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Agricultural Informatics as a Branch of Study in Information Sciences and Technology Domain: A Proposal towards Digital Agriculture

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Abstract **- Agricultural Informatics is an important and valuable domain in the field of interdisciplinary sciences. This is responsible for the applications of Information Technology, Computing, and similar technologies into the agricultural activities. This is the combination of Agricultural Science and Information Sciences. The field due to technological nature is very closed with the Agricultural Engineering or Agricultural Technology. There are many allied and similar nomenclature of the fields, but all of these are primarily responsible for the same purpose. The field is rapidly increasing in recent past and most practiced in the developed nation. However, in developing countries as well Agricultural Informatics becomes an emerging field of practice and growing rapidly. Agricultural Informatics is growing both in pre and post agricultural activity. This branch is considered as branch of Information Sciences & Technology due to its technological applications in the field of agriculture and allied areas. Information Sciences are the broadest field within the allied branches and growing rapidly. Agricultural Informatics educational programs have started in recent past in different level and stream of education viz. science and technology. However, within the broad periphery of Information Sciences it could be offered in other streams and under the wide variety of Information Sciences. This paper is broad and interdisciplinary in nature and deals with the aspects Information Sciences including features, basic role, Information Sciences and Technology, including features, nature, scope and also the potentialities in respect of Agricultural Informatics.**
Keywords: **Agricultural Informatics, Information Science, Informatics, Development, Digital Agriculture, Smart Agriculture, Education, Emerging Degrees**

I.INTRODUCTION

The branch of Computing and IT is useful in diverse areas of commercial agriculture and including in the preproduction and postproduction [1], [5]. As a result, many universities have started the Agricultural Informatics field. Initially, Agriculture field considered important as a client or user of the Agricultural Informatics though this is also practiced in other subjects such as agriculture, horticulture, veterinary sciences, etc and in many other countries and territories Agricultural Informatics practiced started wide manner. In many developed and developing countries as well, the Agricultural Informatics as well as allied nomenclature considered as a field of study with exact nomenclature of Agricultural Informatics and other emerging and allied nomenclature [3], [4], [11].

In Agricultural Informatics, Information Technology is an important component and dedicated in information related activities with the help of subcomponents such as database technologies, networking technologies, web technologies, multimedia technologies etc. In these field, traditional software technologies is playing an important role, though the subject Information Science is much broader and composed with IT and additionally management sciences. It is also interdisciplinary in nature. Its principles and applications can be seen in diverse field with having societal applications and community. Due to the following core aim this is become an emerging field of study.

1. Input systems of the Agriculture and allied fields.
2. Output systems of the Agriculture and allied sectors.
3. Agricultural activities i.e. integrating and facilitating
4. Agro based Marketing.
5. Agricultural Postproduction activities.

In India also Agricultural Informatics become an important and coming fields in some of the universities with science and engineering streams [7], [19], [31]. Though there are huge potentialities of this branch in wider areas of Information Science/IST.

II. OBJECTIVES

The present work 'Agricultural Informatics as a branch of study in Information Sciences and Technology domain-*A Proposal towards Digital Agriculture'* is theoretical and deals with following aim, objective, and agendas (but not limited to)

1. To learn about the Information Sciences including sub fields, types and nature, in brief.
2. To learn about the basic of the IT and Computing related fields and its basic features and areas.

3. To get knowledge on Agricultural Informatics including its evolution, features, and functions.
4. To get about the emerging role of Agricultural Informatics agriculture including its role in building digital and smarter agriculture.
5. To get a picture of issues, challenges, and opportunities in the Agricultural Informatics applications in the field of agriculture and allied fields.
6. To find out the current programs on Agricultural Informatics and its allied nomenclature, in brief.
7. To proposed and suggest in Agricultural Informatics academic programs in international and Indian scenario.

III. METHODS

The work entitled 'Agricultural Informatics as a branch of study in Information Sciences and Technology domain-*A Proposal towards Digital Agriculture'* is theoretical and thus various secondary sources and published works have been consulted viz. on IT, Agricultural Sciences, with reference to the Agro Informatics. Later, the primary sources are also gathered, analyzed and reported. Moreover, websites of various companies been consulted to get an emergence of the services and these are thereafter checked, analyzed and reported. Different reports of the government and different agencies also analyzed and incorporated in this work.

IV. AGRICULTURAL INFORMATICS: OVERVIEW

Agricultural Informatics is simply the applications and utilizations of the Information Science and Technology in different areas such as Agriculture. IT or ICT applications in the Agriculture is also an important example of Agricultural Informatics. It is interdisciplinary in nature and Agricultural Informatics applicable in diverse areas by the uses of different part of the Information Technology viz. Database Technology, Software Technology, Multimedia Technology, Web Technology, Networking Technology etc. Apart from these, Agricultural Informatics also uses the techniques, procedure and methods related to the Mathematics and Statistics as well [8], [9], [31].

The Agricultural Informatics also uses documentation and Information Management. Various emerging technologies such as Cloud Computing, Big Data, HCI, Usability Engineering, Robotics and AI etc are also emerging in Agricultural Informatics practice. These technologies are dedicated in smarter building and in recent past the uses of Robotics, AI helping in enhancing the productivity of using drones, harvesting machines, etc. The population in future can grow up to 9.7 billion in 2050 according to UN. Thud to manage such shortage food are needed and, in this context, the Agricultural Informatics and allied branches may be worthy.

1. Agricultural Information Systems
2. Agricultural Information Technology
3. Agricultural Data Science
4. Agricultural ICT. etc will play a great role.

The field Agricultural Informatics is rising due to its future emergence as well. Today in many developing and undeveloped countries this is rising rapidly [13], [18], [28]. There are programs at Bachelors and Masters level on Agricultural Informatics but there are way to include this in other short term and other than degree programs viz.

1. Certificate in Studies/ Research in Agricultural Informatics
2. Diploma in Studies/ Research in Agricultural Informatics
3. Postgraduate in Studies/ Research in Agricultural Informatics

Primarily these can be started and gradually other allied subjects and level of study and education as well.

V.INFORMATION SCIENCES AND ALLIED FIELDS

Information Sciences is an interdisciplinary subject and better to express as field of fields. Further it is dedicated to the information activities such as collection, selection, organization, processing, management and ultimately the dissemination of information or similar contents (refer fig: 1 for more clarification).

Though evaluation based on the feedback is another important activity of information. In some regions in the world Information Science is also called as Informatics [10], [19], [32]. Information Science is very close with the Information Technology, but it is broader than this. Information Technology takes the help of all the major components viz.

1. Database Technology
2. Software Technology
3. Multimedia Technology
4. Web Technology
5. Networking Technology, etc.

There are many difference between Information Technology and Information Science; and these include the role, nature, components and diversity Both the areas are fall under the applied science however, Information Technology basically concentrated on technologies and automations on other hand, Information Sciences deals with both manual information affairs and parallel with technological tools.

Information Science based on periphery may be considered broad than Computer Science, Computer Applications, IT, etc.

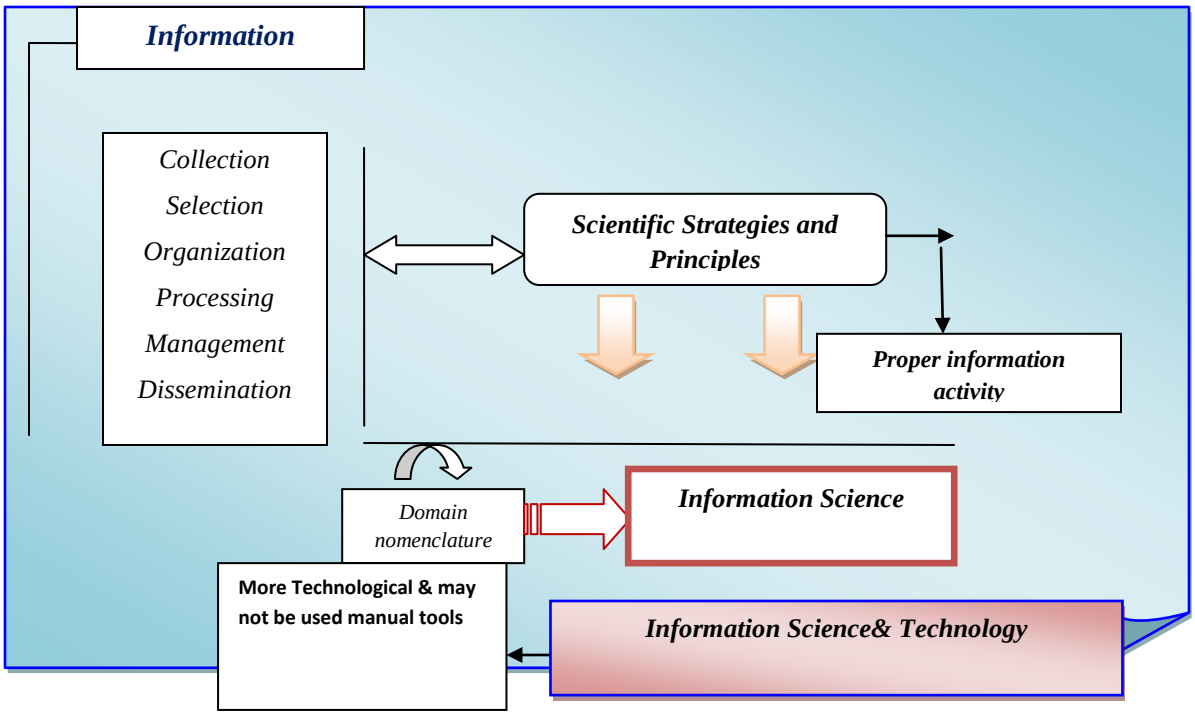

Fig.1 Fundamentals of information and their domain

Another nomenclature developed in recent past i.e. Information Science and Technology and considered as extension of Information Science. Information Science and Information Science and Technology (IST) to some extend similar deal with which is the vital task of Information Science. According to the experts it is a new nomenclature with the core of information activities with proper technological back up [12], [16], [33]. The increasing shape and role of information lead the development of Information Science and clearly advancement of technologies leads information as full-fledged domain and thus considered as Applied Science. During 1960-70's another nomenclature was started i.e. Information Studies however Information Studies is treated as an information field, whereas Information Science and Technology (IST) is concentrated with information and knowledge but the main difference between the two is that Information Science and Technology (IST) is more close to technology and as a whole based on various tools, techniques and technologies for Information & Knowledge Management. Refer fig: 2 in this regard. Information Science and Technology is also used synonymously in most context uses of Information Science. Hence in this context like Information Science following are also considerable.

1. Geo Information Science and Technology.
2. Health Information Science and Technology
3. Agricultural Information Science and Technology etc [15], [21], [27]

It is important to note that, the natures of these subjects are varied from subject to subject and concentration.

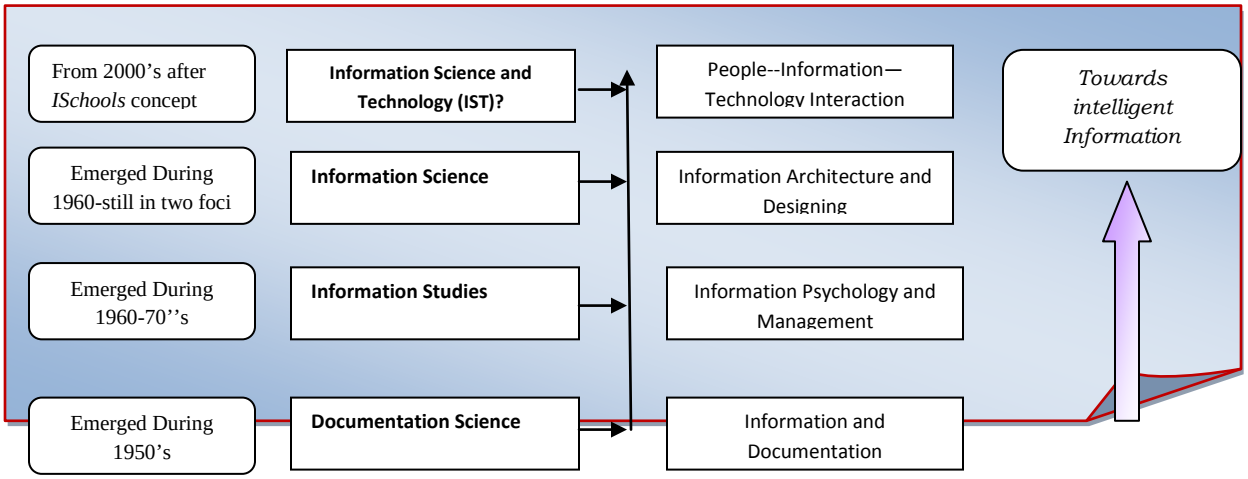

Fig. 2 Generation of information centric programs and nomenclature

VI. AGRICULTURAL INFORMATICS: FEW CONCERNS

Agricultural informatics is also known as "digital agriculture" or "e-Agriculture. It is worthy to note that apart from the technologies Agricultural Informatics also depends on few other concerns on agricultural development and entrepreneurship. Ultimately the Agricultural Informatics also responsible in enhanced agricultural services, enhanced technology information delivery by the enhanced ICT and Computing based services [2], [13], [26]. Agricultural Informatics is an emerging field and basically deals with following features and facts viz.

1. Agricultural Informatics is associated with both Agricultural Sciences (including its allied areas) and Information Sciences (and its allied areas).
2. The field is interdisciplinary and associated with areas viz. horticulture, veterinary sciences, ecology, geography, anthropology, etc.
3. The designing, development and modernization of the advanced agriculture, smart agriculture, or digital agriculture etc become possible with Agricultural Informatics.
4. In modernizing the agro systems various kind of tools, techniques and technologies including management science are highly required for doing its performance.
5. Apart from the core IT such as database technologies, networking technologies, web technologies, multimedia technologies etc. the emerging technologies like Cloud Computing, Big Data, HCI, Usability Engineering, Robotics and AI increasing in Agricultural informatics.
6. In Computer Science, Computer Engineering and allied fields, the uses of Agricultural informatics are increasing rapidly.
7. Contents is most important in Agricultural Documentation to Agricultural informatics and there are different strategies are used for this rapidly [17], [20], [34].
8. Manpower including its development is become an important requirement regarding the applications of healthy Agricultural Informatics practice.

The development and growth of the IT and computing particularly Information in other subjects lead Agricultural informatics to improve the efficiency of production in agriculture and in sustainable development.

Worldwide this is become popular and emerging rapidly with the various technological supports to the agro systems including

1. Conceptualizing and developing,
2. Deploying and Managing agro systems; directly and indirectly.
3. Agro intelligent supply chains,
4. Proactive environmental impact by agro products and management.
5. sustainable and ecological agricultural systems etc

VII. EMERGING CONCERN OF AGRO INFORMATICS

Agricultural informatics is applicable in other systems and concern. Furthermore, methodologically Agricultural informatics is applicable for strengthening agricultural systems into following areas (but not limited to)

1. Enhanced Input as well as Output systems of the Agriculture.
2. Agro and related activities improvement such as integrating and facilitating
3. Agricultural development and marketing.
4. Postproduction of the Agricultural systems
5. In creation of the healthy food security systems on Agriculture.
6. In Climate based monitoring

Hence Agricultural informatics helps in IncreasedEfficiency and monitoring of cultivation with agricultural products management. Expansion of traditional agricultural Systems will also grow including the cleaning of Agro Space sector in the areas viz. managing pesticides and fertilizers etc. Thus it is offered Quicker Agricultural Systems using various IT components including emerging tools robotics, analytics etc It is also thus doing Healthy & Quality Production of Agricultural Systems using aerial drone monitoring systems etc. In Livestock Management such as in postproduction, marketing, agro business promotion etc [22], [25].

VIII. AGRICULTURAL INFORMATICS AS A BRANCH OF STUDY

The agricultural graduates with proper skill set in Computing and IT is demandable IT to provide better support in agricultural systems of the academia and farmers. Hence different universities and educational institutes are offering educational programs in conceptual, theoretical, and applied knowledge to give the input of the Agriculture.

Proper human resources required in contemporary age with right skills, knowledge, aptitude for effective design as well as implementation of in agriculture, preproduction, postproduction, and extension services.

This will ultimately be helpful in the industry, scientific organizations including research in global era in Agri Informatics as well as in related areas.

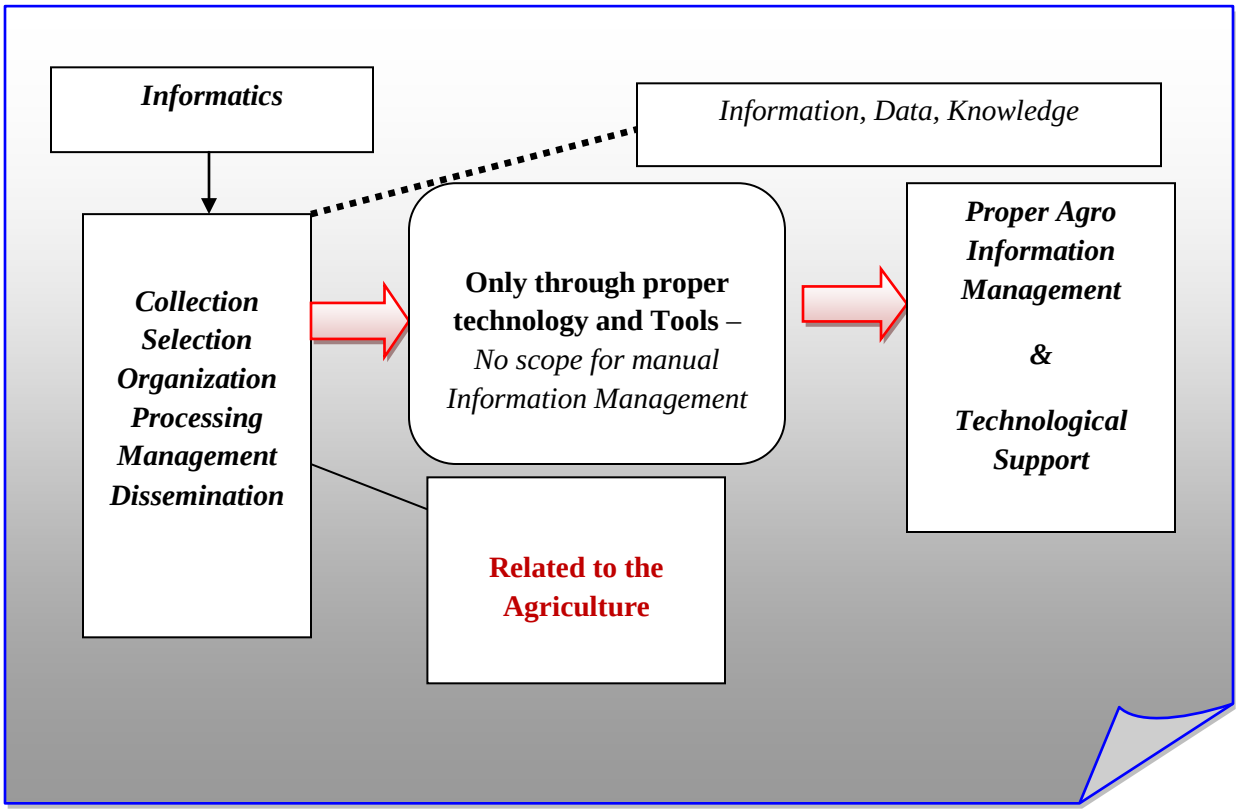

Fig.3 Fundamentals of agro informatics and few concern in development

Agricultural Informatics is the Science of Information, Technology and Management of the agricultural responsible for the Information Systems development. Agricultural Informatics is concerns with the

1. Innovation and modernization in the Agricultural systems.
2. Food and the Environmental systems.
3. Sustainability in agriculture and natural resource conservation.
4. Food security/ protection,
5. Promotion of the environmental research

Apart from these Agricultural Informatics also needed in managing land uses, global climate change, commodity trading, \decision making and policy formulation in respect of agriculture and so on [23], [24], [30].

Thus, various aspects are included in the program of the. This can be easily understandable by analyzing the B.Tech program of an Indian University i.e. Shobhit University, UP, India (refer Table: 1)

IX. EMERGING NOMENCLATURE: WITH REFERENCE TO DIGITAL AGRICULTURE

Agricultural Informatics is changing rapidly with emerging aim and objective for the advanced agricultural systems and agro systems; and thus, following are possible programs in this context

1. Agricultural Information Technology (in respect of existing IT)
2. Agricultural Information Science and Technology (in respect of existing IST)
3. Agricultural Information Systems (in respect of existing Information Systems)
4. Agricultural Information Management (in respect of existing Information Management)
5. Agricultural Documentation (in respect of existing Documentation)

Due to the importance of the Agricultural Informatics, the emerging and bellow mentioned nomenclature can also be offered at different level of study. Here different levels of programs with various streams of Information Sciences are proposed in fig: 2 to 12.

1. Smart Agriculture
2. Digital Agriculture etc.

TABLE I SAMPLE BTECH SYLLABUS OF AGRICULTURAL INFORMATION TECHNOLOGY

BTech (Agricultural Information Technology)	
1st Semester	**2nd Semester**
(Credit-23) Remedial Mathematics I Industrial Chemistry and Environmental Studies Basics of Mechanical Engineering Fundamental of Electronics Presentation, Communication and Soft Skills Basic Electronics Lab. Communication Lab	(Credit-24) Remedial Mathematics –II Electronics Physics Computer Fundamental and Programme using C Basic Electrical Engineering Technical Communication Manufacturing Process Electronics Physics Labs CAD Engineering Graphics Labs Computer Programming using C Lab
3rd Semester	**4th Semester**
(Credit-25) Agricultural Engineering Fundamentals of Soil science Information Technology for Agriculture Environment Management System e-Commerce for Agriculture Management Concept and Practices Soil science lab	(Credit-24) Crop and Soil Management Natural Resource Management for Agriculture Statistics Techniques For Agriculture Business Communication University Elective-I. University Elective-II*
5th Semester	**6th Semester**
.(Credit-25) Soil water plant weather relationship Principles of watershed management Remote sensing and GIS Object oriented programming I.T. Tools for Agriculture Nano Technology for Agriculture Object oriented programming lab	(Credit-30) Data collection processing and instrumentation Fundamentals of Bioinformatics Supply Chain management Internet applications Data mining and data ware housing technology Bioinformatics Lab6.Internet application lab Minor project/ training based Seminar
7th Semester	**8th Semester**
(Credit-25) Method for Technology Development and Transfer Precision Agriculture Fundamental of extension education Agro-meteorology and crop weather forecasting Multimedia and management of Agri web portals Cloud Computing Agri web ports and Multimedia Lab	Dissertation and presentation

TABLE II AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT UG-INFORMATION SCIENCE

Bachelors / Information Science/ (Science & Technology Stream)
BSc-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
BS-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
BTech/BE-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
BS (by Research)-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)

Here in table: 2 Agricultural Informatics and Smart Agriculture nomenclature is proposed and provided in respect of Information Science at Bachelors levels whereas Table: 3 is depicted with the same specializations at Masters Level.

TABLE III AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT PG-INFORMATION SCIENCE

Masters / Information Science/ (Science & Technology Stream)
MSc-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MS-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MTech/ME-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MS (by Research)-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)

The Research programs including MPhil and PhD programs are depicted in Table: 4 in Science and Engineering/ Technological concentration. Here and also at Bachelors and Masters Agricultural Informatics can be offered as Agricultural Information Technology. All the Agricultural Informatics related programs mentioned above can also be offered with Computer Science nomenclature and such are depicted at Bachelors and Masters in the tables no. 4 & 5 respectively.

TABLE IV AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT RESEARCH-INFORMATION SCIENCE

Research/ Information Science/ (Science & Technology Stream)
PhD (Science)-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
PhD (Engineering)-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Science/ Engineering)-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Engineering)-Information Science (Agricultural Informatics/ AIT/ Smart Agriculture)

Candidates interested in Agricultural Informatics research work can also go with the advanced research-based study at Bachelors and Masters level with the streams of Computer Science and Information Science and all are depicted in the tables (no. 2 to 6).

TABLE V AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT UG-COMPUTER SCIENCE

Bachelors / Computer Science/ (Science & Technology Stream)
BSc-Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
BS- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
BTech/BE- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
BS (by Research)- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)

TABLE VI AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT PG-COMPUTER SCIENCE

Masters / Computer Science/ (Science & Technology Stream)
MSc-Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MS- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MTech/ME- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MS (by Research)- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)

Agricultural Informatics in Computer Science concentration is focused with the design and development of Agro based product rather than applications hence research programs are most suitable in CS for those who are planning to move on such carriers (refer table:7).

TABLE VII AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT RESEARCH-COMPUTER SCIENCE

Research/ Computer Science/ (Science & Technology Stream)
PhD (Science)- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
PhD (Engineering)- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Science/ Engineering)- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Engineering)- Computer Science (Agricultural Informatics/ AIT/ Smart Agriculture)

Information Technology is another important branch in which Agricultural Informatics can be offered within the Information Sciences and it should be offered with the responsibility of developing manpower for applications only in agro IoT, AGRO Analytics etc. Whereas CS based Agricultural Informatics can be suitable for agro robotics based applications. Refer Table: 8 and 9 in this context.

TABLE VIII AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT UG-IT/ICT

Bachelors / Information Technology & ICT/ (Science & Technology Stream)
BSc-Information Technology/ ICT (Agricultural Informatics/ AIT/ Smart Agriculture)
BS-Information Technology/ ICT (Agricultural Informatics/ AIT/ Smart Agriculture)
BTech/BE- Information Technology / ICT (Agricultural Informatics/ AIT/ Smart Agriculture)
BS (by Research)- Information Technology/ ICT (Agricultural Informatics/ AIT/ Smart Agriculture)

The by research program is suitable for the interested in research and development organization including universities, agro research centres etc. Though the higher research programs i.e. M.Phil/ PhD in CS with Agricultural Informatics are could be best for all such positions and areas including in teaching in both the areas. Refer table:10

TABLE IX AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT PG-IT/ICT

Masters / Information Technology & ICT/ (Science & Technology Stream)
MSc-Information Technology/ ICT (Agricultural Informatics/ AIT/ Smart Agriculture)
MS-Information Technology/ ICT (Agricultural Informatics/ AIT/ Smart Agriculture)
MTech/ME- Information Technology / ICT (Agricultural Informatics/ AIT/ Smart Agriculture)
MS (by Research)- Information Technology/ ICT (Agricultural Informatics/ AIT/ Smart Agriculture)

TABLE X AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT RESEARCH-IT/ICT

Research/ Information Technology & ICT/ (Science & Technology Stream)
PhD (Science)- Information Technology (Agricultural Informatics/ AIT/ Smart Agriculture)
PhD (Engineering)- Information Technology (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Science/ Engineering)- Information Technology (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Engineering)- Information Technology (Agricultural Informatics/ AIT/ Smart Agriculture)

Information Systems are less mathematical in nature and suitable for organizations and fields. As far as agricultural areas are concerned Table: 11, Table 12 are proposed Bachelors and Masters in this context.

TABLE XI AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT BACHELOR-INFORMATION SYSTEMS

Bachelors / Information Systems (Science & Technology Stream)
BSc-Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
BS- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
BTech/BE- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
BS (by Research)- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)

These students can go with the managerial aspects related to the Agro IT, issues, challenges, and concerns on the subjects very well.

TABLE XII AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT PG-INFORMATION SYSTEMS

Masters / Information Systems / (Science & Technology Stream)
MSc-Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
MS- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
MTech/ME- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
MS (by Research)- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)

Hence candidates interested in research on such areas can move to the MPhil and PhDs in the areas perfectly. Table: 13 is proposed various programs on this.

TABLE XIII AGRO INFORMATICS & SMART AGRICULTURE POSSIBLE NOMENCLATURE AT RESEARCH INFORMATION SYSTEMS

Research/ Information Systems / (Science & Technology Stream)
PhD (Science)- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
PhD (Engineering)- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Science/ Engineering)- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)
MPhil (Engineering)- Information Systems (Agricultural Informatics/ AIT/ Smart Agriculture)

These are the possible programs in Agricultural Informatics. However internationally mainly following programs are still common and popular/ started viz.

1. BTech-Agricultural Information Technology (mainly in India)
2. MTech- Agricultural Information Technology (mainly in India)
3. MSc Agricultural Informatics (mainly in India and abroad)

While the BSc programs are still limited in many contexts and at BSc Agricultural Informatics or allied nomenclature may be started for the betterment in agriculture and similar development.

X. SUGGESTIONS AND RECOMMENDATION

Agricultural Informatics as an interdisciplinary field is growing and based on the need and requirement various programs can be offered. The IT and Information Sciences programs can be offered in the context of applications of IT in different sector of agriculture including preproduction and post production. Whereas use of software and hardware is an important for better ICT applications in agro and in this regard Computer Science could be best.
Furthermore, based on Indian region other nomenclatures can be also offered viz.

1. Computer Engineering
2. Computer Applications

In contrast with international universities, the nomenclature of Computing can also be offered at different level of programs. It is worthy to use the term and nomenclature Information Science and Technology based on need and requirement.

All such proposed programs can easily be deployable in academics for better productivity and enhancement in agriculture.

XI. CONCLUSION

There are many concerns with the Agricultural Informatics applications in diverse areas of agriculture and horticulture and in this context apart from the mentioned Bachelor's, Master's and Doctoral programs. Agricultural Informatics research opportunities need to enhance at Post Doctoral

Fellowship level from the same background of from Agricultural Sciences or Information Sciences. Short term programs on Agricultural Informatics can also be started with certificate, diploma. And graduate from other fields can go with the Post Graduate Diploma. Moreover, the training programs, workshops, seminar and symposium could also be offered in developing IT in agriculture completely. The manpower development is an important issue and thus joint and multiple initiatives are required in this field by the universities, colleges, and other higher educational institutes. The developing countries can go with Agricultural Informatics for further enhancement in economy and society at a large.

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