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Dr. A M Michael: Pioneering Water Conservation and Agricultural Informatics

M Jayapradeep and T K Gireesh Kumar

Abstract

Dr. Michael is an internationally acclaimed figure in the field of Water Resource Development and Management. He is known for developing irrigation systems, which minimise water loss. He established his position as an institution builder of high repute in agricultural sector of India. Beyond all this he is one who first initiated projects that can harness the power of ICT for agricultural education, research, extension and development and laid the foundation for applying Agricultural Informatics to prepare the sector in India for the networked society. Actually the developments that resulted in the establishment of Knowledge management Systems like Shodganga, KrishiPrabha etc have roots in the innovative ICT projects he initiated in nineteen nineties when such systems are not even dreamed off. Even after three decades the higher education and research systems especially for agriculture could not envision or implement ICT compliant systems, which he achieved.

Keywords: Agriculture, Agricultural Engineering, Irrigation Technology, Water Management, ICT, Informatics, ARIES, KAULIS, Knowledge Management, ICAR,

Introduction

Dr. Arayathinal Michael Michael is an internationally acclaimed figure in the field of Water Resources Development and Management. He is known for developing irrigation systems, which minimizes water loss and utilizes the water resources effectively. He established his position as a zealous institution builder of high repute in agricultural sector of India. Dr Michael pioneered projects that could harness ICT for agricultural education, research, extension and development. The developments that resulted in the establishment of Open Access to full text of PhD Theses of universities such as Mahatma Gandhi University Theses Archive launched by Dr. APJ Abdul Kalam, Shodhganga, a reservoir of Indian thesis maintained by INFLIBNET under University Grants Commission (UGC) of India as well as KrishiPrabha the digital repository for accessing agricultural doctoral dissertations maintained by ICAR can be traced back to the ICT projects Dr. Michael initiated in nineties.

The exemplary vision of Dr. Michael could only be appreciated if one understands that such systems were not even thought off in agricultural education, research and extension or even in ICT field at that time. Indian Agricultural Research Institute (IARI) and Kerala Agricultural University (KAU) have been benefited in this aspect on his functioning as Director and Vice Chancellor respectively. Even after three decades of Michael era in KAU, the higher education and research systems for agriculture in Kerala could not envision or implement ICT

systems, which he achieved during nineties. Information capacity and comforts presently held by KAU is the natural result of ICT infrastructure enjoined into the system at national level by government and agencies like ICAR. However it is built on the residues of past era left by Dr Michael.

Dr. Michael functioned as Vice Chancellor of KAU from the year 1992 for a five-year term and left the office without completing the tenure due to peculiar political equations that prevailed in the State of Kerala. He held the office at a time when twenty first century was at the doorsteps and the process of globalization had just begun. But, the pulse of digital communication and networking was alien to the academic, research, extension and Information Service professionals of the university. Dr. Michael had a dream to fulfill and a vision to actualize when he took over the office of the Vice Chancellor.

Education

Dr. Michael was born on June 17, 1930 at Pathampuzha, Poonjar in Kottayam District of Kerala State, India. He studied at the Allahabad Agricultural Institute (now Sam Higginbottom University of Agriculture, Technology and Sciences) when Prof. Mason Vaugh was the Professor and Head of the Department of Agricultural Engineering.

Prof. Mason Vaugh (1894 - 1978) was an American agriculturalist who developed the first agricultural engineering department outside North America in nineteen twenties at Allahabad Agricultural Institute. Prof. Vaugh utilized traditional Indian materials, which he adapted for farmers to use as modern agricultural implements. Among his innovations was the 'Shabash', an improved plow consisting of a plowshare, a moldboard, a few bolts and a wood beam. It cost only Rs. 15. Improved implements like this made it possible for farmers to plow larger areas than previously possible. He also introduced several other implements, such as hoes, cultivators and the wheat threshers. He retired in 1957 and returned to the United States. Dr. Michael was one of the pet students of Prof. Vaugh and he continued his communication with him even after he left India. Prof. Vaugh was a great inspiration and role model. The innovations Dr. Michael made later are akin to that of Prof. Vaugh. Professor Vaugh has often been called the Father of Agricultural Engineering in India. In his honor Indian Society of Agricultural Engineers (ISAE) established the Mason Vaughn Agricultural Engineering Pioneer Award. Dr. A M Michel was one of the recipients of this award considering his contribution to the field.

Dr. Michael obtained the degree of B.Sc. Agricultural Engineering in 1953 and MTech and PhD degrees in Agricultural Engineering from the Indian Institute of Technology, Kharagpur in 1962 and 1968, respectively, specializing in Soil and Water Conservation Engineering.

More Crop Per Drop

Dr. Bhavarlal Hiralal Jain founder Chairman of Jain Irrigation Systems Limited who composed and popularized the slogan 'More Crop Per Drop' once stated 'I believe conservation of water is the most important duty of any individual, community or nation. When millions die of thirst or hunger, who has the right to squander water' (Dudhedia, 2009). Dr. Michel's major research and development also was based on the same thought.

Dr. Michael's academic pursuits, research and inventions were on conservation and optimum utilization of water. The most important factor to increase agricultural production in India lies in more efficient use of irrigation water. Water the precious resource of irrigated farming needs to be wisely used. 'Water lost by surface run off, deep percolation, evaporation and permeable conveyance channels generally exceeds the water available for crop use. Non-uniform excessive application of water is not only a waste of water but it may also depress yields. Further the excessive water applied to the

soil may cause a rise of the water table leading to unfavorable soil conditions for plant growth. Excess water that evaporates leaves salts on the soil surface. An accumulation of salt is detrimental to growth of plants' (Michael, 1968). It implies that judicious application of water is essential for high yields of the crop and also to maintain a favorable salt balance.

Irrigation and farming accounts for the major portion of India's agricultural production. The area under irrigation in India is 22% of agricultural area in 1960s. Seven and a half million hectors were sown under wheat barley and other close growing fodder crops at that time. The check basin method of irrigation was commonly used in India. In this method water is applied to small relatively level plots surrounded by ridges. Water is conveyed to the field by a system of supply ditches and field ditches. The disadvantages of the method are comparatively lower irrigation application efficiencies since irrigation streams applied to check basins are difficult to control and there will be inefficient utilization of land and labor. Also the land under field ditches and ridges sustains crop of low yield compared to the crop in the basin. The area of land covered by ditches and ridges are proportionately much larger than in border irrigation. Another disadvantage of check basins is that the network of ridges interfere with the use of animal and tractor drawn implements (Michael, 1968).

Dr. Michael found that the border method of irrigation is the most suitable for close growing crops such as wheat, barley and fodder crops. If properly designed border irrigation systems are introduced to the area under these crops irrigation efficiency can be substantially increased. But successful operation of the border method requires that the system be properly designed. Proper grading of land surface is also necessary and Michaels' study concentrated on these areas.

The border method has number of advantages -ridges can be constructed

Dr. A M Michael. **'Life is not what one lived, but what one remembers and how one remembers it in order to recount it'** - Marquez.

economically with simple instruments, one man can irrigate larger area with several borders, uniform distribution and high water application efficiencies are possible, large irrigation streams may be used efficiently, operation of the system is simple and easy, and adequate surface drainage is provided if outlets are available (Michael, 1968.

In the circumstances Dr. Michael found that research and developments on the hydraulics of water irrigation and the subsequent improvement in efficiency of water application is a priority and has great potential for development of irrigated agriculture in India. This made him select the topic 'Evaluation of Hydraulic Characteristics Influencing Border Irrigation Design' for his research (Michael, 1968). In his study he states that an improvement mere 10% in water application efficiency could be made on 7.5 million hectors of land under close growing crops an additional 40 to 50 million hectare -centimeters of water per year would be available. This could irrigate about 8 lakh hectares of additional lands without developing new facilities.

From results of investigation, which was not a mere formal PhD like those of present days;

Dr. Michael evolved a criteria for design of border irrigation system based on measurable characteristics of the site. Instruments and techniques to evaluate the dominant variables and also characteristics of border flow were developed. The behavior of irrigation system in the field was also identified. Adaptation of flow pattern and relationships to flow of water in furrows was found possible by addition of a shape factor to the variables studied in the borders. He has also influenced colleagues doing research on computer science to develop some programmes that can be used in these areas, which can be considered as raw stages of Irrigation Informatics. His findings and suggestions have influenced the irrigation and water management systems worldwide and his book based on his studies is the most popular text on irrigation in universities worldwide teaching the subject.

Water Management and Irrigation R &D

The subjects water management and Irrigations systems were close to his heart. Even though he held high administrative positions in agricultural education and research systems during major part of his career he never left his passion for this area. He guided numerous professionals in taking up and successfully completing research and development projects in the specific area even while he was Director of IARI and Vice Chancellor of KAU. In these positions he initiated or supported many projects for water conservation. He himself helped ICAR and other organizations in developing various technical reports and manuals on Irrigation and water management. After his retirement he continued to act as consultant to various national and international organizations. Some of the studies available are still used by researchers are discussed below.

A.M. Michael, in his research and development under the guidance of Prof A CPandya on 'Water front advance in irrigation borders' found that the time-distance relationship in water front advance is an important factor to be determined in designing an efficient border irrigation system (Michael and Pandya, 1971). Water front advance in a border strip is a case of spatially varied unsteady flow with decreasing discharge. Based on the investigations of these research equations to express empirically the functional relationship between advance distance and elapsed time, an advance distance and accumulated infiltration were developed and their limitations was defined. In another study by the same team 'Hydraulic resistance relationships in irrigation borders'' is a very important one on resistance to flow in borders due to the roughness of the ground surface and the retardance offered by vegetation (Michael and Pandya, 1971).

In a study in association with Rajput, T.B.S., 'Scheduling of canal deliveries-I-development of an integrated canal scheduling model' a comprehensive policy was framed for operation of different components of a canal system to meet the actual water requirements of the crops in different reaches of the command area (Rajaput and Michael, 1989). The study also suggested computer based Integrated Canal Scheduling Model for scheduling the canal water deliveries on the basis of the actual water requirements of its command area. It estimated the water requirements of different crops and operation duration of different components of the canal system. These methods were successfully adopted in the irrigation systems of the country.

In another study by the same team 'Optimal layout of water courses in outlet command areas' a modified minimal spanning tree model was developed for determining the optimal layout for watercourses in an outlet command area (Rajput and Michael, 1988). This technique was used in agriculture for determining the layout of water courses connecting the outlet with different fields, providing at least one delivery point for every field with a minimum possible length.

Dr. Michel's work 'Environmental impact assessment of a major water development project in India: a case study of the Mahi Right Bank Canal system, Gujarat' gives a classic overview of the irrigation development in India, the characteristics of India's river basins and the environmental impacts associated with major (Indian) irrigation projects (Michael, 1987). The case study of Mahi Right Bank Canal project where large scale diversion transfers water from the Mahi for irrigation use is provided as a sample to show environmental impacts of such projects and is one of the earliest such studies from India stressing conservation aspect.

Career

After his education Dr. Michael joined the Rajasthan Agricultural University, Jobner campus as Lecturer. He worked there as Reader, and Professor till 1966. In that year he joined as Professor at Punjab Agricultural University, Ludhiana and continued there up to 1968.

In 1968 he joined the IARI, as Senior Research Engineer - Professor. He served as Professor in Water Technology Centre from 1971 to 1974. He took over as Project Director, Water Technology Centre, IARI, New Delhi in 1975 and continued till 1983. In between he also served as a Resource Scientist at University of Nairobi, UN University and Lund University and has been a visiting Professor at Asian Institute of Technology, Bangkok. In 1984 he became Director of IARI and continued till 1990.

KAU, headquartered at Thrissur was in a deplorable condition during early nineties. The State has to invite him to join as Vice Chancellor of KAU for reviving the system and ensuring funds and support of ICAR. After leaving KAU he acted as Consultant in Soil and Water Conservation to various national and international organizations. He also served as Consultant to World Health Organization, World Bank, Commonwealth Secretariat, Food and Agriculture Organization (FAO), United States Development Agency (UNDP), Winrock International, Asian Institute of Technology (AIT), Water and Power Consultancy Services Limited (WAPCOS), International Crops Research Institute for Semi Arid Tropics (ICRISAT) Hyderabad, Indian Council for Agricultural Research (ICAR) and Educational Consultants (India) since 1997.

Dr. Michael is Fellow of Institution of Engineers (India), Indian National Academy of Engineering, Indian Society of Agricultural Engineers (ISAE) and Indian Association of Soil and Water Conservation (IASWC).

An Unique Institution Builder

A man with honesty and dedication to work, Dr. Michael is an institution builder of high repute. In Rajastahan, Punjab and Kerala Agricultural Universities he initiated numerous innovative projects and also established advanced centers on emerging areas of research in agriculture. The immense progress in research, higher education and agricultural technology transfer are landmark achievements of IARI under his leadership. KAU, which was in a very bad condition in terms of quality and integrity at the time of his joining, Dr Michael gave a new life and revived it as one of the best State Agricultural Universities (SAU) in the country. The developments he had embarked upon, is clearly visible in KAU even today, after a quarter century of his leaving the office.

National Institute for Plant Biotechnology

Immediately after joining as Director of IARI; he founded the Lal Bahadur Shastri Biotechnological Centre in 1985, which is also known as the National Institute for Plant Biotechnology (NIPB) at IARI. It is now premiere research institution of the ICAR. Its initial mandate was research on molecular biology and biotechnology application in crop plants. The prescience of the role of biotechnology in agriculture led to a bigger

responsibility for this centre and it was later elevated as National Research Centre on Plant Biotechnology (Now NIPB). It has the responsibility of developing new tools and techniques and to deliver breakthrough in biotechnology for crop improvement.

The centre could successfully deliver varieties such as Pusa Jai Kisan, which is one of the top three mustard varieties released by the ICAR till date. Besides, the centre has released a rice variety Improved Pusa Basmati-1 resistant to bacterial leaf blight using marker assisted selection (MAS) in collaboration with the Division of Genetics, IARI. Moricandia based CMS system developed at NIPB has contributed to the commercial production of mustard hybrids namely NRC Sankar Sarson (DRMR, Bharatpur) and Coral 432 (Advanta India). The rice blast resistance gene Pi54 identified, mapped, cloned and characterized at NIPB has been transferred in mega varieties of rice like Pusa Basmati and BPT 5204 and in many other varieties by the rice breeders using MAS. The centre has matched steps with the changing time and conducted research in basic and applied research for crop improvement. The state-of-the-art infrastructure and expert scientists have enabled the successful execution of international (on rice, tomato and wheat) and national (on Pigeonpea, Mango, Mesorhizobium, Puccinia and Magnaporthe) genome sequencing projects. NIPB is also engaged in teaching postgraduate students with regular PhD and MSc degree programmes in Molecular Biology and Biotechnology.

Identifying Possibilities of Biotechnology & Bio Informatics

India is one of the first few countries, among the developing countries, to have recognized the importance of biotechnology as a tool to advance growth of agricultural and health sectors as early as in 1980s. India's Sixth Five Year Plan (1980-85) was the first policy document to cover biotechnology development in the country, proposing to strengthen and develop capabilities in areas such as immunology, genetics, communicable diseases, etc. The document suggested ensuring coordination on inter-institutional, inter-agency and on multi-disciplinary basis, full utilization of existing facilities and infrastructures in major areas including biotechnology.

Programmes in the area of biotechnology included tissue culture application for medicinal and economic plants, fermentation technology and enzyme engineering for chemicals, antibiotics and other medical product development, agricultural and forest residues and slaughterhouse wastes utilization and emerging areas like genetic engineering and molecular biology.

Thus it has become increasingly important to bring dynamism in the functioning of the agricultural science and technology system at the national level. While the existence of a strong physical infrastructure is necessary for the development of an effective S&T system, the critical factors remain the institutional set-up that supports this system and the cohesion between the overall developmental objectives and the R&D endeavors in different streams.

Biotechnology Information System Network (BTIS)

Recognizing the importance of information technology for pursuing advanced research in modern biology and biotechnology, a bioinformatics programme, envisaged as a distributed database and network organisation, was launched during 1986-87. Dr. Michael found it to be a successful vehicle for transfer and exchange of biotechnology information among ICAR institutes and SAUs and established a strong tie up of IARI with it, which contributed much for BTIS also.

BTIS was developed as a very sophisticated scientific infrastructure for bioinformatics involving state-of-the-art computational and communication facilities and is playing a vital

role in the success of the bioinformatics research and development especially in Genomics and Proteomics. Numerous databases dealing with these aspects and of efforts in biotechnology have been developed under it. A Biotechnology Patent Facilitating Cell has also been established.

Bioinformatics

Understanding the possibilities in 1989 during his tenure as Director, Dr Michael took initiative to establish Bioinformatics Centre at IARI under BTIS Network to function as a computerized information base in fields related to Agricultural Biotechnology in particular and the fields allied to agriculture in general. Since its inception, the Centre at IARI has provided state of the art information services on biotechnology, bioinformatics etc., to the scientists, researchers, students and farmers in agricultural sector. A number of databases, information retrieval system and Bioinformatics tools were developed at the centre. The centre developed the systems 'Wheat Informatics', Genome Browser, MiRule (Rule based micro RNA prediction Tool), Plant Transmembrane Receptor, Kinase Prediction Tool etc

Now ICAR is one the major agencies financing and supporting research in the realm of biotechnology. Under Department of Biotechnology (DBT) a huge infrastructure for bioinformatics has come up, canalizing information from sources worldwide. Dr. Michael was instrumental in establishing strong links between ICAR and DBT, starting full-fledged departments of biotechnology in IARI and SAUs and starting UG and PG programmes in Biotechnology in agricultural stream of education.

Kerala Agricultural University (KAU)

The State of Kerala is isolated from its mother country by mountains in the east and oceans in all other sides, resulting cultural, political, social isolation, slow space development and meager exposure to the

Indian Agricultural Research Institute (IARI)

scientific, technological and infrastructure developments that take place in other parts of the country. Nevertheless, Internet surfing, e-mail, digital platforms, digital equipments like VSATs, computer server, etc were ubiquitous in KAU when rest of the State was deprived off and unaware of ICT amenities in majority of the research, academic, administrative and government organizations during 1990s. This lead of KAU was only possible due to pragmatic and astute Michael, knowing trends and uprisings in the fields of science, technology, commerce, research and developments.

Dr. Michael and his work would have inspired the predecessors in advancing the frontier functions of the university. However, by and large, they remained reapers of the flowers bloomed by Dr. Michael. With regard to ICT applications in agricultural research, education and extension in KAU, Dr. Michael stands alone as the immortal giant of quality and perseverance among the heads of the universities in nurturing funds, development programmes, technology adoption, etc for scientific and scholarly research. Certainly the success and endurance of Library and Information System in KAU is indebted to Dr. Michael and the Library scientist who acted in congruence of his dreams, demands, realities, manpower available, etc.

Environment for Agricultural Information Handling

During 1995-97 Dr. Michael initiated developments in various aspects at KAU and if he could continue to be at the helm of affairs, KAU would have been one of the world's best Agricultural Universities on all aspects and criteria of assessments. Against many odds, Dr. Michael continued to pursue his plans and relentlessly worked for it under the force of his strong will power and quest for excellence, working seriously on newer dimensions of application of ICT in agricultural research, education, extension, biotechnology, library and information systems, radio tracing, remote sensing, food processing etc by taking pro active measures for the development of the university. Any observer into his personality could visualize a rare power of judgment and diligence against all odds in him.

During his tenure as Vice-Chancellor, there was all-round development of academic and infrastructure facilities in all the campuses of KAU. Even after 25 years of the establishment of the university, many colleges and campuses of the university were devoid of permanent buildings, boundary walls, hostels, structures, ground facilities, etc. His dynamic personality and involvement has made it possible to acquire land, buildings, equipments, vehicles, machines, tractors, tillers etc in the campuses. College of Fisheries Kochi, College of Agricultural Engineering Tavanur, and College of Agriculture, Nileswar and many research campuses at high ranges and remote places had shifted offices and quarters from tinned or temporary sheds to modern buildings, pumping a new lease of life in the university system.

The University did not have University Library, University Librarian, professional staff, etc since 1971 the year of establishment of KAU till Dr. Michael took over. Till then, libraries were functional only at the colleges, built on a default system. It was Dr. Michael who took initiatives for the establishment of the University Library System in KAU. A future proof university library building and infrastructure he garnered is exceptional even today when compared to national and international standards. He involved internationally acclaimed architects, designers, technologists and professionals for making his dream come true.

The University Central Auditorium made during his tenure was of international standard, capable of hosting international events, symposia, conferences, etc. All these infrastructure developments and professional staff development catapulted the university to fame which was doomed with non-exposure of its achievements, incapable of reaching the unreached till then. The water conserving and harvesting system he designed and implemented wet and feed various farms and crops in the headquarter campus of the university even today. He has implemented various such projects not only in the main campus but also in stations and campuses spread throughout the State.

The period during which Dr. Michael headed the university can be termed as the 'Golden Age of the KAU' without any hesitation. He remains a hero who has initiated 'development era' by practice and not by precept. His beautiful and brilliant mind worked incessantly to place the university in the front line. Dr. Michael carried forward the vision of the nation on biotechnology to KAU by establishing a Biotechnology Information Centre of DBT, state of the art Biotechnology laboratories, centers for various agricultural technologies, laboratories of remote sensing, radio tracing, food processing etc.

Development of Agricultural Informatics

Dr. Michael initiated a number of programmes for the development of Agricultural Informatics (AgI) - a nascent term and thought that time - during his tenure. The access, storage and dissemination

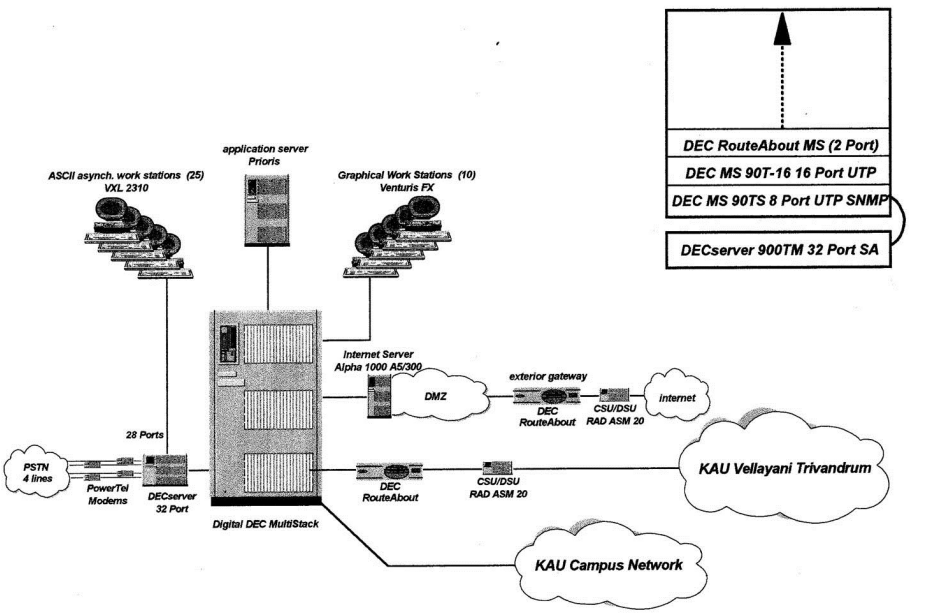
A future proof facility with plug and play type of LAN, into which about 300 systems can be plugged in, with digital storage systems, Internet Servers, ICT training facilities etc built by Dr. Michael in 1997 to house KAULIS headquarters and other ICT Systems.

of knowledge and information being crucial for development of any field, especially agriculture, he coursed Library and Information System as Kerala Agricultural University Library and Information System: KAULIS and designated its network KAULNET as the main carrier for Agricultural Information Highway. He devised Central University Library as the apex centre of the library and information system, and laid infrastructure for campus wide LAN network in main campus and in all satellite campuses state wide, linking to the KAU Network by harnessing funding from ICAR and other national agencies. The University Librarian assisted by devout LIS Professionals have made his dreams practical. Dr. Michael was very fond of LIS professionals, fully understanding their role in the new century.

A state of the art Electronic Data Complex, Agricultural Digital Library for dissemination of topical awareness and global information to those in agricultural sector was established within the university central library as the knowledge hub. This was expected to become a show case of the electronic age in agriculture and allied disciplines which could promote, propagate and catalogue the agricultural economy that India is so dependent on. KAULIS ensured access, storage and dissemination of the cached repository of agricultural information available worldwide, besides acting as a data silo for research forums, concurrent research, electronic publishing and global bulletin boards. Even ICAR or IARI could not develop at that time knowledge resource base as he developed at KAU.

Technology for Informatics at KAU

Machine for Internet Gateway Server used was Alpha Server 1000 A5/300, which can retain the performance and power spectrum and continuum of the hub 900 solution. For hosting the knowledge repository, a server based on Pentium processor was used. The system was later ported to an Alpha based machine under UNIX/Linux Operating System. The Digital Unix of



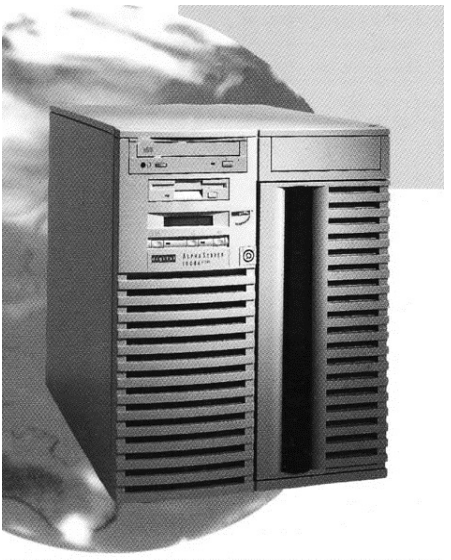
Configuration of KAULIS Network Developed by Dr.A M Michel in 1996

Digital Electronics Corporation UK the first GUI based Unix was used as OS. For storing and disseminating less used digital content a jukebox with 1000 CD capacity was used in initial phase to which Jukeboxes can be added subsequently. For electronic documents of middle level usage a 100 drive CD Server was used. To mount highly used databases like CABI database, AGRIS, ASFA, etc., a hard disk based CD server with large storage capacity into which the CDs can be cached was used. As end user workstations Pentium 4 with 2.5 MHz regarded at that time as the industry standard was used. Even NIC or ICAR or any other organization in India or other Asian countries did not implement such powerful systems for Knowledge Management at that time. An image of the configuration of the system given in the project report is given in the figure above, so that readers can appreciate the communications stacks and solutions used in the KAULIS project then (Raman and Bhagi, 1995.

The high-tech auditorium built adjacent to the University Library was directly linked so that all the academic conferences and seminars conducted could be video recorded and archived at the digital storage systems in the library. Programme could also be made visible online instantly in all campuses of KAU. The scattered campuses of KAU and allied institutions were also linked through electronic bridges that enabled spontaneous exchange of information between the agricultural diasporas of students, faculties, researchers, extension workers and administrators.

The mandate of the system, the specification of computers and communication stack that KAU Campus Wide Information System and Network has to use, the architecture prescription, network design, MultiStack and DEChub900 options, etc were clearly defined. The host environment, financial terms, implementation methodology, installation support continuum, network synthesis and integration, systems engineering support, administrative arrangements etc were clearly specified. Open Network with Protocol Switching and Networked Systems Management based on

Digital's enVISN Networking Architecture and Enterprise Management Solutions was used. Detailed Technical literature and specifications of each and every item of computer and communication stack and solution recommended was documented. The project initiated in 1995 can be of interest for those who research on ICT development in India especially in agricultural sector for comparison of technology used then with contemporary positions. KAULIS has integrated the college and research station libraries spread over the length and breadth of the State. Library units were separated, fractioned and isolated in their roles and functions till then (Raman and Bhagi, 1995).



Alpha Server 1000 A with Digital Unix of DEC.(1996)

HRD for Informatics

Dr. Michael initiated the establishment of a Centre for Library and Information Sciences at KAU under the KAULIS Project. It initially designed, developed and implemented twelve national level short courses and workshops targeting scientists, teachers, research scholars and library and information science professionals of ICAR institutes and SAUs. National Academy of Agricultural Research Management (NAARM), Hyderabad and KAU were the two leading organizations offering such advanced programmes in those days. Details of some of the programmes developed are given below. (Raman, 2001).

Advanced course on CDS/ISIS and WINISIS: CDS/ISIS (Computerised Documentation Service / Integrated Set of Information Systems) and WINISIS (CDS/ ISIS for Windows) the powerful DBMS available that time could be systemized for any Data/Information/ Knowledge Management function in agricultural sector and the course was meant for network administrators, information professionals and extension workers.

National ICT Workshop on Information Infrastructure: was conducted for Senior Managers like Vice Chancellors of SAUs, Directors of Central Research institutes under ICAR, and senior administrators involved; to create necessary awareness among them to help their decision-making in ICT related matters. The course was developed in cooperation with Indian National Scientific Documentation Centre (INSDOC) and financial support from Ministry of Science and Technology, Government of India. Prof. T Viswanathan, Director of INSDOC who was an internationally known expert in Electronics and Communication acted as the resource person and delivered most of the lectures.

Computer Application to Library and Information Services: Short Course on automating library and information systems with support from Ministry of Science and Technology, Government of India meant for library and information service professionals from agricultural universities, colleges and allied organizations.

Digital Presentation: National training for teachers and scientists in agricultural sector on computerized presentation techniques organized with support from IASLIC, Calcutta.

Hightech University Central Auditorium connected to the Net with facility for Conferences, Seminars, Workshops, Exhibitions and webcasting established by Dr. Michael in 1996.

Modern Information Access Facilities: Course for teachers, students, scientists in agricultural universities and research institutes on techniques for retrieval of scientific information from online sources; with support from Ministry of Science and Technology, Government of India.

Managing Digital Libraries in Agriculture: Course on digital library hardware and software meant for Managers of library and information systems in agricultural universities and research institutes, with support from ICAR, Government of India.

Internet for Education and Research: Familiarization of Internet based information sources and search mechanisms for research students.

World Wide Web for Managing Agricultural Information: Course for Agricultural Scientists with support from ICAR.

Taking cue from KAU Centre for Library and Information Sciences, ICAR tried to conduct the courses at INFLIBNET but could not sustain it. After Dr. Michael era, unit libraries of the university have gone back to the square, fragmented individual units without goals, objectives and directions from University Library at the apex.

The inbuilt facilities of KAU high-tech university library consisting training facilities, Digital Library, Farmers Division, the mechanics devised for ensuring inter and intra departmental participation in the functioning of the system, etc are unique and still have no parallel in the higher education sector.

Open Access Initiatives

The PhD research in hundreds of universities in India cost approximately Rs 3000 crore per annum. But the result of research using public funds is not transparent or made useful or known to the society. Generally dissertations remain limited to its origin. Due attention on and application of the results are very feeble in the society. Even in the beginning of the 21st century, it was never thought of providing online or open access of these knowledge and information for wider visibility and access to the researchers, academicians and professionals for use and refinement.

In 1990s, western universities started insisting on submission of theses in electronic form also. The earliest known E-Theses project was initiated in the US, in 1987. In 1990s, Adobe's Portable Document Format (PDF) became available. In the mid-1990s, European Initiative in Library and Information in Aerospace (EURILIA) project successfully tested the uploading of thesis metadata and full text for online access. In 1997 Virginia Tech University in the US made electronic submission of PhD compulsory.

If we examine the attempts in India for digitizing and delivering Open Access to PhD Theses of universities, it can be seen that Dr. Michael was the first academician to initiate such a project in India. In India, the first OA Repository of Doctoral Theses was envisaged in the year 1995, under the leadership of Dr. Michael. This landmark step of OA Repository of Doctoral Theses was a subset of KAULIS. Dr Michael

ensured support of ICAR/ARIS programme and KAU initially digitized 400 of its 3000 Theses and launched a repository in 1997 at a time when even the term digital library was not coined or any special software packages for digital libraries have come into existence. The repository used MS Access at front end for Metadata and to link pdf versions of dissertations. Initially the collection was accessible through university website and WAN. It was one of the earliest successful attempts to bring PhD theses into open access, second only to the EURILIA project in Europe. Shortly the data was exported to Basis Plus TechLib Plus and the digital archive was made accessible over the web for a short time for testing, using the webspace freely allowed to the university by VSNL in 1998.

As KAULIS project was intended to transfer agricultural information to farmers at remote villages, a large collection of literature in local languages was collected by KAULIS for digitization and incorporating in the system for online access. The project found that the potential of the local language and scripts for search in the system was very important. Dr. Michael envisioned projects to develop Malayalam and Tamil language technology for use in DBMS and digital archives in agricultural sector (Bino Jose, 2016)

KAULIS has conducted more than a dozen national level workshops hosted jointly by KAU and ICAR. National Information System for Science and Technology (NISSAT) under Ministry of Science and Technology has also associated in some courses. But before materializing the goals of KAULIS, Dr. Michael and the information Scientist at managerial level in KAULIS were forced to leave the university due to political interference. The system could never gain momentum; the University Library and other Divisions remained without permanent heads since then.

Approximately, 10 crore rupees had been spent for infrastructure facilities of KAULIS

The Central Space into which the user enters in KAULIS/ University Library Building depicting a replica of Planet Earth and technology components involved, Satellites etc

in nineties. All the initial phases were successfully completed and systems like digital library and web based services as well as training in these areas were successfully tested. But there was an abrupt end to KAULIS. History if written, shall divulge the great loss that the country especially, agricultural sector suffered due this. It shall also mark a quarter century retrace from the forward march attained by KAU in AgI and LIS. This gap will never get patched up. A chance missed is a chance lost in this Information Age where technology and trends are always in a flux. An Open Access (OA) repository project was initiated 10 years later by the same information scientist at Mahatma Gandhi University (MGU), Kottayam, Kerala, successfully launching an OA Digital Library of PhD Thesis in 2008, named MGU Theses (Mahatma Gandhi University Online Theses Library).

MGU Theses archive was an indigenous package capable to process Indian languages. It consisted of e- Theses in English, Malayalam, Hindi and Sanskrit, which was

teh wish of Dr. Michael to develop at KAU to enable farmers to search and access digital content using local anguages and scripts. Dr. APJ Abdul Kalam, President of India on 9th November 2008, launched MGU OA archive of theses. It became the first Indian repository of E-Theses approved and incorporated into information system for research maintained by INTUTE and led by Joint Information Systems Committee (JISC). Inspired by MGU Theses Open Repository, UGC initiated Shodhganga (Open repository of ETDs in India) project to extend coverage to research in all Indian Universities (Bino Jose, 2016).

Centre for Agricultural Informatics, an NGO, gave a proposal to ICAR for developing a national online e-theses archive in 2001, taking cue from KAU success story. By this time many digital library packages have come. So ICAR sanctioned the project to Haryana Agricultural University, which resulted in KrishiPrabha -the repository for accessing Indian Agricultural Doctoral Dissertations-starting with digitized collections of theses including those digitized at KAU.

A Reputed Author

Dr. Michael has authored numerous research papers, monographs, handbooks and books. He has authored and co-authored several books on subjects related to Irrigation and Water Resources Management that include Water Wells and Pumps, Handbook of Farm Irrigation Structures, Design and Evaluation of Irrigation Methods, Principles of Agricultural Engineering: Agricultural Surveying, Irrigation, Agricultural Drainage, Soil and Water Conservation, Water Resources of India and their Utilisation in Agriculture, and How to Improve Irrigation Farming in India. Popular books were revised, updated and edited from time to time, sometimes by other scientists by joining him as co-authors. Some of his important works are the following.

Irrigation Theory and Practice

His book 'Irrigation: Theory and Practice' is considered an all-encompassing encyclopedia and authority on the subject of irrigation, its management, and methodology and the technological advances affecting it. It covers different aspects of irrigation such as Drip and Sprinkler Irrigation and its economic evaluations as well as lift irrigation Systems and their design, water requirement of crops and irrigation management etc. with a focus on techniques to improve the development of water as a resource for irrigation. Since the past three decades, this book has always been held in high regard and is considered as final authority on the subject.

Principles of Agricultural Engineering

The book deals with the various aspects of Farm such as Farm Power, Machinery, Buildings and post harvest technology and scope of mechanization. Also covers the principles of operation of oil engines, tractor power trains and agricultural processing and plant protection machinery including dairy machinery, agricultural surveying, irrigation drainage, soil and water conservation. irrigation wells and tanks etc. This is one of the most popular publications on the subject in India with a wider readership.

Land Drainage: Principles, Methods and Applications

It deals with the concepts and technology for ensuring sustainable agricultural production and environmental management by adopting land drainage measures. Topics covered are Drainage and Salt Management for Sustainable Agricultural Production, Physical and Surface Morphological Properties of Soil in Relation to Drainage, Chemical Problems of Soil and Water, conventional and non conventional methods including model studies and case studies in drainage and salt management in irrigated areas.

Water Wells and Pumps

It provides the essential theory and design of ground water structures, wells/tube wells, and pumps, with particular emphasis on problem solving and meeting the requirements of developing nations. Describes the science and technology of water wells and pumps, allied appliances and their applications, development and testing of tube wells as well as a variety of pumps, location-specific and non-conventional and environment friendly. Introduces ground water recharge methods, well rehabilitation, and animal-powered water lifts. Suggests methods to design secure, reliable systems. It is an internationally acclaimed textbook on the subject.

In addition to the above books, 'Water Well & Pump Engineering', 'Water Resources of India and their Utilisation in Agriculture' and 'Design and Evaluation of Irrigation Methods' are some of the popular books written by Dr. Michael

Honors Received

Dr. Michael has made immense contributions in Agricultural Engineering education, research and development, with emphasis to Irrigation and Soil' and Water Conservation. Some of his books are used as textbooks by agricultural universities worldwide.

In recognition of his outstanding professional contributions he has been honored with many awards and recognitions. These include the Rafi Ahmed Kidwai Memorial Award and the Dr. Rajendra Prasad Award of ICAR, Mason Vaugh Award of Indian Society of Agricultural Engineers (ISAE), Degree of DSc. (h.c.) from N D University of Agriculture and Technology at Faizabad; Engineer of the Year 1995 Award of Institution of Engineers (India); Gold Medals of Indian Society of Agricultural Engineers and Soil Conservation Society of India and Eminent Engineer Award (2014) of Institution of Engineers (India).

Conclusion

Eugene Garfield, eminent information scientist of Institute of Information Science fame, on one of his great predecessors Henry E Bliss both who influenced Information Science and Knowledge Management scenario in this century said, 'Individuals live on in the works they leave behind'.Dr. Michael's work needs to be sustained and fully utilized to ensure the quality of research and developments in Agricultural Informatics as well as in water management. New scientists need to be stimulated on his visions and hard work he radiated in a short span at the helm of affairs. .

Dr. AM Michael has an impressive and fast career, made possible only because of the combination of abilities and character traits he possess. The first author had worked in the KAU Libraries and Bioinformatics Centre (DBT-KAU) and therefore, the article specially highlight incredible mark left behind by Dr. Michael at KAULIS benefiting the agricultural education, research and extension in general and informatics in particular. We reminiscent the enormous dynamism he devoted and when linking it in this age of Information Superhighways, we see the torch bearing for the Agricultural Informatics done by Dr. A M Michaelto enable reaching the unreached.

Access to information is directly linked to the enjoyment of basic rights and freedoms and influences the achievements of all the developments in the society. But these developments can only take place if the opportunities are made available to all. In a highly interconnected global society, lack of equal access to information shall increase marginalisation and rapid exclusion from the rest of the world. In this background the efforts of Dr. AM Michael is praiseworthy in the fields of agricultural research, education and extension; Agricultural

Informatics; Irrigation Informatics, Agricultural Library and Information Systems; and ICT applications in agriculture for reaching the unreached, in India.

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