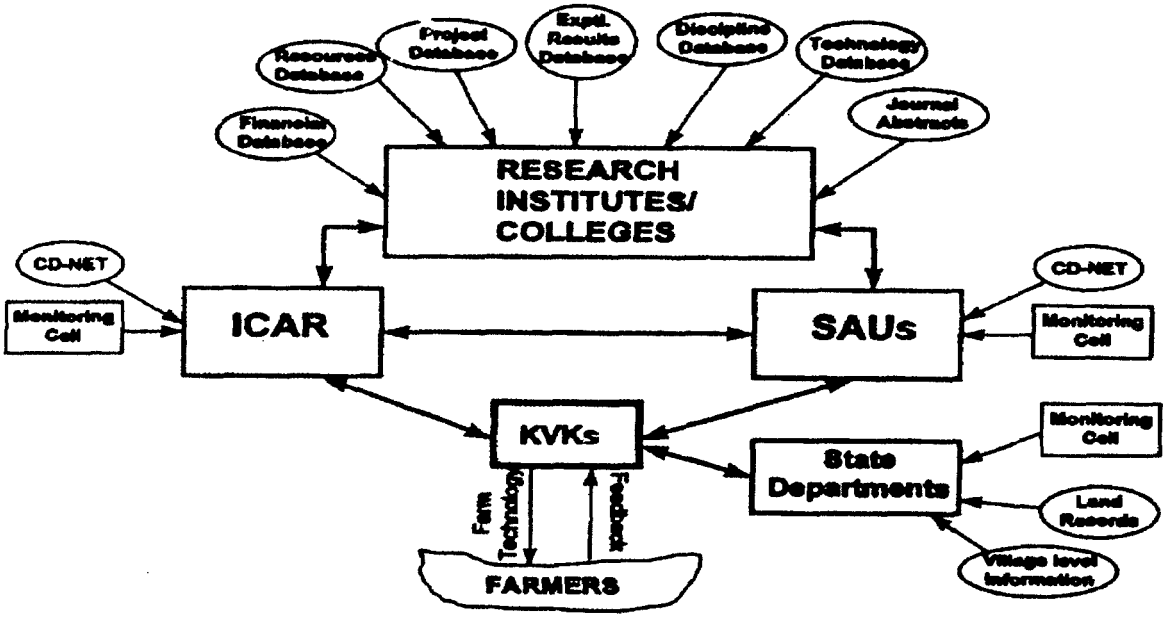

Figure 2. Information System Model for Agriculture and Rural Development

communication, ICAR started an Agricultural Research Information System (ARIS). Basic guidelines to implement this project were provided by a team of experts from ICAR and International Service for National Agricultural Research (ISNAR). In its report[2], a phased implementation was recommended to create infrastructure for ARISNET, a national Wide Area Network for agricultural research.

4.1 Infrastructural Development

A survey by National Centre for Software Technology (NCST), Mumbai showed that ratio of PCs to scientists at ICAR institutes and SAUs is very low. Although it was not an objective of ARIS to cater to total computing needs of a research campus, provision of basic equipment to act as nucleus to networking within a campus was considered necessary. Thus, every campus, including SAUs and their ZRSs as well as ICAR institutes and project directorates have been provided with LAN server and three or four PC workstations with associated LAN cabling. Software for networking, e-mail as well as office automation have been provided along with the equipment. It also included infrastructural equipment like uninterrupted power supply and airconditioning units to provide necessary environment for longer life of these equipments. In addition to this, bigger ICAR institutes and SAUs have been provided with UNIX server to cater to their large user community base. A summary of equipment supplied to SAUs and ICAR institutes during 1996 is given in Table 1. Quantities of computer hardware and software have been worked out to provide connectivity at department level of all colleges and campuses of SAUs and to 50 per cent of the scientific cadre of the ICAR, stationed at more than 240 locations all over the country.

4.2 Databases and Application Software

Besides creating the infrastructural facilities, the four information modules, shown in Fig.3, are designed for ARIS to standardise usage of the different software for the day to day activities of the scientists and office automation.

4.2.1 Agricultural Research Personnel Information System (ARPIS)

To maintain computerised biodata and service history of scientific, technical and administrative staff working at all ICAR institutions, a personnel information system has been planned at ICAR headquarters so as to provide easy access on different types of

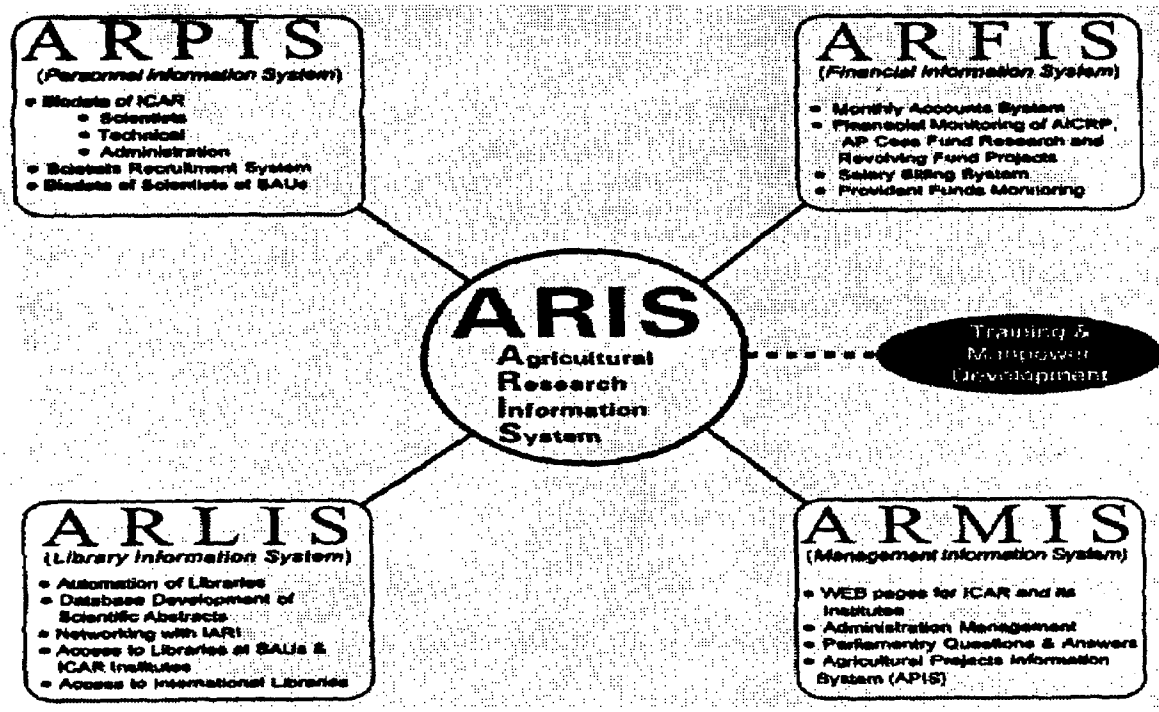

Figure 3. Modules of Agricultural Research Information System

information like cadre strength, number of scientists in position, type of trained manpower available, distribution of scientists according to sex, caste, state, institute and discipline, etc. The information on awards won by different scientists has also been included. This will help the management in planning the personnel policies, manpower planning, recruitment, identification of subject matter specialists in various fields, research work being undertaken on different commodities with respect to agro-climatic zones and resources used, etc. The software and database of all ICAR scientists numbering about 4500 has already been created. It can generate 36 types of predefined reports and any number of queries. This will further be expanded for all staff at KVKs and scientists working at SAUs.

4.2.2 Agricultural Research Financial Information System (ARFIS)

It will maintain computerised monthly accounts of all ICAR institutes and ICAR headquarters, grants to SAUs, All India Coordinated Research Projects (AICRP), AP Cess Fund Research projects, Revolving Fund Schemes and General Provident Fund (GPF) Scheme of all ICAR institutes. In consultation with selected SAUs, a financial information system will also be developed for SAUs after examining the financial information systems already in-place at some of the SAUs.

A software package (ARFIS) has already been developed to computerise the monthly accounts of ICAR institutes and has been successfully implemented in most of the institutes. Its use has been made mandatory from April 1, 1997. More than 300 personnel from account sections of these institutes have been trained on use of this package. codification of all accounting heads (institutes, regional stations, schemes, etc.) has also been carried out.

4.2.3 Agricultural Research Library Information System (ARLIS)

One of the important exercise under ARIS will be to modernise libraries and to put the library information on the ARIS network. All libraries of ICAR and SAUs will be computerised and linked to IARI library which has been identified as National Agricultural Library. This will provide scientists an opportunity to access

information in India or abroad electronically. Thus, library automation and their networking will form a significant part of the ARIS.

Besides modernisation and networking of libraries of ICAR institutes and SAUs, the creation of databases and CDs on both national and international agricultural research contents will be a major work under ARLIS. Agricultural Research Information Centre (ARIC), New Delhi is involved in compilation of information on AP Cess Fund schemes and other research projects funded by ICAR. Also ARIC is serving as National Input Centre for International Information System (AGRIS) for the Agricultural Science and Technology, Current Agricultural Research Information Systems (CARIS) projects of Food and Agriculture Organisation (FAO) and SAARC Agricultural Information Centre (SAIC).

4.2.4 Agricultural Research Management Information System (ARMIS)

It will provide access to research managers/ administrators computerised management tools using software packages to information on different resources maintained under various databases. Reports generation related to particular aspect will be easy to facilitate decision making. Procurement of equipment & inventory, providing connectivity, system operation and overseeing, and information on parliamentary questions and answers will also come under purview of ARMIS.

A database on parliament questions and answers has been developed and being

Table 1: Summary of Computer Equipment to be provided to SAUs and ICAR Institutes under ARIS

Equipment		Supplied under NARP	Proposed under NATP
UNIX Servers	32 users	12	45
	16 users	23	20
	8 users	23	0
Total		**58**	**65**
LAN Servers	32 users	46	180
	16 users	92	83
	8 users	92	0
Total		**230**	**263**
Work Station		745	4250
Laser Printer	Heavy Duty	0	200
	Medium Duty	230	220
Total		**230**	**420**
UPS	5 K	57	0
	3 K	172	300
Total		**229**	***300***
Modem	HS	115	88
	MS	230	0
Total		**345**	**88**
AC		378	126
Router/Switch		30	119
VSATs		0	140

successfully implemented at Parliament Section of ICAR. This is helping research managers in quickly establishing relationship between current questions and answers provided in the past of similar questions.

A scientist recruitment system based on the current procedures has been developed for the Agricultural Scientists Recruitment Board (ASRB), an apex body to recruit scientists for ICAR cadre. It has already been successfully implemented at ASRB's Secretariat.

For SAUs, a package called AGRIUNIS[3] was developed by NAARM to store and retrieve the information. Training was given to all the SAUs to utilise this package but how far this package is used by SAUs is a big question mark and this may be because of non-availability of a suitable follow up.

A management information system (MIS) developed by ISNAR known as INFORM-R will be suitably modified to integrate with ARIS at three levels, i.e. national, institutional (ICAR institutes and SAUs) and research stations (ZRS of SAU, regional stations of ICAR institutes).

4.3 Training and Manpower Development

Presently, most of the computer centres are being handled by statisticians or agricultural engineers who are having mathematical background and basic knowledge of electronics. Computer professionals with appropriate qualification and experience in implementing huge databases are not found in NARS.

In order to develop trained manpower in computer applications in agriculture, training programmes on use of computers and application software packages are being organised. To modernise the present system of working in offices, the staff working in technical, administrative, secretarial, accounting and auditing sections is being trained in the use of computers. Besides this, to keep the ARIS network up & running people from each campus will be provided adequate training for managing various information servers and online databases, and administration of LAN and UNIX networks. Thus, in order to have an effective utilization of the computer resources supplied to agricultural campuses, the training has been divided two major categories.

4.3.1 Users

This includes training the scientists and other technical and administrative staff to use the computers and various software packages. Courses will be planned to give in-depth training for the use of the software packages which will be used all over the ARIS network. Thus, these training courses will be used to bring in the standardization process for data and report formats (e.g. project budgeting, balance sheets, research articles, memos, etc.). Use of the library information system on the ARIS network will also require considerable training of library personnel. Similarly, training to use network services such as e-mail, file transfer, remote logging, information retrieval, library information, WWW, etc. will also be arranged.

4.3.2 Management

To keep the ARIS network up and running, it is important that a few people from each campus are provided with adequate training to manage the equipment installed at their institutes as part of the network. This will include monitoring the e-mail flow, the modem, VSAT and router operations, the LAN and UNIX server operations, and the various software installed on the campus under project ARIS. Minor problems then can be corrected locally. Also, if the problems are beyond the capabilities of the people involved, the same can be reported to appropriate external agency by the people managing the system. Training at the management level will include networking, setting up various information servers and on-line databases, and administration of Novell Netware and UNIX networks. It will also include modem, VSAT and router management, basic PC hardware configuration and trouble-shooting.

In ICAR system, there are two main institute i.e., NAARM and IASRI offering computer related courses to the scientists of the NARS. Under ARIS programme so far about 800 scientist have been provided training on topics like PC trouble-shooting, networking, e-mail, MS-Windows, library information system and

general PC use. Training facilities are being further strengthened to provide higher level computer courses also.

4.4 Networking

Apart from providing wide area network services, it is essential that each campus is equipped with good local area network facilities. Under the ARIS programme most of the ICAR & SAU's were provided with suitable servers and nodes. Six institutes are already having VSAT connectivity for more than two years and 11 more have been provided VSATs during March 1997. The e-mail connectivity has been established to 73 ICAR institutes (47 institutes, 9 PDs and 17 NRCs) out of 86 by linking these institutes through dial-up, including 17 institutes with VSAT connectivity, to the nearest National Informatics Centres (NIC), a Government owned national service provider. It is expected that all of the ICAR institutes & SAUs will have Local Area Network and access to the Internet either by VSAT or by dial-up facility by the end of 1998. To provide effective satellite connectivity 140 more VSATs will be added to the network during next three years.

5. MANAGING THE ARIS

The development of databases and necessary infrastructure is one side of the coin. After establishing initial infrastructure including hardware, software and networking, smooth running of the information system is entirely dependent on the type and quality of monitoring. The experiences in computerisation show that even an established computer database may fail in absence of adequate control mechanism by the people who are supporting and using the system coupled with low level dependency on the information system particularly in Indian context. Necessary monitoring checks will have to be ensured continuously till the users gain fairly good confidence and competence in monitoring.

An Information System (IS) Unit consisting of Assistant Director-General (ADG), Principal Scientist, Senior Scientists and Technical staff is being created at ICAR headquarters to look after the integration of installed equipment into ARIS network. The IS unit will also coordinate among ICAR institutes, SAUs and ZRSs for creation of databases and to ensure free and useful information exchange over this network.

The IS unit will also play a major role in further planning of the ARIS network since no network is static. New nodes will come up, new services will be offered, traffic volumes will grow and new connectivity options will become available. Thus, deciding evolution strategy, creation of databases, evaluation of new connectivity options and implemention of them as and when required will be some of the major tasks of the IS Units.

Creation of monitoring cells is also planned at each NARS institution. These cells would be headed by senior professors/researchers/ managers interested in the information systems. They would directly report to the highest authority like director general, vice-chancellor, secretary, etc. These cells will be suitably supported by competent technical staff and computer centres of the system. ARIS coordinators have already been identified and they are being trained on networking concepts.

6. CONCLUSION

In view of the gigantic task involved in successful implementation of ARIS and lack of technical expertise manpower in ICAR, the following programmes are recommended to be taken up with utmost urgency.

- Since maintenance of databases will depend on data inflow from various components of NARS, the following actions are suggested:

(a) Release of funds of the ICAR, SAUs and government agencies should be linked to the submission of relevant data schedules to the monitoring cells.

(b) Updation of data by the individual scientists like personnel, resources, and research results databases should be linked to the timely submission of the schedules and annual assessments records. This may sound very harsh but in reality it is required as the information is the greatest tool for the better research results.

(c) It should be mandatory for each individual to fill in the required schedules and help the

organisation in streamlining different modules of the information system.

- Presently the curriculums on computers to the under graduate and post-graduate programmes are very limited. Keeping in view of the changes in the information technology, there is a need to look afresh at the curriculums for graduates and post-graduates of different disciplines of agriculture. The concepts of databases, networking, Internet and other advanced areas like GIS, remote sensing, etc. should be considered for the disciplines like agricultural engineering, statistics and economics so that these people will be in a right position to help the development of agricultural research information system and useful for dissemination of information.
- In order to maintain the huge information system, recruitment of computer professionals should be made by giving a separate advertisement rather than combining with the other agricultural allied subjects.
- A comparative study is required with the other research organisation in India regarding the implementation of information system and the difficulties encountered by them. A study of this nature will be helpful to reduce the problems faced in implementing the information system.
- Complete development of software by in-house may not be feasible keeping in view of the scarcity of qualified manpower. However, a collaborative work can be taken with the other agencies like ISNAR, NCST, Tata Consultancy Services and other leading software houses in developing the necessary software for information systems. The care should be taken that the personnel of monitoring cell are involved in the development of software so that modifications can be taken up in house at a later stage.
- In order to capture the data at source level, getting the data in time, maintaining different information systems, there may be some structural changes in procedural formalities. In the recent past different Government agencies (eg. NICSI of NIC, RITES of Railways) have established a separate public sector undertaking so that the decisions can be taken up much faster. This way one can hire the consultants from outside for software development or can call experts on deputation to higher position (even from the system) and to skip the present bureaucratic delaying procedures. This will speed up the effective implementation of information systems of different kinds.

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