

Participatory Approaches for the Development and Use of Information and Communication Technologies (ICTs) for Rural Farmers

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Abstract

One of the prime ingredients for rural development in developing countries is information access. Although the Information and Communication Technology (ICT) revolution in these countries has gained momentum, most of the farming communities still have no access to value added information. The agricultural researcher and the farming community need to enhance their knowledge by increased 'farmer participation' in research. This paper makes a strong case for the use of participatory approaches involving farming community for development and adoption of ICT in the agricultural sector. It acknowledges that farmers are knowledgeable and encourages researchers to work with farmers and development workers for agricultural improvements. This paper discusses how digital ICT developed by means of participatory learning and action research can spur development and eradicate poverty by providing services to farmers in rural areas. It also highlights how participatory approaches can empower collective groups of farmers and help to put decision-making in the hands of the farmers. Although no single ICT will be satisfactory for farmers, the use of a wide range of ICTs in agriculture can improve the livelihood of the farmers in rural areas and help in their socio-economic growth. The paper focuses on various participatory approaches such as participatory communication and participatory learning for effective use of ICTs in agricultural domain. It highlights how participatory approaches can assist in 'participatory information and communication technology development' for rural farming community.

1. Introduction

ICTs are multi-faceted tools that can play a major role in agribusiness. They can deliver services to farmers, agricultural traders, agricultural researchers, and various non-governmental organizations (NGOs), only if the needs and aspirations of the farming community are

expressed through participatory methods to the scientists and researchers. The farming community's involvement in research would enable more communication and enhance the researchers' ability to interpret the farmers' needs.

The main objective of this paper is to find out how various participatory approaches can cater for effective use of ICT services in an agrarian economy. It also evaluates the need for information exchange between the farming community and the researcher and how it can cater for the development of ICT services relevant to them.

Participatory approaches can empower collective groups of people and put decision-making in the hands of the farming community. Participatory approaches here include different fields in which 'participation' with local farming community takes place, like 'farmer participatory research' (FPR) [1]; [29], 'participatory learning and action research' (PLAR) [13], 'participatory communication' (PC) [29], participatory information and communication technology development (PICTD) and 'participatory video' (PV) [30]. Various community based organizations like NGOs, community residents, and local farming community in rural areas will be the so called 'participants' of the research.

Farmer Participatory Research is a process where "the farmer acts as a subject who investigates, measures, and studies in collaboration with researchers" [1]. A typical PLAR session in the agricultural sector involves introduction of a subject by a facilitator, active discussion on the topic, field visits, report back sessions by mini-groups, evaluation and a wrap up summary session [13]. A mix of these approaches along with participatory video and participatory communication can be used to develop ICTs relevant for the agricultural sector.

The paper emphasizes the need for community involvement and use of a mix of participatory approaches for participatory information and communication technology development. The next section briefly gives an overview of research methods.

2. Research methods

The initial purpose of the study was to establish the need for rural farmer-researcher-developmental worker participation in developing ICTs for the agricultural sector. A literature survey was conducted from peer-reviewed articles by experts and various publications from the United Nations and the agricultural sector. This led to further investigation into the impact of participatory approaches on development of ICTs by various organizations and rural farmers. The synthesis of the literature survey also revealed a “farmer-back-to-farmer model” [33] used for farmer-researcher participation.

The farmer-back-to-farmer model “involves diagnosis to define problems; interdisciplinary team research to develop potential solutions; on-farm and experiment station testing and adaptation of proposed solutions to farmer's conditions; farmer evaluation and adaptation of the technology and monitoring of its adoption”[33]. The model explains the significance of farmer - researcher participation for development of technology in an agrarian economy.

Asian and African countries account for most of the world's rural farmers. Many South African and Indian organizations were consulted to find out how the farming communities participate in developing and using ICT services. Although all organizations that use farmer-researcher participation could not be interviewed, responses from a reasonable number of organizations were obtained.

Three organizations in South Africa and India that use any one of the participatory approaches for technology transfer were selected for investigation. The projects in India and South Africa used ICTs to enhance crop productivity, to make farmers aware of the latest farm machinery, to improve livelihood, and to increase bargaining power and social ties among farmers.

Due to wide geographical locations of the organizations and time constraints it was not possible to visit all the organizations. Telephonic interviews and discussions via e-mail in a period of 4-5 months provided digital agricultural information used by rural farmers and the extent of farmer-researcher participation in developing ICTs. Interviewees were briefed on the term participatory approach. Some of the probing questions sent by mail were:

- Do you use any participatory approach to know farmers' requirements?
- Was the technology developed with input from farmers?

The Indian organization that used participatory communication and participatory learning approaches is Indian Tobacco Company's e-choupal [17]. SEWA [18]

used participatory video, PLAR and participatory communication approaches. RWM [28] uses a participatory communication approach. Further observations and findings revealed these organizations use more than one participatory approach, but not all of them.

Most of the ICTs were developed for these organizations by farmer-research participation and mutual learning. The paper explores the significance of use of FPR, PLAR, participatory communication and participatory video and shows how all these approaches, when used together can cater for ‘participatory information and communication technology development’.

3. The potential impact of participation and use of ICTs in agricultural development

Agriculture remains the principal activity in most of the developing and least developed countries. The United Nations Food and Agriculture Organization report shows that in three regions of the developing world – including sub-Saharan Africa – about 84 percent of rural households participate in agricultural activities and in some countries the number reaches as high as 99 percent [2]. Most of the rural population is spread across hilly and forested terrain or in deserts. Food scarcity and illiteracy are the main areas of concerns for rural people especially in the least developed countries.

Rural development can take place only if people to people communication is improved. This paper discusses various ways of information extraction from farmers by means of participatory methods. ICT is important for global trade, rural community empowerment, encouraging competitiveness, participatory communication and eliminating inequalities between the information rich and the information poor. Although various challenges will be faced by researchers while using participatory approaches in agricultural research, this paper illustrates how they can overcome these to produce desirable results.

Although the use of ICTs in agriculture is not new many farmers in rural areas of Africa and Asia may take some time in using ICTs like internet and mobile phones. So providing easy to use information systems will convince computer illiterate farmers to make use of ICT in agricultural activities. The award winning agricultural websites were developed in consultation with farmers and later by participatory diagnosis for technology selection and development.

Disasters of many forms like theft of livestock, epidemics of plant and animal diseases, mass mortalities of livestock, famine and sickness (malaria, diarrheas and dengue fever) can be avoided by means of community

participation. Digital ICTs such as agricultural websites have become more interactive. Access to web-linked information particularly about the prices and quality of agricultural products, about various crops and livestock, soil, fertilization information and weather information would help farming communities across the globe to exchange ideas in an international market.

Farmer Participatory Research is a “practical process for bringing together the knowledge and research capacities of the local farming communities with that of the commercial and scientific institutions in an interactive way” [12]. In the agricultural sector there is a need for wider participation between the farming community and the researcher. Other than data collection it will help farmers to address farming issues and get more control over the research results and allows decision-making in the hands of farmers.

Lewin argued “understanding of a social system could best be achieved by first introducing change into it and then observing its effects” [22]. It is important to observe the changes or the effects of adoption of a particular ICT by the farming community. Unlike conventional research, farmer participatory research is a shared process which involves local community-researcher participation and allows mutual learning and empowerment. Pretty argued that “the central concept of sustainable agriculture is that it must enshrine new ways of learning about the world” and that “such learning should not be confused with teaching” [24]; [25].

Processing of staple foods, carrying water, plough back, weeding, transplanting and seed breeding are areas where very few researchers have spent time to improve the technology used for such activities. It is possible to enhance the technological development in these fields by participatory learning and action research. Farmer involvement in research is crucial for PLAR. It is crucial for researchers and scientists to extract relevant geographical and indigenous data from the farming community, pertaining to the particular area under study for effective PLAR and for technological development.

Mass communication by means of publications, a play by local theatre, leaflets, mobile cinema-vans and community radio were the older modes of communication for propagation of information in a rural community. Community radio played a major role in giving farmers information, on various methods of farming, change in weather patterns, cures for various crop diseases etc. The farmers were involved in producing voiced programs on current and local issues that affect them daily.

Participatory communication programs involving farmers should include group activities, speeches, community-based broadcasting, internet kiosks, agricultural portal and various techniques that trigger people’s participation. Any means of transfer of information (or communication) to the rural people needs

‘community level participation’. Participatory learning is the understanding of participants’ needs by posing questions to them and finding solutions to their problems by working in partnership.

Although broadcasting technology was used in the past, farmers have started using digital video cameras and still photographs to reflect issues on crops, incidents of oppression and any external resistance affecting their communities. Gyandoot [15]; [16] and Indian Tobacco Company (ITC)’s e-Choupal[17], discussed in this paper illustrate how the community-based web portal has helped in participatory learning. These two organizations used participatory communication and participatory learning approaches to develop or improve their web portals. The Self Employed Women’s Association (SEWA) [18] on the other hand encourages participation by women through participatory video.

Participatory learning will help researchers and technology developers to produce web-sites that provide ‘farm-walks’ and the video-footage on best farming practices. It motivates farmers to be inquisitive and pose the researcher with questions on the latest trends in using pesticides and about modern crops that would sell in the market. Thus PLAR will serve a two way communication and learning process.

Based on the information accessed by farmers using ICT developed by various organizations the authors have developed Table 1 (Annex A) which gives the sample information accessed by rural farmers, the modes of communication used and the technology required to access it.

It is best to keep monitoring the plant growth because seasons rule the rhythms of daily rural life. Some rural areas in Asia have started using web-camera to monitor plant growth and collect crop images. Sugawara developed a mobile-phone-based farm-working journal to collect field data [7]. All these were possible to scientists, by the “farmer knows the best” approach – by allowing farming community to get involved in research.

The United States Agency for International Development (USAID) provides funds for the use of ICT in agriculture for Africa’s development. USAID has already established a portfolio of ICT investments for long term natural resource planning in support of “location based” information services such as remote sensing, Geographic Information Systems (GIS), Global Positioning Systems, Internet mapping, and others [8]. Technologies such as Digital Personal Assistants (PDAs) have helped farmers to collect farming data more effectively. These were the outcome of participatory technical development.

Niger, one of the poorest countries in the world uses Rural Radio Network (RURANET) to provide access to information on social and economic development. *Djilali Benamrane* explains how RURANET’s independent

solar-powered local radio stations in Niger are becoming community-based rural information centers [9]. These non-digital ICTs like the local radio stations in Africa broadcast the latest information on crops, weather, market requirements, soil requirements, new farming methods, news chemicals used etc.

Both FPR and PLAR when used in the agricultural sector focus on empowering marginalized groups of farmers rather than individuals. It involves the art of story telling and helping farming community to get involved in group discussions. Educating farmers, listening and learning from farmers, providing simulation games to improve learning process and social relations have all helped researchers to improve participation with the rural people. Some of the games which have stimulated farmers are the Green Revolution Game [3]; [4], the Peasant Farming Game [5] and Ganeshpur [6].

4. How do participatory approaches help in the development of ICTs that benefit a rural farming community?

The different participatory approaches will benefit the rural farmers and researchers for mutual learning. In turn they cater for participatory technology development and research. Table 2 shows the different participatory approaches and their use in agricultural information and communication technology development. Sections 4.1 to 4.6 explain the table further.

The people who participate in developing ICTs and the use of ICTs developed in consultation with the farming communities is the same irrespective of the participatory approach used. How, when and where we ensure participation varies depending on the approach used. Our literature survey has revealed participatory video is one of the approaches used by women farmers to empower themselves and give a feedback to the developmental workers.

4.1. PLAR and participatory communication using innovative ICT training methods

SEWA [18], founded in 1972 in Gujarat (India), is an organization for poor self-employed women workers. The goal of SEWA is every family gets full employment. Almost 70% of its members are illiterate. Its other objectives include capacity building, collaborating with government rural programs, increasing the bargaining power of women, making women self-reliant and providing food and social security.

Training rural farmers to use digital ICTs might require innovative ideas. Training caters for participatory communication and mutual learning for the farmers and the trainers. It is worth following SEWA's innovative

training for women (mostly vegetable vendors) using the video-cameras for policy making and learning. "Participatory communication approaches require innovative and interactive training processes" and "women learn more effectively through field experience and practice" [19].

These innovative training skills allow participatory learning and action research. Even simulation games using local seeds or piles of stones may be used to initiate discussion and provide training for farmers. Due to cultural norms, often rural women would prefer a specific 'women-only' time allotted for them for video equipment or any ICT training. Another innovative training method will be to provide training to farmers by means of the local language.

SEWA Academy's trainers provide income-generating training on salt farming, crafts and dairy farming. It also facilitates Advanced Leadership (Kadam) Training and research training and healthcare training. "Participatory learning approach based on the tenets of action research, experiential learning and critical learning systems is an appropriate and legitimate way of improving farming and agricultural development work" [26];[36]. More than being recipients of technology, the rural farmers get a chance to experiment and evaluate the ICTs developed for them through the PLAR approach.

4.2. The farming community's involvement in farmer participatory research

The farming community's participation is crucial to ensure participatory approaches benefit the rural community. Farmer participatory research caters for community involvement and rural development. The increased farmer-researcher participation leads to empowerment of farmers by allowing them to make decisions.

According to Vogt and Murrell "the empowerment of communities is based on the process of creating power with others, rather than on self-empowerment"[27]. The intensity of farmer participation in research is relevant for farmer participatory research. Engel presents a (general) typology of participation in extension which attempts to qualify levels of intensity of farmer participation as [10]; [11]:

- "participation in extension meetings or activities"
- "participatory diagnoses" (e.g., participatory rural appraisal [34], problem-census, etc.)
- "participation through organization"

Often the farmer participatory researcher tends to collaborate with the 'leaders' of the community. Depending on the group of people consulted for research the intention and interpretations of research would vary. There should be commitment from the participants to get

involved in research for any change to happen by the adoption of ICT.

According to Locke “action research is generally conceived as a cyclical and multi-phased inquiry process” [23] distinguished by two commitments. The two commitments involve “a commitment to learning by attempting to bring about some form of organizational transformation and a commitment to involving in the research and change process those organizational members likely to be affected” [23].

4.3. Participatory communication (PC) through community radio, internet, e-mail, and telephony

Oral communication is certainly the best way to encourage farmer participation. This can be done using group discussions, story telling, talk shows, games or quizzes on agricultural information through community radio. A ‘token of appreciation’ for those who win quizzes, would encourage more farmers to get involved in group discussions.

One of the leading private companies in India, ITC, has initiated an e-Choupal [17] movement that has helped around 40,000 rural farming villages get connected to the national and international markets. This unique ‘click-and-mortar’ initiative, offers the Indian farmers all the information, products and services they need to enhance farm productivity, improve farm-gate price realization and cut transaction costs in marketing farm produce.

ITC’s e-Choupal digital revolution has benefited 3.5 million farmers and has won a World Business Award on 19th May 2004 and a Development Gateway award in



Fig.1. Farmers gather at the Choupal to access latest information available on the information portal and the sanchalak playing the role of facilitator.

Source: ITC – International Business Division, India

2005. This initiative helps to alleviate rural isolation, create more transparency for farmers, improve price realization for farm produce, provide information on global weather and best farming practices and improve productivity and income. The e-Choupal is a communication channel for services.

ITC maintains its own IT network in rural India and trains local farmers to manage each e-Choupal. They also have opinion polls to gauge the requirement of a farmer and this helps them incorporate any suggestions coming in from Sanchalaks or farmers.

Through this initiative a farmer can access Internet from his home computer via a V-Sat connectivity. The prominent host farmer (choupal sanchalak- a lead farmer) is obligated to serve the community and acts as interface between farmer and computer, but gets a commission for all e-Choupal transactions.

Farmers use e-Choupal [17] to order seed, fertilizer and other products from ITC or its partners at prices lower than those available from village traders. The crops are electronically assessed for quality at an ITC processing center. At harvest time ITC buys the crop directly and the farmer is paid for the crop and a transport fee. Fig. 1 explains how farmers access latest local and global information on weather, scientific farming practices as well as market prices at the village itself through the web portal – in their respective local languages.

Farmers who sell through ITC receive a higher price (2.5% more) than what they receive through mandi system, faster processing time, accurate price knowledge and market trends for the season. Although initial products bought by ITC’s International Business Division included soya only, ITC has decided to supply and buy other products like shrimp, wheat, pulses etc., and expand on additional crops like onions and potato.

Its agenda for the next decade is to empower 10 million farmers in 100,000 villages in 15 states in India. ITC’s unique Internet-based e-Choupal project has helped farmers across eight States to gain know-how on best-farming practices and get real-time market information. The content on the site is specific to the region.

For example, a farmer in Maharashtra will get information in Marathi that is relevant to his farming requirements. There is a Question and Answer section wherein a farmer can raise a query, write a mail to webmaster and in turn get reply from Agricultural Scientist in 4-6 days flat.

The farmers are also encouraged to talk about the new farming methods, market value for their agricultural products, change in weather pattern etc. through community radio.

Choupal Radio [17] an online streaming audio radio programs, primarily is about topical timely advice from Agricultural Scientists (updated every week). It also takes

account of feedback in shaping the future programs. A

village-run broadcasting center which uses local language to communicate will be the best to encourage farmers to speak out more openly.

TABLE 2
A COMPARISON OF DIFFERENT PARTICIPATORY
APPROACHES USED FOR DEVELOPMENT OF ICTs IN
AGRICULTURAL SECTOR.

participatory approaches	who all participate and why?	when, where and how do we ensure participation?	use of the participatory approach in agricultural sector
farmer participatory research [1][29]	developmental workers, NGOs, farming community and researchers	ensure “collaborative farmer-researcher participatory research”[28]. encourages farmers to become researchers by conducting research on farm fields.	encourage farmer developmental worker researcher participation. increased productivity through use of technology. capacity building for empowerment through ICTs. mutual learning and transfer of knowledge through ICTs. allows to observe the changes in productivity on introducing technology
participatory learning and action research [13]	participate and allows decision-making partly by farmers. consultations are often made with the leaders of the farming community before making final decisions.	ensure participation through on-farm experiments, field visits and discussions. farmers are encouraged to evaluate and make observations for further action.	
participatory communication [29]		oral communication through community based broadcasting centers, group discussions, story telling . a ‘token of appreciation’ can motivate more participants. electronic communication via e-mail, digital story telling, e-discussions. exhibitions to showcase and communicate with other farmers and developmental workers	ensures expression of agricultural needs in local languages. increases social ties via electronic and oral communication.

Community radio encourages discussions and hence community participation. It allows direct expression of cultural and agricultural needs in local languages. One of the advantages is radio can work using batteries even in places with no electricity.

SEWA has also recognized the need for participatory communication amongst groups of self employed women on issues like health, legal, existing government and non-government programs and policies. The Rural Women's Movement[28] (RWM) is an independent non-profit making organization made up of poor landless rural women (40,000 of them) whose communities were forcibly evicted from their ancestral land by the apartheid system in South Africa.

The reasons for starting this project were the following. Women in South Africa were not recognized as independent tenants after the death of the spouse who was a farmer and they were not consulted in any decision making. Women had unequal succession rights to land and most often a male relative should accompany them to allocate the land. Culture and family were the primary obstacles for the establishment of human rights.

RWM takes care of the legal issues, community partnership issues and land inheritance issues of rural women. RWM actively participated in the consultation process of Draft Communal Land Rights Bill.

RWM later partnered with Fahamu [35] to implement a pilot project - UmNyango Project. This project helps rural women to report violation of their human rights (even domestic violence) by using mobile phones. Women will also produce their own radio programs and pod casts in future. Clickatell SA has donated free SMS credits for these projects so that relevant information may be transmitted to rural women.

RWM has provided the means of income generation by means of SMS technology to Kwazulu Natal Women. RWM provides information (via mobile phones) on where to access agricultural support and whom to contact. It sends information on indigenous crops and other crops for vegetable gardens and ways to plant them via SMS. Women sell their crops to other community members.

It has partnered with MTN [32], South Africa to provide computer and internet training to grass roots women. Some of the Community Media Centers that provide these facilities have internet access. Women also consult via e-mail on agricultural queries.

4.4. Improving PLAR process through information kiosks

PLAR in agricultural field can be improved by means of community-based information kiosks which provides

access to both agricultural and health information. These

TABLE 2 (CONTINUED)
A COMPARISON OF DIFFERENT PARTICIPATORY APPROACHES USED FOR DEVELOPMENT OF ICTs IN AGRICULTURAL SECTOR.

participatory approaches	who all participate and why?	when, where and how do we ensure participation ?	use of the participatory approach in agricultural sector
participatory information and communication technology development	developmental workers, scientists and researchers consult farmers while developing agricultural ICTs.	ensure participation when developing ICTs through organization. ensure adequate training is provided to use ICTs. women only working sessions may motivate more women to use ICTs. use innovative ideas specific to the community to develop their ICT skills and adapt to new technology.	allows researchers to observe how farmers empower themselves by using ICTs. mobile phones and e-mails creates community bonding and caters for mutual learning. farmers get to test the ICTs before they adapt to technology
participatory video[30]	developmental workers, men and women farmers and researchers	ensure farmer participation in audio visual center. ensure training via the use video cameras and other audio visual equipments. ensures women farmers' participation by taking videos relevant for women farmers. helps to build confidence in using ICT	feedback instrument which reflects participants feelings. ensures expression of agricultural needs in local languages.

information kiosks can provide a meeting place for the

farming community and cater for group discussions and digital story-telling about farming issues.

In the case of e-Choupal host the farmer motivates other farmers to use the information kiosks and digital ICTs. The e-choupal's 'choupal sanchalak' (host farmer) provides the farming community to use the internet kiosk and in return he gets a commission for all transactions in that website.

The people who benefited from the use of e-Choupal were not only the farmers but the government departments, civil advocacy groups, farmer organizations researchers and private sector. The partners and participants built their local farming knowledge by means of mutual learning.

The location and use of internet kiosks were marketed using community radio, or via community members using the kiosk. Surfing the net on agricultural information provides farmers a learning medium, with visualized pest control techniques and information on 'farm walks', farming style, crop diseases, banned pesticides etc.

PLAR has helped farmers and researchers to participate in the learning process and create databases and web portals relevant to agricultural sector. With the help of farmers' indigenous knowledge researchers were able to study more on local pest outbreaks, soil fertility management, Nitrogen fixation for crops, local land ownership, rainfall pattern etc.

4.5. Encouraging women's participation through participatory video

Women play a major role in food production for consumption in developing countries. Olawoye suggested that "due to the important roles that women farmers play in supply of labor for production processing and distribution of food crops, they must have greater access to those resources necessary for agricultural production" [20].

Women living in rural areas are often reluctant to participate in group discussions and community gatherings due to cultural norms. Often women are skeptical in terms of the energy spent on using ICTs and think there are no direct benefits to using it. Participatory video was one of the innovative ways discussed here to encourage women's participation in agricultural research.

The rural women might forget the presence of the video after a few minutes in front of the video camera and will talk about their needs. Participatory video can be used as a feedback instrument to collect data on a true reflection of participants' feelings on a particular scenario or project. Video is interactive and it enhances the dialogue process with agricultural researchers and authorities. "Participatory Video enhances research and development activity by handing over control to the target

communities from project conception through to implementation, monitoring and evaluation" [30].

Women tend to keep away from male-dominated meetings in rural areas. Video enables women to share their views, build confidence and cater to preserve their knowledge and help to foster collective identity.

Another way to encourage women's participation might be 'training session for women only' hours in information kiosks or community centers. Women often tend to prefer the assistance of women trainers when it comes to ICT training. SEWA has its unique training of trainer sessions by women for women only. The literature survey has shown Video SEWA is one of the most cited examples for participatory video.

Head-loaders and vegetable vendors were given audio-visual equipment training to produce informative video programs on SEWA's existence and contribution to society. These video tapes which are tools for policy action and learning, have reached policy makers in Washington and Delhi and the slum dwellers in Gujarat. This illustrates video is not a sophisticated technology for rural women.

4.6. Sharing agricultural information online for participatory learning

Online dissemination of agricultural information would cater for participatory learning and improved production. Buckland expressed the opinion that information is regarded as a vital resource in the production process and becomes intuitively plausible in this age of global information and communication flow [21].

Gyandoot is a computer network that helps poor villagers in Dhar, India to communicate more effectively with public officials. The internet-intranet cybercafes (soochanalayas) can even provide farmers with 'caste and income certificate' and allow farmers to track crop prices. It helps them to negotiate crop prices with other farmers in the local and international market and to print out a copy of land records or the information on leased out land that they own.

Gyandoot and ITC's e-Choupal clearly illustrates farmers were motivated to use the network or the web portal for agricultural queries. Gyandoot in particular allows "participation in evaluation". Farmers are most welcome to lodge any complaints via the website in their local language. The farmers get involved in major decision making on land ownership and latest local wholesale price for crops.

Gyandoot and ITC's e-Choupal have illustrated how effective a web portal is for participatory communication. Agricultural information collected from local farmers should be shared online for participatory learning and action research. For example it is crucial for farmers to

share information on local pests, indigenous plants, volume of production of a local crop etc. for participatory learning and technical developments in agricultural fields. ITC's e-Choupal allows farmers to browse the net for various food safety norms for antibiotic usage, hygienic washing, sanitized dressing and air-tight packing and how to manage the risks of White spot virus.

Weather patterns should be made available by means of a weather database, so that farmers can learn more about recurring rainfall or drought in a particular season. Other means include providing updated weather forecast using mobile phones or web site. To develop region specific websites one needs a sound knowledge of local agricultural information. For example soil fertility, water

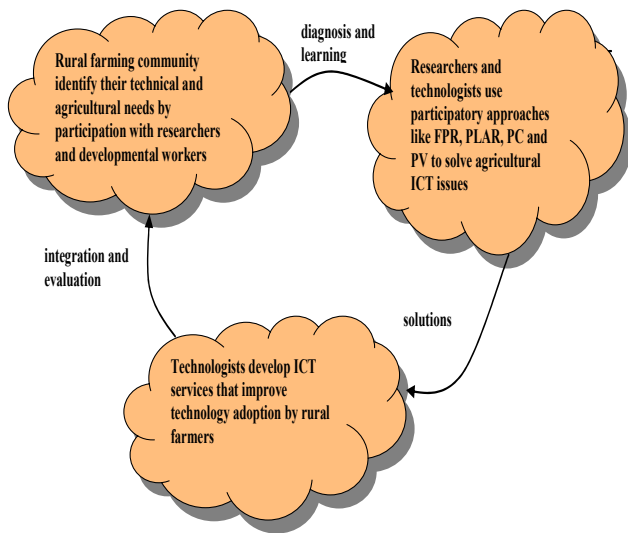


Fig. 2 PICTD using participatory approaches

availability and climatic changes vary from region to region even within a specific province.

5. Participatory Information and Communication Technology Development (PICTD) in the agricultural sector using participatory approaches

Community workers, practitioners and researchers need to share their ideas and innovations with each other for agricultural ICT development and adoption. Uphoff has identified four different ways of participation in most development projects [14]; [29]. They are:

- “Participation in implementation: People are actively encouraged and mobilized to take part in the actualization of projects” [14]; [29].
- “Participation in evaluation: Upon completion of a project, people are invited to critique the success or failure of it” [14]; [29].

- “Participation in benefit: People take part in enjoying the fruits of a project” [14]; [29]. An example can be a truck to transport crops they produced to local market.
- “Participation in decision-making: People initiate, discuss, conceptualize and plan activities they will all do as a community” [14]; [29]. An example can be farmers applying for land ownership or praying (cultural) for rainfall to end the drought in a particular season.

These four modes of participation and the different participatory approaches were used to develop Fig. 2. This figure illustrates a need for the development of ICTs for rural farmers by means of participatory approaches. The ‘participants’ in all the approaches used are rural farmers, researchers, technologists and developmental workers.

Different participatory approaches like FPR, PLAR, PV and PC are used to exchange information with participants and diagnose ICT needs of rural farmers. The use of one of the approaches alone is not ideal. This is due to the fact that participatory communication is possible through participatory video. Participatory communication enhances participatory learning and action research.

Researchers consult farmers to identify their basic technical needs. Farmer participation is relevant for wider adoption of ICTs developed for them. The participatory approaches allow decision making in the hands of farmers and allows them to participate in developing ICTs. Developmental workers, researchers and technologists use participatory approaches to diagnose and solve technical problems. This helps mutual learning and PICTD that improves wider adoption. These ICTs are integrated into the farming environment for evaluation by ‘participants’.

After the ICTs are integrated in the farming environment farmers are consulted directly, to evaluate the frequency of usage of the ICT, and to validate farmers’ experiences in technology adoption. These ICTs and any of the participatory approaches can act as a feedback mechanism for all participants.

The farmers may need incentives to motivate them to use any particular type of ICT developed for the agricultural sector. Participatory Rural Appraisal [34] will also motivate rural farmers to use any of the participatory approaches and improve the chance of adoption of technologies.

The wide range of farming machinery and other technology used for farming were developed by farmers themselves with their local knowledge. The scientists and researchers can provide a broad range of solutions to technical problems for the farmers to test and select. The farmers and development agents should work together to

test the technology and adapt it and integrate it on their farms.

The researchers need to diagnose their farming needs and find solutions by frequent field visits. PICTD would result in adoption of technologies developed only if there is a deeper understanding of technologies that would solve farmers' problems. Farmers tend to adapt to technology rather than adopt it for their use.

E-discussions (preferably in a local language) between researcher and farmer, as a part of the web portal are one way of identifying the technical problems and planning an activity. Field visits by researchers may help real participation and trust in the researchers or the scientists who are trying to find solutions for technology development. Once the solutions are suggested to farmers new technology should be demonstrated to them to encourage more discussion.

This will motivate and ensure wider farmer participation and finding a solution to their needs. E-discussions and e-forums would enable for PICTD and mutual learning. They also help farmers to share ideas on new methods of cultivation, new crops that can be planted in a particular region, new pest control techniques etc. Community needs will be dealt with by the major information and communication technology developments in the agricultural sector.

6. Conclusion

Researchers need to exploit the vast amount of untapped knowledge amongst the rural community. Rural peoples, depth of knowledge about climate, agriculture, mixed cropping (used in West and East Africa), indigenous plants, herbal medicine and farming practices have always been underestimated. This paper emphasizes the need for participatory learning and action research which encourages farmer-researcher-developmental worker participation for the socio-economic developments of the farming community. Participatory information and communication technology developments in the agricultural sector can be achieved only if agricultural researchers and government organizations 'learn from farmers' by using the participatory approaches discussed in this paper.

The importance of the use of ICTs in agriculture to the rural economy remains very high. This paper highlights participatory approaches that were used to develop digital ICTs that empowered rural farming communities. Although use of digital ICT in agriculture would take a long time to emerge in least developed countries, non-digital ICTs like radio and video are reaching the poorest of the poor. The exciting examples discussed in the paper have revealed how rural farmer-to-researcher communication about cropping style, market

requirements, farm products and weather patterns and soil conditions can improve the living conditions of farmers and enhance the knowledge of researchers and developmental workers.

There are certain drawbacks in using these approaches for the development of ICTs. The use of participatory communication and participatory video could result in conflict between the participants. It is important for the community leaders to get involved to resolve the conflicts. It is not known whether a particular participatory approach would benefit a particular farming community. The authors suggest the use of a mix of approaches to solve the ICT adoption issues. The extent of community involvement in PLAR needs to be investigated. Some of the benefits of using participatory approaches for PICTD include improved adoption of ICT, allowing experimentation of ICTs, and allowing researchers to get access to farmers' indigenous knowledge systems.

E-agriculture would certainly help to bridge the rural divide and alleviate poverty. Diversity of languages especially in the African continent and various Asian countries has been a barrier in sharing information over the net. If agricultural information needs to be published over the net, machine translation especially from English to local languages is essential, because the rural people would prefer to exchange ideas with researchers and with their counter-parts in their home language. This would enable effective participatory communication and learning.

Although literacy rates amongst rural people is a grave concern, access to information by means of other ICTs like radio, television, internet surfing and mobile phones is fast advancing. Women account for most of the food production in rural areas. So they should be involved in training other women and participating in decision making.

Women farmers should be consulted while developing any agricultural ICTs relevant for them. The need to make such consultations is one of the areas open to other researchers for more discussion and research. There are many innovative ways in which women used participatory video for empowerment. Specific working hours for women in information kiosks would allow them to get connected and provide a space for 'participatory learning' in spite of all cultural barriers.

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Annex A

TABLE 1

VARIOUS INFORMATION ACCESSED BY RURAL FARMERS, THEIR COMMUNICATION CHANNELS AND THE TECHNOLOGY NEEDED

Information accessed by farmers using ICT	Communication channels used to access all this information	Technology needed to access all this information
1.weather update 2.agricultural products' market prices 3.information on field visits or "farm walks", 4.cropping methods 5.nitrogen-fixation, 6.organic culture 7.pest control techniques 8.information on banned pesticides 9.information on soil and water conservation system for a particular region 10.toll-free numbers to assess community's farming problems or provide feedback 11.information on farmer training to use farming machinery 12. information on organizations that provide funding to farmers 13. information on ICT training schedule 14. information on farm animals and crop diseases 16. 'local crops for sale' information 17. information on land owned by farmers 19. information on seeds available 20. monitor plant growth	Internet, email, e-discussions, chat room, surfing the agricultural portals, community radio, teleconferencing, sms, mms, videos, pictures, telephone	computers with internet access, radio, community telecenters with audio visual equipment, mobile phones, digital personal assistants, video camera, still cameras, web-cameras, telephone connection