AN INTEGRATED AGRICULTURAL INFORMATION AND COMMUNICATION SYSTEM FOR MANAGEMENT AND EXTENSION: A COMPREHENSIVE FRAMEWORK

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Abstract:

Electronic culture (e-culture) and the applications of Information and Communication Technology (ICT) are continuously increasingly in every sphere of human life. It play much bigger role in industry and service sector as compare agriculture sector, to transfer information and knowledge rapidly over large distances through communications networks efficiently and cost-effectively. As agricultural sector is multifaceted in nature and require information from different sources and disciplines of agricultural technology. There is a high demand for agricultural information at global, national, regional levels for farmers, skilled farm-workers, suppliers, agricultural scientists and technologists, extension officers etc. However, agricultural information/data is currently collected and archived by different stakeholders leading to problems of overlapping and duplications, among others. Hence, there is a current need for an integrated information and communication system for agricultural management and extension. However, the credibility and acceptability of any information system in agriculture will depend upon "how much accurate, cost-effective, reliable, timeliness, aggregate information produced" and also its user-friendly form, easy to access and well protected from unauthorized accesses. In this paper, we have presented comprehensive framework of an integrated information and communication system for agricultural management and extension which minimizes duplication in information storage and improves flow, quality and quantity of information provided to different community of farmers and scientists.

KEYWORD: Integrated Information and Communication System, Model, Extension, Management.

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I INTRODUCTION:

Several sectors coming together might prove a boom and may give rise to a new growth wave. So far, the world has witnessed five such waves (so called Kondratieff waves, named after Russian scientist) namely steam engine and cotton, steel and railway, chemistry and electrical engineering, petro-chemistry and automobile and 5th the information technology. One may wonder what the sixth wave is/ would be. According to Mayer [1] this time four sectors viz. informatics again, biotechnology, health and environment have come together to give a synergetic effect. It is sure that the next wave will be agriculture, forestry and environment- and nature-based-risk-management because big parts of environment are linked to agriculture and forestry that covers big parts of our earth, 50% of the health is coming from good food and clean environment, biotechnology shows also to agro-forestry and last but not least Information and Communication Technology[1]. At present, in Agriculture India is rank second worldwide in production. Indian agriculture contributes to 8% global agricultural gross domestic product to support 18% of world population on only 9% of world's arable land and 2.3% of geographical area. [13]. But agricultural production in India is less 30% to 50% as compare to developed country and china. Also, agriculture contribution in the gross domestic product is continuously declining in India, which in 2008-09 touched at 15.7% from about 30% in 1990-91 and today agriculture sector provides employment to about 52 % of the workforce that used to be about 61% in 1990-91. In past two decades, the average annual growth of agriculture sector was less than half (around 3%) of the overall average growth of the economy (6 - 7%). Still, agriculture and allied sectors is the pivotal sector for ensuring food and nutritional security, sustainable development and for alleviation of poverty. There are projections that demand for food-grains would increase from 192 million tonnes in 2000 to 345 million tonnes in 2030. Hence in the next 20 years, production of food-grains needs to be increased at the rate of 5.5 million tonnes annually [3].

The food insecurity situation is effected by global warming, population growth, focus on bio-energy, low technology acceptance, unfavorable policies, sustainability criteria, changing natural risk-situation, subsidies etc. Further, food crisis has aggravated further because of frequent severe droughts and floods, soil erosion, climate change, and diversion of arable lands to urbanization, industrialization. Sustainability, agriculture, forestry and environmental targets

belong together and influence each other [1, 4]. As natural resources are continuously shrinking and deteriorating, but we have to increase the agricultural production in future to meet the projected demand of food-grains in our country [5]. Agricultural data distributed and resides over different places and controlled by different stake-holders in India which is required by agriculture community at different stages of agriculture system. Consequently, all experts' advice/information is not possible to provide physically at farm/ organizational level to desire agriculture community. Therefore we need new types of ICT based comprehensive computerized integrated agricultural information and communication system for management and extension (IAICSME) because right information and its timely communication is sought to put Indian agriculture on high growth trajectory. In this paper we have proposed a comprehensive framework of integrated agricultural information and communication system for management and extension which integrate science based expert data, minimizes duplication in data storage, easy to use software and manageable precision farming technologies essential to agricultural community: farmers, scientists and extension officers.

II ICT INITIATIVES IN INDIAN AGRICULTURE SECTOR:

In the agriculture sector constant application of latest ideas and better work technologies is essential to enhance productivity in the interest of economic well being of farmers and for ensuring food security. Still, in India agriculture extension activities are mainly based on radio and television discussions, person to person contacts, publications, and exhibit of products, fertilizers and seeds at farmers' fairs. Recently, enormous efforts are being made in India for adoption and absorption of information technologies for agriculture information communication. "The National Agriculture Policy lays emphasis on the use of Information and communication Technology (ICT) for achieving a more rapid development of Agriculture in India. In pursuance thereof the Department of Agriculture and Cooperation is in the process of preparing a National e-Governance Plan in agriculture (NeGP-A) for a more focused implementation of e-governance activities in agriculture sector. Phase 1 of the plan identified the prioritized list of services to be provided to the farming community and the list of processes requiring re-engineering for the purpose. The Phase 1 of the NeGP-A is nearing completion. The Phase 2 will define the role of the private sector and civil society. To promote e-governance in agriculture at the centre and

provide support to states/UTs for the same, the Department has already implemented a Central Sector Scheme, Strengthening/Promoting Agricultural Information System's during the Tenth Plan with a budgetary provision of more than Rs. 100.00 Crores" [6]. The Government's National Commission on Farmers has recommended the establishment of Rural Knowledge Centers all over the country using modern information and communication technology (ICT). Mission 2007 is a national initiative launched by an alliance comprising nearly 80 organizations including civil society organizations. Their goal is to set up a Knowledge Centre in every village [7]. The Indian public and private sector established some Internet and telephony based agricultural information system in India. They provide wide variety of information to the Indian agriculture farming community and shows very encouraging consequences.

A. PUBLIC SECTOR AGRI-BASED ICT INITIATIVES IN INDIA:

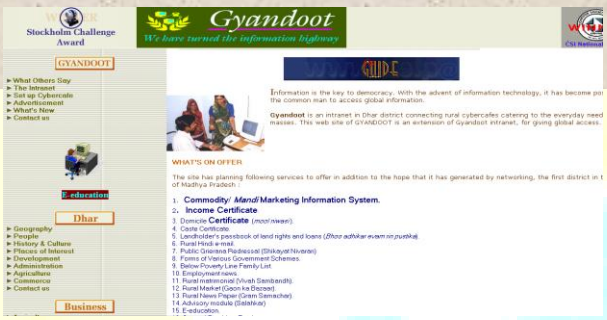
The Government of India has set up the world's largest satellite based communication network namely National Informatics Centre Network (NICNET) which connects all the state capitals and districts of India with a super computer at Delhi. It hosts most of the official information of various ministries and departments including agriculture information. It maintains District Rural Development Agency (DRDA) portals. It has initiated Smart Village Project during the Tenth Plan [8]. Some of the ICT projects sponsored by government /public sector in Indian agriculture as discussed below:

1. AGMARKNET: It is a portal for agricultural marketing information that uses NICNET for reporting daily prices and arrivals data of 300 plus commodities, 1700 plus markets, 2000 varieties on daily basis which is being disseminated through the portal. This project has a potential of expansion to about 7000 wholesale markets located throughout the country and further to 35,000 rural markets in India [12]. The scheme has made rapid strides and by the end of X Five Year Plan, a total number of 2965 nodes have been covered under the scheme

(Figure-1: AGMARKNET)

comprising of 2784 agricultural produce markets, field offices of Directorate of Marketing and Inspection (DMI) and State Agricultural Marketing Boards/ Directorates and their attached offices, etc. This includes 735 agriculture produce wholesale markets, State Marketing Boards/Directorates (48) and DMI offices (27) spread all over the country [14].

2. Gyandoot: On January 1, 2000, Dhar district began the new millennium with installation of low cost, self-sustainable and community owned rural Intranet project Gyandoot. This net is another attempt to set up rural information facility by the district administration of Dhar, Madhya Pradesh "The experience of "Gyandoot" indicates that the village information Kiosk can be self sustainable enterprises with potential to provide jobs for two young rural people at each Kiosk" [15].



(Figure-2: GYANDOOT)

3. EXOWHEM: It is a web based Expert System developed for the wheat growing farmers of India. It provides the information about the Wheat Crop Management in the country. It advises wheat varieties on the basis of area, cultural and climatic conditions and other characteristics of farmer's interest. It also suggests the appropriate cultural practices like field preparation, fertilizer application, schedule of irrigation etc. It guides them in protecting the crop from insects/diseases/weeds etc. It also provides solution to the problems faced by the farmers through online queries [22].

(Figure-3: EXOWHEM)

4. aAQUA.org: It stands for almost All Questions Answered is a farmer-expert Q&A database supporting Indian languages. It is an online multilingual, multimedia agricultural portal for disseminating information from and to the grassroots of the Indian agricultural community. The aAQUA technology developed by Developmental Informatics Lab, KReSIT, IIT Bombay and was sponsored by Media Lab Asia and Development Gateway Foundation's R&D Center [16].

5. Honey-Bee knowledge network: ICT can help empower the knowledge rich but economically poor people. Under the "Honey-Bee" knowledge network (of the IIM, Ahmedabad) implemented with the support from InfoDev division of World Bank the purpose is to augment grassroots inventors and overcome language, literacy and localism. The project has mobilized those creative and innovative farmers, artisans, mechanics, fishermen and women and laborers who have solved the problems through their own genius without any outside help, whether from state, market, or even NGOs. Such self triggered and developed innovations whether technological or institutional are scouted, supported, sustained and scaled up wherever possible with or without value addition, or linkage with formal science and technology institutions. Idea is to generate incentives and benefits for the innovators and traditional knowledge holders. The objective of this entire exercise was to create a clearing house, so that potential investors, venture capital or angle investors & entrepreneurs can link up with grassroots innovators, thus facilitating a golden triangle of innovation, investment & enterprise and thus build a bridge between formal & informal science [16].

B. PRIVATE SECTOR AGRI-BASED ICT INITIATIVES IN INDIA

1. E-choupal: Indian Tobacco Company (ITC's) International business division is one of India's largest exporters of agricultural commodities has conceived e-choupal has launched in June 2000 as a more efficient supply chain aimed at delivering value to its customers around the world on a sustainable basis. ITC's e-choupal is a unique example of using ITC's for agricultural

development; e-choupal has already become the largest initiative among all internet based interventions in rural

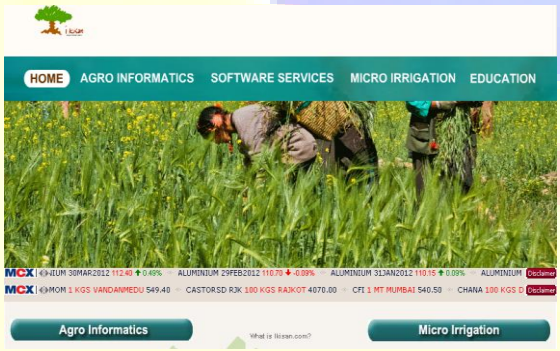
(Figure-4: E-CHOUPAL) India. E-choupal link rural farmers directly for the procurement of agricultural / aquaculture produce like soya, coffee, prawns etc. eliminating the role of the middleman. The principle of the e-choupal is to inform, empower and compete. There are 6,500 e-Choupals today. ITC Limited is adding 7 new e-choupal a day and plans to scale up to 20,000 e-choupal by 2012 covering 100,000 villages in 15 states, servicing 15 million farmers [17, 18].

2. I-Shakti: An IT based rural information service has been developed by the Hindustan

Levers Ltd to provide information services to meet rural needs in agriculture education, vocational training, health and hygiene. The promise of I-Shakti model is to provide need based demand driven information and service across a large variety of sectors that impact the daily livelihood opportunities and living standards of village community [19].

(Figure-5: I-SHAKTI)

3. I-Kisan: It is the ICT initiative of the Nagarjuna group of companies, the largest private



entity supplying farmers' agricultural needs. I-Kisan was set up with two components, the iKisan.com website, to provide agricultural information online, and technical centers at village level. The project operates in Andhra Pradesh and Tamil Nadu. However, it really proved popular in Andhra Pradesh where nine technical centers (kiosks) were established in different districts [20].

(Figure-6: I-KISAN)

4. Warna-Project: Warana Wired Village project in Maharashtra, The Warana cooperative sugar factory, registered in 1956, has led this movement, resulting in the formation of over 25

successful cooperative societies in the region. About 80% of the population is agriculture-based and an independent agricultural development department has been established by the cooperative society. The project was initiated with six business centers, six IT centers and 70 village booths (kiosks) and utilizing IT to increase the efficiency and productivity of co-operatives providing agricultural, medical, crop information, bus and railway timetables and educational information to the villagers. Warana cooperative complex, bringing the world's knowledge to the villagers' doorsteps through the internet via the National Informatics Centre Network (NICNET), and establishing a geographical information system (GIS) of the surrounding 70 villages [21].

5. Infosys ICT initiatives: Infosys Technologies has partnered with ACDI/VOCA, a non-profit international development organization that promotes broad-based economic growth, to develop an ICT-enabled application that would improve efficiencies in the agro supply chain in India. The solution successfully minimizes inventory requirements, reduces waste and allows retailers and farmers to be better integrated. This application falls under ACDI/VOCA's Growth-Oriented Micro- enterprise Development Program (GMED), which is a $6.3 million, USAID-funded initiative. Maintaining on-time, programmed delivery of fresh produce from a large and scattered production base is a complex and critical operation. This solution gives the organized retail sector access to a reliable small holder production base. It thereby decreases farm-to-market losses, currently estimated at 30% to 40% on certain products [16].

III INTEGRATED AGRICULTURAL INFORMATION AND COMMUNICATION SYSTEM FOR MANAGEMENT AND EXTENSION:

A FRAMEWORK OF SYSTEM:

A comprehensive picture of the concept of the proposed framework of integrated agricultural information and communication system for management and extension (IAICSME) is illustrated in figure- 1 below. It can be seen that the IAICSME comprises a large number of information and communication technology (ICT) tools and database organization. The ICT tools include simulation & modeling, ES, DSS, EIS, MIS, whether forecasting system, marketing

information system, fertilizers & pesticide, information system, irrigation information system, soil nutrients & erosion information system, GIS/GPS/RS application system, data warehousing, data mining technique, farm management and land record information system , horticulture & floriculture information system, fisheries and live stock information system etc. as depicted in the outer layer of IAICSME. It can also be seen that the database organization of IAICSME consists soil health database, spatial meteorology database, fertilizer, pesticide database, 3D, graphics, video database, irrigation database, marketing database, educational & training database, seed database, financial, technical Database, project database, fisheries database, viniculture &wine production database, mechanical database etc. depicted in the inner layer. The acquired data complement the monitoring of the operational activities. Furthermore, the structure of the IAICSME should enable the interrelation/ mapping with each other ICT tools and database (e.g. financial, market, administration, seed, fisheries, viniculture &wine production etc.). Figure- 1 depicted how the operational field data needs to be collected and transformed in an automated way. The filtering of information (external as well as internal field operation data) is initiated by the system administrator according to the operational activity which is to be planed. This relates to issues such as ideas and advice, counseling, information flow from administration and regulations depicted in the rich pictures. The outer middleware of IAICSME, analysis the query and mapping the command with required ICT tools. The inner middleware of IAICSME interpret the actual demand of users and match to appropriate database. Overall system functioning & database management will be responsibility of system administrator. ICAR, SAU, agriculture ministry, research institute, DWR (AE, researcher, policy maker, farmer) etc. can provide data from laboratory & expertise knowledge through Internet and look overall control, monitoring & funding. Research Inst., KVK, Mkt. Board, ADO, DDA, Traders, Extensionist, NGO etc. can use of IAICSME for training and extension purpose. Agriculture workforce: farmer skilled labor, unemployed, live – stock herders, fishermen, NGO etc. are the end user. They can analysis the performance of the system as per their required information and give feedback through Internet. They can also share their own experiences and new practice in the agricultural process. The model divides the IAICSME into three functional components: internal database collection, ICT tools and external users. From this component-based model of the required system, the formal specification of the behavior and interfaces of each component,

based on the dependencies illustrated in Figure- 1, may be straightforwardly derived and used as the basis for implementations.

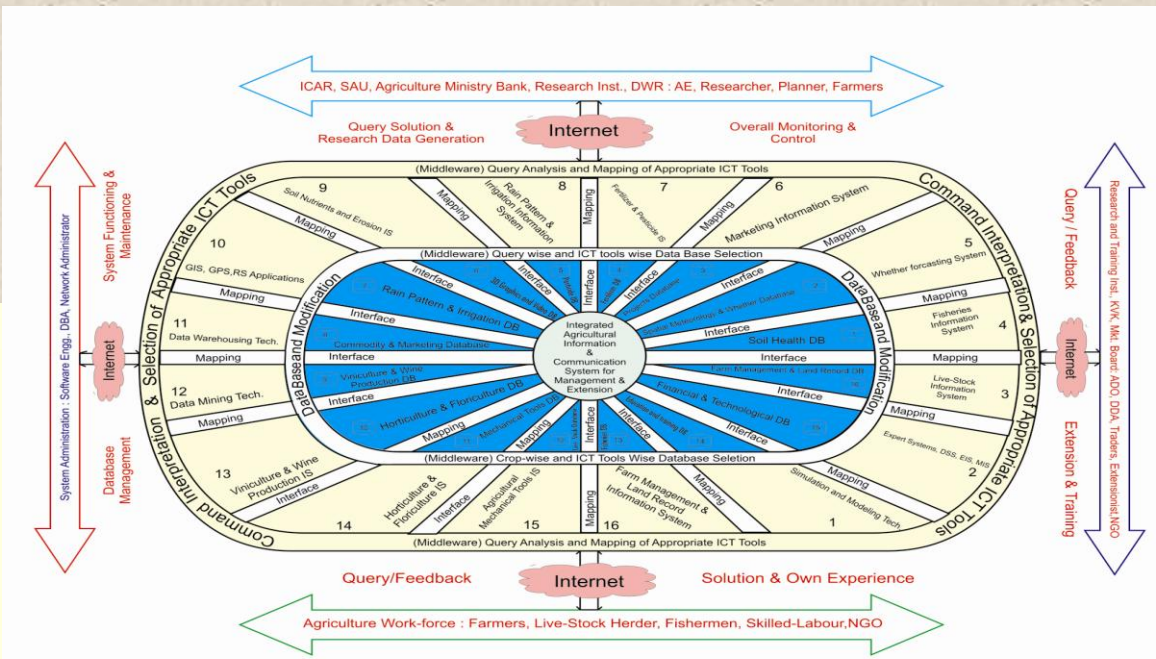


Figure- 1: Framework of Integrated Agricultural Information and communication System for Management and Extension

B IMPACT OF IAICSME AND POVERTY REDUCTION MODEL

India is well-known around the world for its rapid economic growth rates of more than 8%-9% (2nd globally after China) over the last fifteen years or so, fuelled in part by the spectacular growth in its export-oriented software and ICT-based services sector. This is expected to continue with growth just under 7% by 2015.Many other countries look to India as a model for global outsourcing and try to imitate elements of this in their own strategies [11, 2]. Agriculture contribution in the gross domestic product is continuously declining in India, which in 2008-09 touched at 15.7% from about 30% in 1990-91 and today agriculture sector provides employment to about 52 % of the workforce that used to be about 61% in 1990-91[23]. Still a huge number of people of India are not only poor but also undernourished. It has been analyzed that the Information Technology and Information Communication Technology (ICT) can doubtlessly contribute much to agriculture development [9, 10]. Below in figure- 2, it can be

illustrated that ICT tools, computer science technology, database and network technology with agricultural science & engineering and allied sector can developed IAICSME. Agriculture system will covert into E-agriculture. E-agriculture will definitely bring (8Es) effectiveness, estimation, economical, enhancement, ethics, education, extensiveness, efficiency in agriculture management. Further, overall management of agriculture system and quality of the agricultural products will be increased. It will increase business, export and reduced import of agriculture products. Finally, gross domestic product (GDP) of Nation and foreign capital will be increased and automatically it alleviates poverty from the nation.

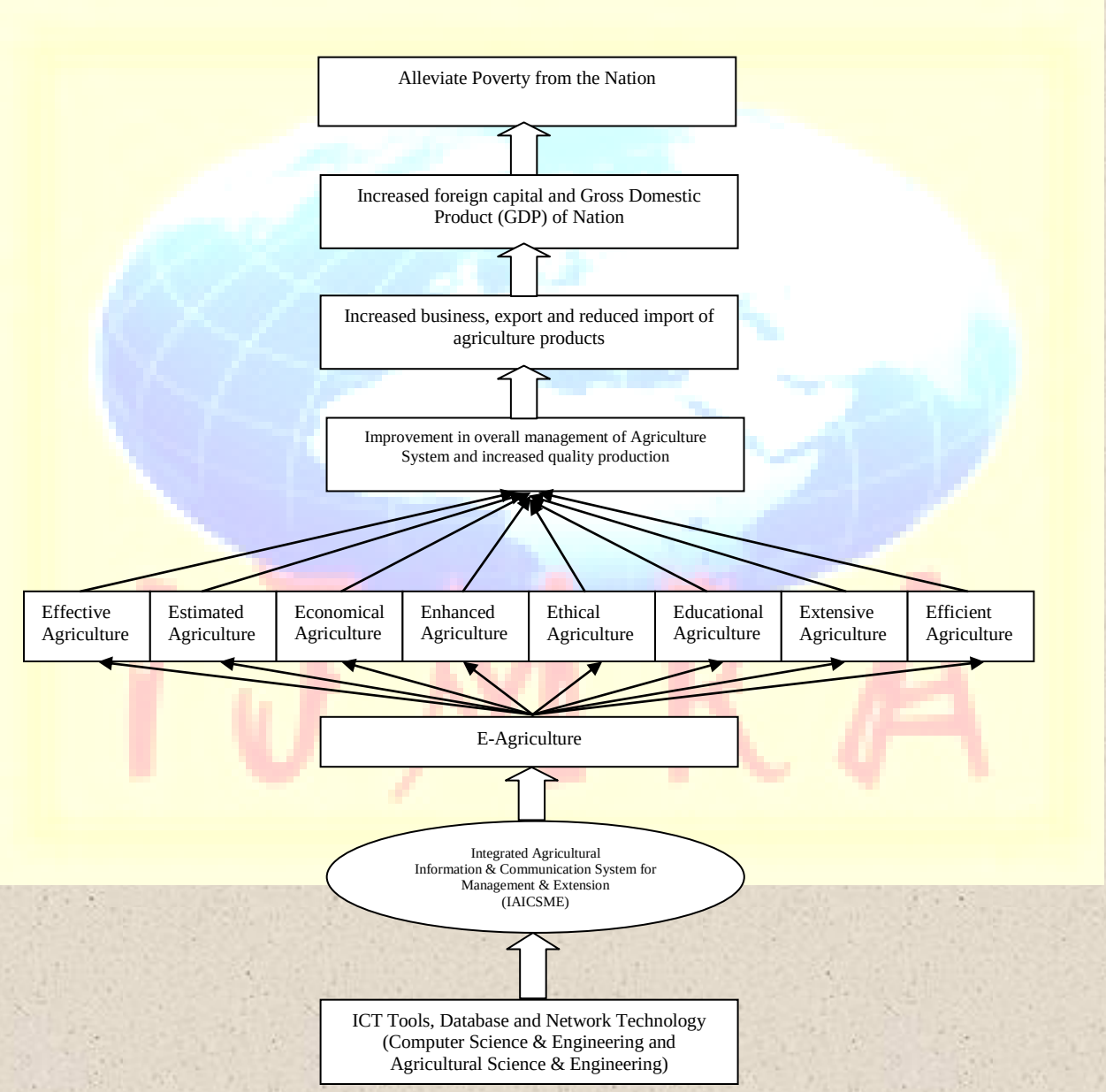


Figure-2: IAICSME and Poverty Reduction Model

IV CONCLUSION:

Agricultural system is a most heterogeneous in nature and production of different crops depend on many diverse resource and random factors such as climate, temperature, edaphic conditions, fertilizers, soil nutrient, cropping systems and rotation, quality seed, pesticides, irrigation scheduling and socioeconomic situation. It is not possible to provide or make available all information and advice about every crop, floriculture, viniculture, live-stock, fisheries, horticulture etc. by traditional information technology or manually to different community of farmers and scientists. A web based integrated information and communication system can resolve this problem. In the presented comprehensive integrated information and communication system for agricultural management and extension, different crop-wise and floriculture, viniculture, live-stock, fisheries, horticulture database systems etc. are prepared for their different activity such as irrigation, weather forecasting, pesticide and fertilizer use, market information, live-stock management, human resource, financial plan etc.. Furthermore, in the proposed different ICT tools: Expert System, MIS, EIS, DBMS, DSS, GIS, GPS, RS, data mining, data warehousing, simulation and modeling, artificial intelligence, marketing information- system etc. are also include for generation of various information. These tools will deliver the information instantly as per requirement of the different community of the farmers as well as agricultural scientists for their use. The generated information will be relevant, timeliness, precise, accurate, cost-effective, reliable, usable, exhaustive, and aggregate information is used to improved decision making in different phase of agriculture sector such as crop cultivation, water management, fertilizer application, pest management, harvesting, post harvest handling, transporting of food/food products, packaging, food preservation, food processing/value addition, food quality management, food safety, food storage, food marketing, planning, diagnostics, marketing, human resource planning, effectiveness, production, quality control and monitoring, budgeting management. In this way the agricultural system can improve and economy of nation (GDP) can be enhanced and poverty can be alleviated. However, it is not so easy to develop such type of integrated information and communication system for agricultural management and extension because it require various type of area-wise data for

different crop and the implementation of different ICT tools and there mapping and interfacing. This system can be organized in distributed manner for crop-wise, floriculture-wise, viniculture-wise, live-stock- wise fisheries- wise, horticulture- wise etc. then it can integrated through fast communication line in a integrated information system.

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