ICT Based Agro Advisory and e-Extension Approach For Sustainable Agricultural Development

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ABSTRACT
Indian agricultural strength includes the vast human resource, diversity in agro-ecological regions and agronomic and cultural management practices for growing of crops. Agro-advisory to small and marginal classes of farmers looks tedious. With information and communication technology, there is a challenge to link the agro-advisory knowledge of various agro-ecologies for effective dissemination of knowledge. Various agro-informatics tools like decision support systems (DSS), remote sensing, technical coefficients, thumb rules, expert’s judgment, Information retrieval systems for agro and farm management and advisory systems can provide the solutions to various problems of agriculture in diverse agro-ecological situations. GIS is becoming important to link the agri-informatics with the simulation tools to extrapolate the decisions on spatial scale over the diverse agro-environments within the country.

Several ICT based initiative have been taken in India by various government, corporate sector institutions and NGO’s. These initiatives vary in purpose, target group, nature and quality of information and mode of implementation. In our approach information is generate and collated to construct and validate reliable simulation models on crop growth, input management, pest dynamics and yield estimation. On line agro advisory is available on our website. KRISISEWA is available both in Hindi and English. KRISISEWA is covering farmers advisory for resource management, early warning system, site specific nutrient and water management, agri-management for synoptic/medium range weather forecast, market trends, demand and supply relationship for agricultural commodities.

KEYWORDS
ICT, Extension, Farmer, dissemination, simulation, model

INTRODUCTION
“Every thing can wait, but not Agriculture”. This has been said by none other than Late Jawahar Lal Nehru, first prime minister of independent India and the visionary architect of India’s agricultural development programmes. The Indian economy largely hinges around agriculture and is the backbone of our country, which contributes nearly 30 percent of the GDP and 70% of our population is fully dependent on agriculture. The green revolution ushered in an era of break-through production from the late sixties has begun to exhibit the signs of fatigue. Dissemination of the information to the farmers, well in time can help them in adopting appropriate resource management options and enhance the agricultural productivity in their fields [1]. The extreme climate events, rapid increased in land degradation and land use and land cover change, industrial effluents disposal in the agricultural field etc. are putting pressures on the agricultural productivity system, and farmers have to be advised for adoption of appropriate land use options, cropping system and associated packages with regard to the sustainable productivity. Since there are diverse agro ecologies, land holdings and bio-physical and socio-economic pressures, the farmers have to be advocated appropriate technologies and options through communication skills which are efficient and cost effective.

Information is key to make appropriate agricultural management decision. e-Extension and on line agro advisory can offers appropriate resource management options to control insects/pests, as well as sustain agricultural productivity and safeguard environment. This system includes use of chemical pesticides and biological control options. Since Indian agriculture is complex, having diverse agro-ecologies, number of crops and cropping systems along with control management options, there is a need to collate the information and decisions on agro-ecological basis [2]. The early warning for infestation and associated control options can save farmers from losses in the agricultural production. It is necessary to strengthen the communication links between farmers, researchers and extension workers, to expedite multi-way exchange of information and transfer of technology. Information technology has advanced in recent times, and farmer’s window for agro-advisory options is displayed, but localized at limited locations. The existing services at the limited locations is not very well calibrated and tested, most of the times non-realistic for application purpose.

This Center at IARI has prepared Agricultural Information System for crops associated in the Indo-Gangetic Plains, which subsequently is put on the Institute’s website for subsequent linkages with the farmers, planners and researchers. Planning Commission is seriously thinking of effective tool of dissemination the knowledge base to the farming community for better management options for achieving higher productivity. For knowledge propagation to the panchayats within the country use of remote sensing satellites are though for, which will be linked with the decision tools through
scientists/experts for effective agro-advisory to the rural masses. Pest forecasting, in terms of infestation, associated losses and control options, is a tedious task and integration of the knowledge within the discipline needs to be strengthened at regional scale. Recently this Center has prepared software for rice, wheat and maize informatics to cover all the aspects in relation with AIS.

There is already a large database of useful agri information available on the Internet, however, the information is scattered all across the globe. These resources range from topics such as pest identification, control practices, IPM, pest modeling and forecast [3]. As awareness of the Internet increases worldwide, more people are participating not only as users of the information but also as creators of new information; as a consequence, the number of both AIS Internet servers and clients is increasing rapidly, perhaps slightly lagging but generally accompanying the exponential growth of the internet itself.

The transfer of research and extension information to farmers plays the key role in the adoption of AIS. Electronic Mail provides an effective multidirectional exchange of information. Electronic extension systems provide 24-hour access to an inquirer of specific information to be used in planning and decision support. In fact, it is rapidly changing the way individuals exchange information and make decisions. Now it is possible for extension services and applied researchers to deliver and receive information to and from much larger audiences, i.e. Internet- and telephone-based document delivery systems, multimedia packages, email, and the World Wide Web [4]. The emphasis is, however, beginning to shift from traditional one-way flow of information from research, then to extension, and finally to the farmer the end-users of information, to the more egalitarian process where the pool of total experience and knowledge available in the community, from growers, industry, research and extension, is readily exchanged through electronic means.

**e-Extension and Web-based Decision Support System:**

E-mail, web based interactive information systems, video conferencing and farmers call centres are the main medium of information sharing and dissemination in e-Extension approach. From many studies and reports it is clear that lack of feedback mechanism is the major weakness in the existing agriculture extension system and e-Extension approach is most suitable option to fill the gap.

A Decision Support Systems (DSS) integrates a user-friendly front- end tool to complex models, knowledge bases, expert systems, and RDBMS [5]. DSS are important component of IPM informatics. Web-based models and DSS are becoming popular because no external software is required, thus reducing software management and distribution costs. Several internet-based DSS have been developed for meteorology and agricultural applications [6]. DSS have emerged as essential tools to bridge the gap between technology and the farmer who make day-to-day management decisions Generally, an AIS-DSS should provide users all necessary information including pest identification/disease diagnosis, pest/pathogen life cycles, sampling and decision making criteria, sampling threshold calculators, pest/disease developmental models linked to weather networks, bio rational pest control methods, plus currently available pesticides, and their safety issues and environmental impacts.

There are no true AIS DSS online at this time, but many of the resources are available and waiting for proper integration. For example, various weather-based disease and insect pest models are available online for local forecasting of pest situations based on real time, near-real time, and/or historical weather data. This information can be utilized for developing web-based pest management decision support system. Dynamic sites that include interactive models, Geographical Information System based decision tools, real-time weather, and market information were being rapidly developed and made available on the Internet. A key feature of this system is pest and disease warnings based on weather data-driven forecast models separately for each agro-ecological region.

**Comparative study of ICT initiatives in Agriculture and rural development:**

Several ICT based initiative have been taken in India by various government, corporate sector institutions and NGO’s. These initiatives vary in purpose, target group, nature and quality of information and mode of implementation [7] [8]. A comparison is made in the following table.

<table>
<thead>
<tr>
<th>Features</th>
<th>Govt. sector</th>
<th>Corporate sector</th>
<th>NGO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding</td>
<td>Funds from central and state Governments</td>
<td>Expenditure from company</td>
<td>Funds from National and International organizations</td>
</tr>
<tr>
<td>Major projects</td>
<td>ARIS, ATIC, NAIP,NATP, DACNET and AGMARKET from central govt. and Wyandot, Boom, Kiss an from state govt.</td>
<td>e-Chaupal from ITC, Tata kissan Kendra from Tata chemicals chirag Kendra from n-Logue etc.</td>
<td>IVRP from M.S. Swaminathan Research foundation, Drishti.com, agriwatch.com</td>
</tr>
<tr>
<td>Focus</td>
<td>Based on the research and training needs at grass root</td>
<td>Commercial main focus on marketing</td>
<td>Economically and socially under-development</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Thrust area</th>
<th>Target</th>
<th>ICT facilitator at lowest level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research, Education, Training and Extension</td>
<td>To make a model for sustainable agricultural development</td>
<td>Extension workers from government departments and agriculture graduates</td>
</tr>
<tr>
<td>Business goals with some social orientation</td>
<td>To generate benefits for the company as well as farmers</td>
<td>Local traders, farmers and company officials</td>
</tr>
<tr>
<td>Uplifting of poor people in remote areas</td>
<td>To create awareness about socio-economic issues of new and innovative technologies</td>
<td>Volunteers from villages and social service oriented people</td>
</tr>
</tbody>
</table>

Initiatives and approach at IARI:

In our approach information is generated and collated to construct and validate reliable simulation models on crop growth, input management, pest dynamics and yield estimation. The information and databases have been translated into an 'Agriculture Information System'. It has a three-layered architecture consisting of Client Side Interface Layer implemented in HTML and JavaScript; Server Side Application Layer implemented in Active Server Pages and Database Layer implemented in Microsoft Access 2000.

- Crop/pedigree contains varieties, pedigree, sowing time, cultural operation, fertilizer, irrigation, harvesting.
- Pest/weather informatics contains identification, distribution, spatial and temporal changes, economic threshold, management options, hot spots, ecological zonation, forecasting and climate change impact.
- Socio/economic informatics contains land holdings, land use patterns, marketing and credit facilities, demands and supply.
- Input use informatics contains fertilizer, farm machineries, pesticides, seed availability and their prices

AIS provide information about recent developments in agriculture in cultivation practices of crops like rice, wheat, maize, sorghum, pigeon pea etc. We have also included relevant photographs of high resolutions of insects/pests/diseases/weeds etc.

Various informatics layers and their details are given below.

- Soil/water informatics contains detailed databases of primary soil characteristics, moisture, soil fertility, status of organic carbon, water availability etc.
- Crop/pedigree informatics contains varieties, pedigree and sowing details, cultural operations, fertilizer, irrigation, harvesting etc.
- Pest/weather informatics contains identification, distribution, spatial and temporal changes, economic threshold, management options, hot spots, ecological zonation, forecasting and climate change impact.
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This information system would help different users to access site-specific information with respect to various parameters for appropriate crop management. Simulation models can account for changes in weather, soil, fertility, water use, genotype, management and pest intensity. These models have been used to determine potential yields of crops and yield gaps. It also assesses the effect and impact of climatic variability on pest incidence and yield losses due to pests [9] [10].

Fig.1 Linkage of agri-informatics with simulation models

Fig.2 Proposed model for e-Extension at grass root level
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Application of agri-informatics in Indian agriculture can be major source of poverty alleviation and empowerment of agrarian folk. Indian Council of Agricultural Research has to take a lead, by developing an infra-structural frame work for this mission, where organizations related with information technology, remote sensing, non conventional source of energy, environment, commerce and NIC have to join along with group of dedicated inter-disciplinary group of scientists from various organizations and state agricultural universities representing various agro-ecological situations have to participate, for the cause of uplifting the poor and marginal farmers.

CONCLUSION

ICT has been the most aspired fields in today’s world. Integration of ICT with agriculture will help to regulate overall economy of India. The different ICT technologies like Expert systems, GIS and remote sensing, knowledgebase and data mining techniques can bring revolution in Indian agriculture.

The tradition extension approach in agriculture needs reorientation to meet the expanding need of information at grass root level. Limited internet connections, slow speed bandwidth and limited number of interactive governmental web sites are some of the specific loop holes of our extension system ICT based agriculture can play a major role for sustainable development for the farmers as well as researchers and extension policy makers. Indian agriculture which is mainly dominated by the resource and information poor farmers can be boost up through agro advisory and e-Extension approach.

To sum up, for effective and efficient utilization of ICT in agriculture policy makers should focus on 6 I’s: Information, Integration, Interface, Institution, Investment and Incentives. The agriculture information system is to be developed by adopting state of the art technologies on development of knowledgebase, DSS, communication network for efficient dissemination, application of GIS, multimedia etc. with the ultimate aim for sustainable agricultural development.

FUTURE SCOPE

At regional scale (some selected locations), we have been successful in providing e-Extension. Since our country is vast and diverse in ecological characters, and the decision is usually spatially variant. We have to take this mission on a mega scale with group of inter-disciplinary knowledge and a tool (either through remote sensing or any other effective communication medium) to disseminate the knowledge fast. The informatics on basic soil properties like texture, density, OC content and moisture characteristics is very crucial to make appropriate decisions for adoption of suitable management options to sustain crop productivity. The available information is mainly point based and has great extent of spatial variability. So it is very important to extrapolate the point based observations with the help of simulation and other decision tools to identify proper land use plan for sustainable agricultural development.

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