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**Impact of Globalization and Emerging
Information Communication Technologies on
Agricultural Knowledge Transfer to Small
Farmers in India**

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Abstract

Globalization and growing competition have accelerated the need for knowledge intensive work performance in all the sectors of economy. 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. The current models of agriculture knowledge transfer in India are mainly based on extension activities where knowledge is transferred to farmers through person to person contacts, publications, radio and television discussions and exhibit of products, fertilizers and seeds at farmers' fairs. This paper discusses the advances in information and communication technologies (ICTs) and their penetration and impact on Indian agriculture sector.

Introduction

The ongoing process of globalization has influenced all the sectors of economy including the agriculture sector. Globalization has offered enormous opportunities but also threats to communities that are not adequately prepared to face its challenges. It has created turbulence, uncertainty, competitiveness, need for adaptation to change and timely adoption and absorption of technologies. “As the world is globalizing, a global knowledge and information society is emerging, spanning all regions. Knowledge and information have become significant factors for production of goods and services. They affect the international division of labour, determine the competitiveness of economies and corporations, generate new growth patterns and in the process spawn new products, jobs and livelihoods” [1].

The globalization has affected the poor and illiterate people of the world particularly the rural people and small farmers having small land holdings. Moreover many of them have no access to information and other facilities that can help to enhance their participation in economic development, improve their productivity, income and living conditions. “Of the world’s 1.09 billion extremely poor people, about 74 percent (810 million) live in marginal areas and rely on small scale agriculture for their livelihood. In most developing countries, agriculture continues to be the most important sector of the economy, accounting for the biggest proportion of employment” [2].

The irony of the situation is that many of the small farmers engaged in agriculture are undernourished. They are producers but not the consumers of food because of poverty. “In the overall, the number of hungry people in the developing world increased by 34 million from mid 1990’s to stand at 815 million in 2002” [3]. This number has increased further as the benefits of development are not reaching the masses in the developing countries. “Most of the 842 undernourished people in the developing world today are from farming families in developing countries” [4]. Lack of rural infrastructure and low income let the things go on as they are going on and acts as impediments to speed up the process of rural development. “In 2003, close to 700 million Asians were estimated to be living on less than a dollar a day” [5]. In spite of improvements in agricultural production, the poverty alleviation programs are not making a substantial headway in many developing countries. For instance in India, the drought conditions at some places and floods and hailstorms at other places cause loss of crops. Due to globalization, there is a real threat for decline in prices of agriculture products. On the other hand a constant increase in crop inputs is also causing a concern for farmers and several small farmers have started thinking that agriculture is not a viable occupation.

There are other global changes that are hitting the small farmers and threatening food security of nations. “A recent study shows how temperature changes are already hitting the global economy with the Indian agriculture bearing its brunt. The study proves that agriculture losses worth \$5 billion annually, from 1981-2002, can be correlated with temperature rises over that period. The study appearing in *Environmental Research Letters*, a reputed journal published from the UK has shown that almost 30% variation in the global agriculture yields can be explained by temperature rise. With wheat, barley and maize being the three crops hit the maximum due to temperature rise, India, the second largest producer of wheat and the

fifth largest producer of maize in the world, is obviously suffering silent kill on its agrarian economy” [6].

With the increasing use of chemical fertilizers, the soil salinity is increasing and soil conditions do not help to enhance agriculture production. On one hand there are challenges to feed the growing number of the Indian population and on the other hand several problems are cropping in the way of increasing the agricultural production. The future increase of agricultural production will be realized through integrated knowledge applications such as greater use of biotechnology, more effective irrigation management and soil preparation, avoiding environmental degradation and cutting costs wherever possible. However agricultural knowledge applicable to one environment may not be suitable for crop production in another environment. “For example, soybeans are day-length sensitive, so different varieties must be developed for different latitudes. Likewise, many tropical soils are naturally acidic, a less prevalent problem in temperate areas, consequently, crops that thrive in temperate soils can fail or falter under tropical conditions” [7].

Any poverty reduction and national development effort in the developing countries cannot succeed without improving the economic conditions and effective participation of rural populations, majority of which constitute small farmers. Timely accessibility to appropriate information and eradication of illiteracy from rural areas can help in alleviation of rural poverty. The United Nations has addressed the issue of illiteracy in its eight Millennium Development Goals (MDGs) for poverty reduction by addressing the goal of universal primary education. One of the goal of the United Nations in MDGs is to ensure environmental sustainability. Developing Countries and poor nations should make efforts to preserve environment through the use of environment friendly technologies and farming practices. “Organic agriculture is likely to benefit the poor living in marginal areas the most, by improving productivity and incomes, and providing environmental sustainability. In Thailand contract organic rice farming in marginal areas has produced significant livelihood improvements for participating farmers” [8]. Organic farming is finding favour in resource poor areas. “In Kandy, Srilanka, an organic tea project for resource poor farmers has led to favourable environmental outcomes in an area where tea had almost been abandoned” [9].

There are now abundance of choices and farming technologies in knowledge intensive agriculture work and most appropriate decision making pertaining to what is relevant for which area is thus very crucial for agricultural growth and development. “Even in Europe, reportedly more likely to be found in disadvantaged areas, or areas unfavourable for conventional agricultural production” [10]. Abundance of knowledge in the field of agriculture has accumulated out of the outcomes and experiences of various farming practices in various parts of the world. “For instance, farmers in Southern Sudan and Zaire noticed that the sites of termite mounds are particularly good for growing sorghum and cowpea. Farmers in Zaachilla, Mexico use ant refuse to fertilize high value crops such as tomatoes, chili and onions” [11]. Some of the accumulated knowledge of years remained confined to communities and not even documented, and thus remained inaccessible to other farming communities. Globalization and rapid exchange of information made possible by developments in information technologies have facilitated global access to local knowledge and vice-versa. “Promoting Local Innovation (PROlinnova) is an NGO-initiated program to

build a global learning network to promote local innovation in ecologically oriented agriculture and natural resource management. The focus is on recognizing the dynamics of indigenous knowledge (IK) and enhancing capacities of farmers (including forest dwellers, pastor lists and fisher folk)...”[12].

Impact on India

As far as agricultural development is concerned India is a unique country among the developing world. The most advanced as well as the most primitive kind of agricultural technologies are practiced in the country. On one hand there are most modern agricultural implements such as tractors and harvesting combines, on the other hand there are millions of farmers using bullock carts and ploughs. There are areas like Chirapunji where it rains all the time and there are places in Rajasthan which often witness drought conditions. Diversity of soil and climatic conditions are existing in the country and hence India is known for diversity of plant species and varieties of crops. Even system of medicine namely Ayurveda is based mainly on formulations made from various medicinal plants. The country has diverse geographical settings such as hilly terrains, wet lands, valleys, deserts and sea coast. A variety of crops can thus be grown and various agricultural technologies can be adopted and adapted to specific needs. There are farmers who have developed hundreds of web pages of agriculture information and communicate through email and there are also the farmers who still dispatch their messages through pigeon carriers. There are hundreds of languages spoken and several ethnic groups of farmers living in various cultural settings and having different belief and ethical systems.

The major problems of Indian agriculture are fragmented farms, monsoon dependent irrigation in several areas, disrupted power-supply, increasing cost of farm inputs, non-availability of international quality seeds, exploitation of poor and illiterate farmers by intermediaries and lending institutions, lack of adequate information pertaining to what can be most useful and relevant in a given area and situation. Small farm holdings are one of the barriers to modernization and automation of agricultural farms. There is an enormous fluctuation in the prices of agricultural commodities. The prices of onions or tomato may be Rs. 2/- when the farmers sell it but may increase ten times up to Rs. 20/- when sold in the retail market at a different time and such price hikes not only affect the farmers but severely affect the pocket of common man and polity of the nation.

The increasing cost of agricultural inputs and comparatively low cost of agricultural products in the international market is creating a crisis situation for Indian agriculture. For instance it is cheaper to buy wheat from the international than buy it from the Indian market and some mill owners prefer to import instead of buying it locally. Similarly it is cheaper to buy milk and milk products from the international markets than buying it from the Indian markets. The constantly growing input cost of agriculture is affecting the small farmers and their families. The small farmers are increasingly under debt and under stress. According to a recent study [13] conducted by the Punjab Agricultural University, Ludhiana 89 percent of the farmers in the state of Panjab are under debt. If this is the plight of farmers in a state that is considered as bread basket of India, what will be the condition in other states?

“In India 70 percent of farmers are cultivators of small plots from which they can hardly get food security let alone sustainable incomes. Most of them are small and

marginal farmers cultivating land less than one hectare in size, average size of which decreases by half every 15 years due to rapid population growth. Today nearly 60 percent of farmers belong to marginal category with an average of 0.4 ha. land” [14]. Small land holdings, growing cost of production, increasing debt, low prices of some agricultural commodities in the international markets is aggravating the problems of small farmers and leading to some suicides. Hundreds of farmers in the Vidarbha region have committed suicides and such incidences have also been reported from other parts of India.

The National Knowledge Commission (NKC) set up by the Government of India in its report to the nation 2006 recorded.

“Agriculture provides the principal means of livelihood for over 60 percent of India’s population. Despite a steady decline in its share of the Gross Domestic Product (GDP) it remains the largest economic sector in the country. Low and volatile growth rates and the recent escalation of an agrarian crisis in several parts of the Indian country side are a threat not only to national food security, but also to the economic well being of the nation as a whole” [15].

As per its report to the Nation 2006, the NKC has identified several areas of intervention within agriculture, examining the traditional agricultural practices, held meeting in conjunction with the Indian Council of Agricultural Research (ICAR) focusing areas like post harvest infrastructure, organic farming, integrated pest management programs and energy management in agriculture. “In addition, the NKC has begun work on agriculture research and extension systems to enhance and expand mechanisms for the creation and dissemination of relevant social and scientific knowledge” [16].

The globalization has also offered immense opportunities for Indian farmers to export their agriculture products in world markets, concentrate on herbs and agricultural commodities that are in great demand in world markets, e. g. Indian mangoes, safed musli (Indian Viagra). “Regarding medicinal plants we have plenty of resources in the country... The government is making attempts in this direction. Upto Rs. 80,000 Crores can be earned from exports [of medicinal plants]. At present the government is giving upto Rs. 1 Crore to some of the farmers in Nalgonda and Mahabubnagar in A. P., to cultivate medicinal plants [for exports]” [17].

The globalization has brought greater awareness of opportunities and alternatives for farmers to enhance their incomes from farming. “By switching from subsistence farming to cash crop farming, Maharashtra’s small farmers have gained an additional \$200 - \$ 400 in income per year” [18]. The globalization is helping to bridge the technological gap and provide solutions to problems with the help of developed countries and international organizations. It is often quoted to indicate the technological gap that it requires three times the effort to produce a ton of rice in India than in the United States. “Now a major agricultural transformation developed with the help of USAID is sweeping across India’s northern rice and wheat growing belt and helping farmers save time as well as preserve precious natural resources. This method called zero-tillage utilizes a seed drill that can cut through seed residue. The seed is then dropped directly into the soil. Farmers no longer have to engage in expensive and time consuming ploughing. Nor do they have to resort to burning off harvest waste to decrease their time to next planting. This practice saves 75 percent on tractor fuel, obtains better yields and requires up to 30-50 percent less water. Farmers

save at least \$65 per hectare in production costs, which makes a big difference to their profit margins” [19]. Efforts are also being made by some Indian research institutes to solve small farmers’ problems in collaboration with international development agencies. “The Bio Energy Research Institute (BERI) and the International Development Enterprises (IDE), began to implement a new irrigation project to solve the plight of small landholders. The project proposed a novel model by which farmers organized themselves into groups of 3 to 8 members that formed itself into a Water Users Association (WUA). A bore well was allotted to each WUA on a cost-sharing basis. The cost of the bore well and water distribution line was born by the project while the investments in a Krishak Bandhu Drip System (KB Drip) and Water Tank, accounting to Rs. 7,000.00 was met by the farmers themselves” [20].

Progressive farmers from India are getting exposure to best possible available technologies and educated young-men working in International agriculture related companies are helping in diffusion of better agriculture technologies in their geographical areas. “Mohammad Mushtaq, a farm expert [earlier worked in a foreign company] has helped as many as 265 farmers to start greenhouse technology in Bilaspur, Hamirpur and Mandi regions of Himachal Pradesh. He has set up his own greenhouse in 30,000 square yards in Morni Hills in Sirmur district where from he expects to earn 5 lakhs a day in ten years time from now. About 10-15 farmers are consulting him everyday” [21]. This is how Mushtaq’s experience with a multinational company is helping in introduction of green house technology in the hilly state of Himachal Pradesh.

“Globalization in the context of agriculture can best be discussed in the context of three components – improvement of productive efficiency by ensuring the convergence of potential and realized outputs, increase in agricultural exports and value added activities using agricultural produce, and finally improved access to domestic and international markets that are either tightly regulated or overly protected” [22]. However country like India must venture into areas where better growth and enhanced productivity through amelioration of existing situation is possible and retain the status quo in areas where best practices are existing. According to Mckinsey Corporation, “American food giants recognize that Indian agro-business has lots of room to grow, especially in food processing. India processes a miniscule 1% of the food it grows compared with 70% for the US, Brazil and Philippines”. It is not that we Indians eat our food raw. Global consultants fail to see the 99% food processing is done by women at household level or by a small cottage industry” [23]. Globalization however is likely to have a profound influence on food processing cottage industries and big industrial houses are likely to venture in the area of food processing for greater profitability through exports of such products that are in demand in international markets e. g. mango pulp. “In a bid to boost the food processing industry, the government is considering a Rs, 1500 crores subsidy scheme for the development of mega food parks across the country. As per the proposal the food parks would be developed by a special purpose vehicle (SPV), jointly funded by the centre, state governments and the private sector. Each food park funded by the scheme will get a subsidy of Rs. 50 crores” [24].

Globalization is also influencing the marketing of fresh agriculture produce. India has a middle class that have purchasing power equivalent to the whole of the Europe. This component of population is determining the imperatives and dynamics

of new business environment in India. “Fresh produce retailing through supermarkets, with integrated supply chains back to the farm is growing rapidly in India. From close to zero in the recent past this market segment is expected to make up over a third of the market in the next several years! This is a stunning development and calls for radical changes in existing marketing relationships. This is significant because marketing is often neglected by farmers – especially small farmers – yet it is vital to their income.” [25]

To facilitate second Green revolution in India, a massive effort for training of farmers is required. Merely transfer of information to farmers is not sufficient by itself. Farmers themselves must be able to make choices what is best for them and thoroughly understand what to do and how to do it to enhance their agriculture productivity and improve their economic lot. World’s best available agriculture knowledge must be available to Indian farmers and they must be motivated to use it in their best interest. Necessary motivation to use the latest ideas in agricultural practices is possible only if it serves the farmers’ interests. Agricultural development and small farmers’ economic advancement must go hand in hand. It is not difficult to convince farmers for a good cause provided concerted efforts are made and information technologies are adequately used to show how to do the things and explain what are the possible benefits instead of merely transferring the know-how. Farmers should also make increasing efforts for learning new technologies and become information literate for surviving and thriving the knowledge intensive farming era. For constant access to latest agriculture knowledge someone from the farmer family must have access to the Internet facilities, knowledge of using the electronic information resources and be competent enough to make effective use of information technologies.

Information Technology Services and Initiatives for Small Farmers in India

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 Technology (IT) 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 Rs. 100.00 Crores” [26].

Efforts are being made at various levels to improve the information communication infrastructure in India. There is consistent growth of mobile telephony in India. Because of fierce price competition, mobile telephony is becoming one of the cheapest in the world and helping the rural India to get connected and facilitating people living in difficult hilly terrains and isolated humble hutments to get connected with the rest of the world. Mobile telephony is having a profound impact on rural India and improving communication among small farmers. “Recently the

Government's National Commission on Farmers has recommended the establishment of Rural Knowledge Centres 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 by the 60th anniversary of Independence Day [27].

The National Informatics Centre (NIC) runs NICNET, a government owned network for exchange of government information. 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 [28] in the Tenth Plan. One of the objectives of this project is to introduce and promote information and communication technologies (ICTs) that are cost effective and appropriate for use in rural areas. AGMARKNET (agmarknet.nic.in) is a portal for agricultural marketing information that uses NICNET for reporting daily prices and arrivals data of 300 plus commodities and 2000 varieties on daily basis. "As of 31st March 2005, 1347 Agriculture produce wholesale (APWMs) have been networked. 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 [29]. "An arrangement has been worked out with Indian Farmers Fertilizer Cooperative Limited (IFFCO) for regular transmission of prices and arrival data from Agmarknet to the touch screen multimedia kiosks being installed by them at the rural cooperative societies" [30]. Rural Bazaar Gateway is an e-commerce solution from the NIC that brings to the notice of world, the exotic products of rural India and thereby help to strengthen the rural poor. The NIC has also played a major role in the computerization of land records in India and has loaded thousands of pages of information pertaining to various ministries and government departments. It has developed e-Gram Panchayat Monitoring System and provided facility for loading audit reports of cooperative societies.

The Ministry of Agriculture, Government of India is strengthening and promoting agricultural informatics and communications. "One of the component of this program is AGRISNET which envisages to support e-governance and facilitate improved services to the farming community through the use of ICT. Under this project funding is available to states/ and union territories on the basis of project proposals submitted by them. During 2006-07, the Department has approved AGRISNET project proposals from the states of Uttarakhand, Meghalaya, Himachal Pradesh, Nagland, Sikkim, Orissa, Maharashtra, Mizoram and Punjab" [31].

A number of initiatives are taken by state governments to provide connectivity in rural areas e. g. Rajnidhi scheme and Janmitra scheme of Rajasthan and Lokmitra project of Himachal Pradesh. "On 18th November 2002, H. E. The President of India Dr. A P J Abdul Kalam, launched Akshaya... The project involves setting up of network of around 5000 e-kendras throughout the state of Kerala. Under this project at least one person in every family in Malappuram district has been made e-literate, making it a fully e-literate district in the state. Ultimately one person in every family in the whole state will be made e-literate. The project intends to provide unmatched access for the rural population to ICT services" [32].

The concept of 'village information shops' is being discussed, debated, and experimented at various places in India. Experiments include M S Swaminathan

Research Foundation (MSSRF), Chennai, “Information Villages” of MANAGE in Ranga Reddy District in A. P., Gyandoot.net initiative of District Administration Dhar, Madhya Pradesh, EID-Parry’s Wireless in Local Loop based Village Kiosks in Cuddalore District of Tamilnadu and “Warna Wired Villages” of NIC in Kolhapur-Sangli districts of Maharashtra... The experiences of Gyandoot indicate that the ‘Village Information Kiosk’ can be a self sustainable enterprise with a potential to provide jobs for two young rural people at each Kiosk [33].

India has a good institutional infrastructure. The agricultural universities and research institutes helped in ‘Green Revolution’, ‘White Revolution’ and ‘Blue Revolution’. Some institutions are also helping in developing technologies for ICT development in rural areas and improving national information infrastructure. “The Wireless in Local Loop (WLL) technology developed by IIT Chennai has helped in providing the Internet connectivity to 250 Community Kiosks that offer these services to over 700,000 people in rural India” [34]. To provide affordable computers in India, the Indian Institute of Science, Bangalore developed a low cost affordable personal computer namely Simputer. “HRD ministry’s idea to make laptops at \$10 is firmly taking shape with two designs already in and public sector undertaking semiconductor’s complex evincing interest to be a part of the project. So far the cost of one laptop after fabricating in labor charges, is coming to \$47 but the ministry feels the price will come down drastically considering the fact that this demand would be for one million laptops”[35]. Novatium, a Chennai based company has announced a plan of selling a PC at \$100. “Researchers at the Kanpur – Lucknow Lab of Media Labs Asia, based at IIT, Kanpur, have created “Infothela” – a mobile pedal – driven unit geared to bring the benefits of Internet, telephones and fax to villages where there is no land telephone and no electricity. The rickshaw – mounted PC is driven by a bank of batteries, which are charged by the dynamo action of the pedal. And to provide the Internet connection, the Media Lab Asia has created a 75 km. long corridor between Kanpur and Lucknow using the WI FI technology which was also unlicensed by the Government in recent months” [36].

Adoption and assimilation of ICT in rural India is not a problem when it is beneficial both for the local population and the agency responsible for introduction of ICT. The ITC Company has set up about 5300 e-choupals in 33,000 Indian villages. These e-choupals were initially operated by persons like village panchayat pradhans, village teachers and postmen, who acted as sanchalaks. Now a number of educated farmers also act as sanchalaks. “E-Choupals provide beneficial and useful information to farmers such as farming practices, weather reports and prices of agriculture crop products in various markets, and transfer other desired agriculture knowledge in local languages through expert panelists’ advice. The ITC also uses this network for its own business of procurement of produce and selling products to farmers. “The ITC is targeting to set up 20,000 e-choupals in one lakh villages by 2010” [37].

Human networking is still more important than computer networking and should be in place before computer networking. Hindustan Lever Limited (HLL) is another company that has penetrated rural India’s market through human networking. The company understands the psyche of rural Indian communities and rising women power in India and blended it with the company’s business strategies looking after both local communities’ interests and company’s objectives. It has launched project Shakthi in 2001 and engaged rural poor women (Shakthi Ammas) for company’s

operations in rural areas and thus creating more business for the company and at the same time generating more income for rural women. The company is likely to increase the number of 'Shakti Ammas' to 100,000 to have its reach to the whole of India. "In order to impact both livelihood opportunities and living standards of rural communities 'I – Shakti' – an IT based rural information service has been developed by the HLL to provide information services to meet rural needs in agriculture, education, vocational training, health and hygiene. The promise of the '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" [38].

Another major initiative in the corporate sector is Dairy Information System Kiosks (DISK) developed by Amul in Gujarat. DISK is a network of village milk societies. A few other corporate houses e. g. Tata Consultancy, EID Parry & Co. have contributed for capacity building plans and transferring information to farmers.

Knowledge Transfer to Indian Farmers

Though enormous initiatives have been taken and are being undertaken to develop rural infrastructure for transfer of knowledge to Indian farming communities, yet these are not adequate enough keeping in view the number of Indian farmers, complexity of their problems and impediments in successful implementation of plans that may ultimately ensure access to need based knowledge resources for every farmer. There are more than 60 billion people engaged in agriculture and infrastructure is not adequate enough to meet the knowledge requirements of such a huge number. "According to latest National Sample Survey Organization report, 60 percent of farmers in India have no access to agriculture technology. Disturbed by this report, the Union Agriculture Ministry is now considering a proposal to revamp ICAR... in a bid to bridge the gap between technology generation and technology dissemination" [39].

The agriculture sector is not able to make use of full potentialities of farmers because of illiteracy, economic disparities, gap between the information poor and information rich and digital divide. We are not able to make use of full potentialities of even our literate farming manpower because of lack of information literacy. The agriculture extension work is being revamped to make it more farmer related, information technology driven, integrated, accountable and employment oriented. The government has plan to set up Agri Clinics-agri- business centres that will be financed through banks and central government will meet 25 percent of the cost through subsidy. Agri-clinics are being offered to unemployed agricultural graduates. Thousands of unemployed agriculture graduates applied for the two month training and a number of institutions in various states have been involved in this training work.

The Indian Society of Agricultural Professionals aims to reach at least 1,00,000 agribusiness professionals and provide answers to questions such as – Can olives be grown in India? Or is there a market for grafts from Maharashtra in remote Assam? [40]. India is a welfare state. Wherever government is found insensitive to a problem or governmental help is delayed, NGO's usually swing into action. "Art of living programmes are making strides in bringing back life to suicide prone Vidarbha farmers. More than 1700 farmers have committed suicide in past one year. At a time when all seemed lost for the farmers in the area; 50 yuvachayas (youth leaders) of the

Art of living have conducted Samagra Arogya Shibirs, five day camps focusing on trauma relief and alternative farming methods in the suicide prone area of Vidarbha... In a span of 90 days over 1,25,000 people in 21 villages benefited from the programmes which prompted the government of Maharashtra to issue circular to Collectors of other affected – districts – Yavatmal, Akola, Buldana, Washim and Wardha to take up this project now called ‘Swavalamban’ [41].

This international NGO having its headquarters at Bangalore has not only helped the farmers in overcoming stress, shun alcohol, tobacco and gutkha but also resume their interest in farming through their Chetna Shibirs and Y-L-T-P courses for farmers. This NGO is also engaged in providing services such as creation of self help groups, construction of Gobar Gas plants, chemical free farming, Vermi compose, water conservation, and plantation of Lakshmi Taru (Simaroniba glanca DC). The oil extracted from the seeds of this plant is free from bad cholesterol. “Also a modern farm has been set up in five acres of land at ‘Gondkhari’ under the banner of Y-L-T-P to show the farmers that farming is still a profitable venture when the proper technology is known and implemented. With the combined technology of Bio-Dynamic, Wormy Culture and Agnihotra, tomatoes have been planted and a record production of over 20 tons of high quality tomatoes achieved from two acres of land” [42].

There is no dearth of agricultural knowledge and information and organizations that can render possible help. There is need for synergy and coordination of existing efforts for effective transfer of agriculture knowledge to farmers so that every farmer is able to do better farming and still better farming and their culminated farming practices help to increase growth rate in the agriculture sector. Farmers when exposed to new technologies, provided worthwhile training and imparted information literacy, learn with interest, sincerity and hard work. They then generally help fellow farmers. “For 42 year old, A V Narayanaswami, a coffee planter in Wayanad, it has been a labour of love to his vacation as a farmer and as a Keralite concerned about the woes of the state’s farm sector. His huge data collection currently runs into 1.5 lakh webpages in more than 300 modules. The database covers the state’s farm potential, new norms of production, packaging and marketing” [43].

Nallusamy Anandaraja, a farmer’s son begged the young scientist award for developing farmer friendly interactive multimedia compact disc and testing its effectiveness in transfer of farm technology. “He was influenced by a report that multimedia had an impact on people more than audio or video presentations, for it was interactive. He prepared a multimedia CD to educate farmers in three villages in Thondamuthur block in the Coimbatore district of Tamilnadu State on reasons for eryophyte mite reducing the yield of coconuts. His finding was that the knowledge of the pest and its management among farmers went up from below 2 percent to over 50 percent” [44]. Many illiterate farmers should be imparted knowledge of latest farming technologies by doing and through show how instead of merely transferring know how.

“As far as developing country like ours is concerned, the extent of usage of the Internet in the farm decision making is very less. Hardly 12 percent of farmers are applying this technology and majority of them are using traditional technologies like radio (77.3%) and newspaper (11.3%)” [45]. The agriculture extension departments

exist but they too lack computerized networks to constantly transfer ideas and information to farming communities. “The extension personnel of the Department of Agriculture disseminated the technological messages to the farmers manually. Through this approach information has not been able to reach majority of the farmers who are spread across the whole country. This gap remains a challenge for the extension system even to-day... Farmers’ needs are much more diversified and the knowledge required to address them is beyond the capacity of the grass root level extension functionaries” [46].

Along with the challenge of imparting literacy to a large number of people, India has the additional challenge of imparting information literacy to a sizeable number of people including small farmers. These competencies will help the farmers to even independently access information of their interest and profitably use it for better functioning and performance. As important is development of information facilities for farmers, equally important is work environment of farmers because propensity to make use of information resources and urge to learn largely depend on the work environment, encouragement, elation, outcomes of hard work and time spent in the occupations they are engaged.

It is not completely because of transfer of knowledge from Lab to Land that farmers are finding a way for doing something better, adopting and adapting agricultural technologies, they have been experimenting at their own level to improve crop varieties, animal breeds, irrigation methods and other farming practices. They have been sharing improved farm management practices and technologies with fellow farmers through informal communication systems and passing it on to their next generations. Even it has been seen that their religious beliefs, ethical systems and ethnology do influence their farming practices. Tulsi and Pipal are worshiped in Hinduism and Coconut is used in worship of gods. “Here is a mantra for controlling grain disease, “Om am ghan ghin ghun gha:” These words should be written with the red-lac-dye and should be tied to the crop. Thus there will be no danger from disease, insects, wild animals, etc... Krishi-Parashara (400-100 BC) gives a mantra for protection of crops and we find the same practice mentioned in the texts written between 1000 and 1600 A.D” [47].

The documentation and accessibility of indigenous knowledge is helping the farmers to adopt integrated farming practices and make appropriate choices for farming practices. For instance, “Centre for Indigenous knowledge for Agriculture and Rural Development (CIKARD) demonstrated that harvesting crabs from the bunds of rice fields, an indigenous production technique in a south Indian villages, contributed significantly to the protein intake of marginal farming households” [48]. Cross-disciplinary communication of information and integration of traditional knowledge with scientific knowledge is also contributing to improve farm practices. For instance, “Azollas an aquatic floating fern that lives in symbiotic association with a blue alga, *Anabaena azollae*. It fixes nitrogen from the atmosphere and has therefore been promoted as cheap alternative for certain chemical fertilizers in irrigated rice fields. Farmers introduce Azolla into the rice fields, let it expand in rice fields, and at the end of the cropping cycle work the Azolla cover into the soil. An added advantage of Azolla is that, it reduces weed growth” [49]. There are some regional practices followed for farming in various Indian states. For instance, “Adding basuti (*Adhatoda vasica*) leaves and twigs in flooded fields is a method to kill weeds in the Punjab. A

special implement used generally in southern India and called hodata in Thane, was used to press ground firmly against the young rice seedlings. Hodata is a mud roller with a broad bar of wood hollowed on the lower side in the direction of its length. This reduces excessive growth of rice plants and keeps the weeds down” [50].

Efforts are being also made to document information on some of the past good practices in agriculture and bring these to the notice of agriculture professionals. “The Asian Agri-History Foundation (AAHF), a non profit trust, was established and registered in 1994 in Secunderabad, India to facilitate dissemination of information on agricultural heritage in order to promote research on sustainable agriculture in South and South East Asian regions. One of the major objectives of AAHF is to disseminate information on ancient and medieval agriculture by translating old texts/manuscripts into English and publish these translations with commentaries on the scientific contents of the text. The aim of these commentaries of the experts is to stimulate research to validate old practices” [51]. The National Innovation Foundation (NIF), Ahmedabad has created a database of grass-root innovations and traditional knowledge and this database is very helpful for scientific validation of traditional knowledge practices and is publicizing innovations from various areas. The NIF founded by the Department of Science and Technology (DST) in March 2000, maintains the internationally acclaimed Honey Bee database and SRISTI.

Transfer of agriculture knowledge to small farmers is very challenging task as it involves timely transfer of most appropriate knowledge to various individuals working in diverse settings, remote locations and some of whom are illiterate and have different cultural, socio-economic levels and political affiliations. The current models of agricultural knowledge transfer in India are largely based on extension activities where knowledge is mainly transferred to farmers through person to person contacts, publications, radio and television discussions and exhibits of latest agriculture machinery and equipment, fertilizers and seeds at farmers’ fairs. The Department of Agriculture launched a scheme during (2005-06) that provides support to extension programs of various states for undertaking extension reforms. A registered society namely Agricultural Technology Management Agency (ATMA) will integrate activities of all related organizations, including NGO’s, KVKs, village panchyats and other stake holders at the district level “There are 27 states and two UTs that have already established ATMAs in 261 districts till January 2007 and over 11,000 master trainers have been trained in 27 states. Over 4,21,00,000 including 1.54 Crores farm women (36 per cent) have benefited through farmer oriented extension activities viz exposure visits, training, demonstration, kisan melas/goshties upto 31st December 2006.”[52]. States were asked to prepare state extension work plan (SEWP) focusing on public sector reforms, encouraging private sector initiatives and facilitating use of media and IT applications in extension work.

A central scheme involving mass media support to agriculture extension has also been launched. “The existing infrastructure of Doordarshan and All India Radio (AIR) is being utilized for production and telecast of 30 mintues agricultural programs five or six days a week. Programs are being produced by 36 narrow casting centers (high/low power transmitters), 18 regional kendras and DD’s national channel, as well as 96 FM stations of AIR. Farmer’s feedback is being collected regularly through the Audience Research Units (ARUs) of DD and AIR state/district level

monitoring committees are mandated to guide and monitor implementation of scheme at the respective levels” [53].

To play their role extensively and effectively, the extension workers require to continuously learn the technologies that are beneficial in their area of operation. They can play a still better role in transfer of knowledge to farming communities if they are continuously apprised of the latest agricultural developments. Continuing education and training of extension workers is thus another major challenge for agriculture extension activities. “A pilot initiative on capacity building through distance learning has been taken up in collaboration with the Indira Gandhi National Open University (IGNOU). It would provide information/knowledge to enrolled extension workers in both governmental and NGO sectors on value added products from fruits and vegetables” [54].

Another major challenge for putting agriculture knowledge to work in agricultural fields is farmers’ information literacy level, urge to learn and learning facilities available to them. Development of rural public libraries network can play an immense role in providing adequate learning environment, imparting information literacy to rural communities and even in transfer of agricultural technologies to farmers. To play an effective role in knowledge transfer public libraries are required to be modernized and networked. The NKC has recommended networking of public libraries in a phased manner in three phases. There are about 54000 public libraries in India and in the first phase 1,000 libraries will be networked as a pilot project by DELNET (Developing Library Network) and INFLIBNET (Information and Library Network), each covering 500 libraries in 12-18 months. Based on the experiences of phase I, up to 10,000 libraries will be covered in one year. The remaining libraries may be networked in the third and final phase in three years. The project should be completed by 2011” [55].

The reorganization of extension department to make them farmer driven and farmer accountable, modernization and networking of libraries to make them play more effective role in knowledge transfer and mass media support still provide only generalized but modernized knowledge transfer facilities. The new competitive situations in agriculture profession demand a model that provides real time access to pin pointed and prescriptive information for solving present and anticipated future problems. For instance the ground water level in Panjab is going down because of large scale cultivation of Paddy. “The Rs. 900 crore KBRL group has launched a campaign in 100 villages of Sangrur and bordering Patiala for cultivation of its PUSA1121 variety. The need of the hour is to diversify the paddy cultivation from PUSA44 as it required watering 10 times a month and matures only after five months. On the other hand, PUSA1121 requires watering only three times a month and matures in just 120 days” [56]. The new knowledge transfer models also demand to analyze individual situations and reach up to every farmer with prescriptive information after diagnosing personal level problems. “For instance, the semi-literate, daily wage earner Lalmuni Devi of Azadnagar village of Patna district, now figures in the list of top 25 Asian farmers following her adoption of mushroom farming under the guidance of ICAR. According to Lalmuni, turning point in her new profession came when a group of instructors from ICAR taught her the skills to grow mushroom. This method taught by ICAR instructors convinced her that it did not require much

land. She has inspired 22 other women of her village to take up mushroom cultivation” [57].

Farmers’ views

Do the facilities developed through lofty plans and enormous programs of developing knowledge infrastructure reach up to the needy farmers. About hundred farmers in the Ludhiana district of Panjab state and another hundred farmers in the Jammu district of the Jammu and Kashmir state were visited to know their views. In the Jammu region, 25 percent of the farmers surveyed were illiterate, 36 percent were primary school pass, 27 percent were matric pass, 7 percent were intermediate pass and two had graduation and three had above graduation qualifications. Sixty seven percent of farmers surveyed had up to five acres of land, 32 percent had land holdings between five to fifteen acres and one had above 15 acres of land. Sixty five percent of the farmers said their land is irrigated by the canal, 26 percent have access to canal water as well as tube well, 7 had tube well only and one irrigates the fields through well. Analysis of random survey of hundred farmers in the Ludhiana region reveals that they were better qualified, hold bigger farms and had access to irrigation facilities that are under their command and control. Ten percent of farmers randomly visited in the Ludhiana region were illiterate, 13 were primary school pass, 40 were matric pass, 21 had intermediate qualification, 15 were graduates and one had above graduation qualification. Among the farmers visited in the Ludhiana region, 17 had land upto 5 acres, 35 had a farm size from 5-10 acres and 48 had farm size of above 15 acres. Eighty nine percent of these farmers made use of tube wells for irrigation of their fields, ten percent use both tube well as well as canal water and one is dependent on canal water only. Twenty five percent of the farmers surveyed in the Jammu region had tractors where as 87 percent of the farmers in Ludhiana region had tractors. Both the regions mainly grow wheat, paddy and vegetables in their fields. Ludhiana have well established Panjab Agricultural University (PAU) and Jammu have an upcoming campus of Sher-e-Kashmir University of Agriculture Science and Technology (SKUAST).

Eighty seven percent of the farmers in the Jammu region reported that extension workers are not very cooperative. They visit only the farmers who matter and with whom they have contacts. About 47 percent of farmers mentioned that extension staff is not responding to farmers’ queries and problems. What to talk of knowledge dissemination, 86 percent farmers of this region informed that even agricultural inputs such as seeds, fertilizers, water for irrigation is not timely available. For instance 25 percent farmers mentioned shortage of irrigation facilities and 35 percent reported electricity problems. Forty six percent farmers reported that there are various formalities for approaching extension officers for seeds. One fourth of the farmers surveyed wanted that information regarding the new varieties of seeds should be timely disseminated. Farmers mentioned that help from the government agencies is not timely provided e.g. Lab testing of diseases takes a lot of time. About seventy three per cent of farmers of this region purchase fertilizers and seeds from private companies and traders. Ten percent of farmers demanded that information regarding cash crops and hybrid seeds should be promptly communicated to farmers. Farmers reported that there are no good public libraries in Jammu region and wherever some libraries exist, they are not holding books on latest methods in agriculture or other material that can be useful for farming households. No one among the farmers surveyed had an Internet connection at home, 39 farmers are not

using the Internet at all. The rest are using it in the nearby places. Some farmers conveyed their concerns regarding disparities in prices of agriculture produce and processed products. They pointed out that anyone can compare what rate the potatoes and potato chips sell, what rate the maize and corn flakes sell, what rate the cane sugar and sugar sells? Some extension workers were also contacted to know their views about lack desired level of performance of extension activities. Majority of them mentioned that a state-of-the-art infrastructure is not available for effective performance of extension activities.

Fifty five percent of the farmers in the Ludhiana region reported that extension staff is prompt and helpful. However, 35 percent farmers mentioned that extension staff is not cooperative, and 25 percent even opined that extension workers respond only to the rich and powerful and no help is available for honest and poor farmers. However, a farmer holding 32 acres of land mentioned extension workers never visited his farm nor ever conveyed any useful information. Forty three percent of farmers mentioned that they are ready to diversify but there is no organized market for the produce. Sixty percent of farmers of Ludhiana demanded updated information of market prices of agricultural produce. Several farmers mentioned that they receive very useful information by attending farmer fairs and exhibits organized by the PAU, Ludhiana. Farmers in the Ludhiana region also mentioned that there are no rural public libraries where they can have access to relevant information. There are some panchayat reading rooms that do not have reading material on agriculture. Two farmers reported that they are having their personal libraries. Seventeen farmers have the Internet connections at their homes, 76 do not use the Internet and the rest use it at other places. Some farmers in the Ludhiana region seem to be resourceful and innovative. For instance one of the farmer kept most of the agricultural implements for demo purpose and even made many alterations in them keeping in view the local conditions. Ten percent of the farmers even mentioned that government officials are corrupted and nothing good can be expected from them without the strings attached. Ten percent of the farmers opined that all the government promises with regard to agriculture are on paper only. Farmers voiced their concern regarding the increasing input cost of agriculture and allied activities. For instance a farmer discontinued fish farming due to costly seed, feed and electricity problems. A farmer who earlier stayed in Canada praised the speedy western information and knowledge support systems for farmers.

Conclusions

India has immense biodiversity and natural resources. There is no dearth of knowledge and farmers are hard-working. In spite of this, the small farmers' gains from agriculture are not commensurate to the efforts put in and agriculture cost inputs. This is going to affect the agricultural productivity and food security of the nation. The globalization has helped in the mobility of foreign flowers in India and Indian mangoes abroad. The developments in ICT too have facilitated just in time access to global agriculture knowledge. What is lacking is strategy and agility on the part of government machinery to put the existing infrastructure to best possible use, identify gaps and quickly attend to the problem areas. The private sector steps in where the public sector keeps thinking only. The success story of ITC's e-choupals in rural India indicates that a lot of potential for development exists in rural India. The development process will hasten if agricultural development and small farmers' development go hand in hand. There is a need to constantly build and improve rural infrastructure

such as improving irrigation, electric supply and building a type of public libraries that may act as local gateways to global knowledge. Such public libraries will not only provide access to desired knowledge but also keep the rural youth away from many social evils, help them to realize their true potentialities and keep them aware of opportunities that are existing for them. Rural development in India should be a mission accomplished through synergy of many ongoing efforts and coordination of various activities where speedy transfer of knowledge and information for various developmental activities should be an important component. There is an urgent need for imparting information literacy to farmers and build their capacities so that they can competently face new developments in agriculture. There is also need for cross disciplinary communication of information from related areas such as ethno-botany, biotechnology, environmental sciences for sustainable agriculture development so that agricultural productivity can be increased, and farmers' economic position improved without degradation of planet earth. Mahatma Gandhi said that earth provides enough to satisfy every man's need, but not every man's greed.

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