OPAALS PROJECT

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Del 11.4 – Research Paper on Policy Models for Developing Effective Structures of Communication and Collaboration on a Virtual Platform for Knowledge Sharing and Creation

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Short Description: A collection of papers on models for developing effective structures of communication and collaboration on a virtual platform for knowledge sharing and creation. The papers start from attempting to identify optimal collaboration structures for participating in an open knowledge space at the level of an individual participant and then widen the approach to looking at communities and social capital. Since this research is informed (and driven) by a open knowledge space that has been developed for the Indian agricultural domain called **agropedia**, a detailed chronological narrative of the process of **agropedia** development is also included.

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Partners contributed: None

Made available to: All

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Dependences:

Achievements*	Many of the answers to a large set of questions, including the formation evolution and stability of knowledge communities, nature of knowledge creation and verification processes, the nature of motivation for participation, role of trust, reputation and governance issues have been explored under the head of Policy Models. The answers combine theoretical findings with insights from an experimental knowledge platform, **agropedia**. The **agropedia** platform is an open knowledge space in the domain of Indian agriculture, with a great degree of realism, control and information gathering capabilities.
Work Packages	This deliverable will influence D11.9 in WP 11, as well as inform the development of WP12 in Phase III. Data collected from the experimental OKS is also being used by the EVESIM model by SUAS and is being statistically analysed by IPTI. The findings from this deliverable will inform the OKS work in the next phase (WP 10) and task 6.4
Partners	T6ECO, NUIM, CAM, UniKassel, LSE, SUAS, IPTI, TUT, WIT
Domains	Social Science Domain. The domains of knowledge management, economics and regional development have been covered by this report
Targets	Domain researchers, Policy makers, Knowledge Management Consultants
Publications*	Amritesh and Sarkar, R. (2009). "Conceptualizing 'Knowledge Organisms' for a sustainable Digital Knowledge Ecosystem". Proceedings on Third IEEE International Conference on Digital Ecosystem and Human Space Computing. Istanbul. Amritesh and Sarkar, R. (2008). "Identifying and Capturing Knowledge from Networked Knowledge Spaces: Theoretical Insights and Applications". Proceedings on Second International OPAALS Conference on Digital Ecosystem. Finland.
PhD Students*	Amritesh – Doctoral Student in Knowledge Management
Outstanding features*	This works bridges the application of ICT with that of community and social capital, which has been appreciated by the Economics Group at IIM Calcutta. It is among the few attempts to develop a roadmap and manual on how to use ICT within a community to harness and share tacit knowledge on a large scale in an unorganised knowledge environment. The documentation of how agropedia has evolved is another exemplary feature of the work.
Disciplinary domains of authors*	Runa Sarkar Economics, Sustainable Development Amritesh Industrial Engineer and Doctoral Student in Knowledge Management, Kasturi Sadhu Ghosh Economics Sugatha Chaturvedi Industrial Relations and Business Management

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1. INTRODUCTION

1.1 BACKGROUND

Knowledge is a critical resource, which when transformed into intellectual capital, manifested as human capital becomes a key driver of socio-economic transition. The knowledge economy is driven by processes through which knowledge flows across the social and business units where it disseminates in multiple forms through the entire system. The appropriate dissemination platform helps the individual and society learn and innovate at a much faster pace to cope with social and market needs. Adequate availability and easy accessibility to a large knowledge repository when complemented by the ability to learn and passion to create collectively give birth to innovation, which is necessary for survival and sustenance of any organisation and society in the market. Keeping knowledge at the centre stage, economic productivity and social wellbeing are now seen as a function of abilities to create and make effective use of knowledge.

In this context, there arise a large set of questions, including the formation evolution and stability of knowledge communities, nature of knowledge creation and verification processes, protection of property rights, the nature of motivation for participation, role of trust, reputation and governance. Many of the answers to these questions have been explored under the head of Policy Models, which combines theoretical findings from literature with insights from an experimenal knowledge platform, **agropedia**. The **agropedia** platform is an open knowledge space in the domain of Indian agriculture , with a great degree of realism, control and information gathering capabilities.

As OKS like platforms have introduced a highly unstructured model of computing, prescriptive models do not fit their exploration very well. It is individual agents rather than organisational entities that are the primary players. Highly dynamic and decentralised communities engaging in grassroots innovation lead to significant unpredictability in the system. Some aspects of such a digital knowledge ecosystem are striking enough to merit the rethinking of basic ideas such as organising production in Economics. The Wikipedia revolution is a case in point. It took only around 4 years (and non specialist contributors) to develop a knowledge repository that can claim to be in the same league as Encyclopaedia Britannica, which follows traditional means of knowledge production. Any model for knowledge co-creation will need to go beyond hosting social networks to focus on indentifying and fostering the underlying success factors. We have documented the process of **agropedia** development and mined the rich information available from the platform for insights on the process of knowledge co-creation.

Individuals are the smallest social units who are key players to participate in transfer and transformation of knowledge. The underlying process requires learning as the central activity to make the knowledge flow work and utilize its potential. Connectivity of individuals is a social dimension where ICT has its significant role to bring the individuals on a common platform and facilitate interaction among them to encourage knowledge sharing behaviour.

The conceptual framework of a Digital Ecosystem, adopted from the observational learning of natural sciences, has been applied to SMEs in Europe promote collective participation among the

local business units to foster regional co-operation through the common agenda of knowledge sharing. The idea is to create a self creating, self organising, self maintaining, self growing and self sustaining organisation of involved actors. A Digital Ecosystem is characterised by a networked set of entities connected together through ICT enabled virtual platform, mutually interacting and exchanging knowledge in a co-operative and collaborative self sustainable digital environment. ICT provides the fundamental backbone to create such environment and provide it the opportunity to unleash the potential of collective interaction among the networked intelligentsia, which drives the cross fertilisation of knowledge and further to continuous innovations and inventions.

Our approach has been to implement a digital ecosystem like development framework to the Indian agriculture domain, to create a digital knowledge ecosystem. An open knowledge space for agricultural specialists to interact, develop and share common practices and recent developments has been developed under the aegis of NAIP (National Agriculture Innovation Project). This is a Government of India initiative, financially supported by World Bank to revamp and rejuvenate Indian agriculture. The need to influence local agricultural practices with the help of widespread information and communication technology (ICT) intermediation has been recognised by NAIP, and appropriate use of ICT is a thrust area. Indian agriculture has been lacking such a powerful initiative and the stagnancy in interactive knowledge exchange and innovation is matched by the stagnant productivity indices. We believe that a knowledge sharing platform such as **agropedia,** could propel agriculture practices through connecting agriculture scientists, academicians, agro-business units and farmers, and make them a part of global agriculture community engaged in knowledge creation and sharing.

The structure of communication and design intricacy of such a digital environment are critical elements which need dedicated effort through which it can encourage the networked actors to proactively work together at an accelerated pace. Such an environment facilitates rather than controls the way knowledge actors communicate with each other, and influences their knowledge sharing intention and knowledge sharing behaviour. To start with, the incentive to participate in the OKS may be different for different actors. For example, few people may look at knowledge sharing activity on an open public forum (OKS) as their social pride and a matter of self-esteem. Others may not like to be visible in the open space, but would like to contribute to knowledge sharing with a hidden identity. Other (different) types of behaviour of knowledge actors could be as a result of regional cultural values and past beliefs. This compels the OKS designer to think of mechanisms which can provide an opportunity for each knowledge actor to express himself or herself in their desired way, which they are comfortable with, to participate in knowledge based activities.

Dealing with complex tasks in a collaborative environment requires shared understanding, shared values and a level of social cohesion, which do not simply emerge in a virtual setting. Social capital present in the form of pre-social disposition of historical social structures amalgamates two strikingly different objects: Beliefs and Behavioral rules, which guides the communitarian relationships among the actors (Dasgupta, 2005). Both theory and evidence caution us that communitarian relationships can involve allocations where some of the parties are worse off than they would have been if they had not been locked into relationships structured under an ‘equilibrium strategy’ of fair social practices (Dasgupta, 2005). The idea behind the ‘equilibrium strategy’ says that one member of a community is obliged to follow certain set of norms only in the case all other members are following it fairly. The nature of

interaction among the nodes of a system highly depends upon this strategic viewpoint. The structural design of a knowledge organization must consider the driving forces behind the mutual interaction between their knowledge centers (nodes). The nature of interactions also depends upon the direction and reciprocity of transactions taking place between them.

Social capital theory has a direct relationship to the community aspects of and motivation for participation in an OKS. The theory's dimensions of networks, trust, reciprocity, willingness to participate and social norms are directly relevant to the factors driving engagement in online communities and sustaining them as social systems. While there are different views on whether social capital resides in relationships or accrues to the individual participants, given that many users approach content publishing platforms as a forum for individual expression rather than for any social benefit (Parameswaran and Whinston, 2007), there is a lot of value in exploring social capital as a motivation for participation is an OKS. Viewed from the social capital angle, different approaches to the design of incentive mechanisms based on prevalent social norms can be developed, thus in effect, obtaining a social alternative to the engineering or economic tools for incentive mechanisms.

This deliverable on Policy Models for developing effective structures of communication and collaboration, attempts to identify optimal collaboration structures for participating in an open knowledge space at the level of an individual participant and then widen the approach to looking at communities and social capital. In addition to technology centric interventions, the development of an OKS, also involves several interventions from social scientists to ensure that optimal collaboration structures are in place in the OKS. Some key stages that such social science interventions must go through include (a) understanding the user needs (akin to developing system requirement specifications), (b) a clear awareness of current knowledge management and knowledge creation practices, and contextualising the practices for the target group, (c) analysis of formation of networks of actors, for knowledge sharing and dissemination, and (d) a feedback process to continuously modify the knowledge sharing process for optimal knowledge creation. Accordingly, our deliverable covers these sequential tasks. The initial task was to conduct exhaustive field visits to know the local needs and identify the inhibiting forces specific to information flow in the agriculture domain, assess the gap between demands of supply of information, and the lacking of the existing knowledge flow mechanisms to address the information needs (Chapter 2). This was followed by a comprehensive literature survey for getting theoretical insights of knowledge management practices in order to address the problems raised in the first phase of study. Chapters 3 and 4 summarise these lessons, with Chapter 3 providing a soft architectural design of the network typology, and chapter 4 describing the characteristics of a knowledge actor in a digital knowledge ecosystem. When a digital ecosystem or knowledge sharing platform is created for actors who are already part of a community, it is important that the links created as a result of the virtual networking infrastructure are in harmony with existing communal ties and relationships, so as to reinforce the existing social capital. The importance of enabling social capital with ICT interventions from an economic perspective and its role in development forms the subject matter of Chapter 5. The need for feedback and constant review when developing effective structures of communication and collaboration can never be overemphasized. Chapter 6 is a rich and interesting narrative of the process of development of **agropedia** till date. This deep and resonating discussion is of use to policy makers and practitioners alike to understand and appreciate the real life nuances of developing an open knowledge system. In what follows, a brief description of each chapter is provided. The Introductory chapter concludes with a listing of common themes that underlie all

six chapters and form the basis for developing effective structures of communication and collaboration

1.2 SYNOPSIS

This deliverable aims to throw light on collaborative and communication structures in open knowledge spaces through contextualising theoretical insights with experimental evidence from the development of an OKS in the Indian agricultural domain. To begin with, Chapter 2, entitled 'Information Need Analysis of Farmers, KVK[1] Scientists and Agriculture Traders' is a study report developed from detailed field investigations to develop a clear understanding of the actors in the proposed agricultural knowledge sharing platform. This multi-objective research was aimed at assessing the agriculture related needs of farmers, understanding the present sources of information and identifying existing (physical) networks in addition to identifying the needs of the KVK scientists and their willingness to contribute to the co-creation of knowledge and examining the effectiveness of the existing agricultural extension system[2]. It was found that farmers have a rich traditional knowledge base of their field experiences which is carried over through generations. At the same time they are lacking scientific knowledge of advanced farming techniques. It is seen that they own abundance of a particular type of knowledge (often called 'tacit' knowledge) which they can supply, and they need certain specific type of scientific knowledge which creates demand of knowledge in their community. Later it was also observed that although there are government mechanisms (e.g. KVKs) established to fulfil their information need, but due to inherent system's flaws, and lack of ICT integration in their information flow mechanism, there is a need for a different knowledge sharing mechanism.

Chapter 3, entitled 'Identifying and Capturing Knowledge from Networked Knowledge Spaces: Theoretical Insights and Applications', attempts to interpret knowledge management in a network context and observe the nature of transfer and transformation of knowledge while it is being transferred through the network. After mapping the potential knowledge spaces (which Nonaka & Konno, 1998 calls 'Ba') on the networked spaces of links ad nodes, it is easier to see the potential intensity of knowledge creation and innovation in the respective knowledge spaces. We have come up with a soft architectural design of the network typology which was broadly clustered into two separate knowledge communities according to their potential and requirements: These were 1)'content community', those who are responsible for creating the initial certified knowledge base for the knowledge seeker, and 2) 'target community' who are the seekers of certified content and also have the potential to share their ground experience with other communities for their mutual verification and updating of the collective knowledge base. We conceptualised a networked organisation among and within these two knowledge sharing clusters having loosely coupled boundaries, where actors are playing multiple roles e.g.,

[1] KVK is the acronym for *Krishi Vigyan Kendras*, which are farm level institutions set up by the Government of India to disseminate knowledge on agricultural practices to the farmers

[2] Agricultural extension is the application of scientific research and new knowledge to agricultural practices through farmer education through an Institutional mechanism administered by the Government of India

knowledge creation, assimilation, dissemination, maintaining their own organisation whose sustainability is supposed to be independent of entry or exit of actors.

We found that the nodes and links both are critical elements to the knowledge network. Knowledge nodes are the fundamental units of the knowledge network and can be in the form of an individual, group having collective identity or an Institution. The links are the other fundamental units of analysis of a knowledge network, and they can either exist in the form of embedded social relationships, or can be created by providing ICT enabled online connectivity. Both individuals and relationships (i.e. nodes and links) influence each other in order to maintain their mutual development and sustenance. This led us to analyse both these entities separately towards their inherent characteristics and potential outcomes on a digitally networked platform in Chapter 4.

Titled 'Conceptualising Knowledge Organisms for a Sustainable Digital Knowledge System', Chapter 4 is focused towards signifying the potential strengths of vital knowledge nodes in the form of Knowledge Organisms (KOs). Here the knowledge actors (as knowledge nodes) are seen to grow through a series of development phases where they wilfully increase their socialising and technological skill, rise in the capacity hierarchy to become a proactive participant of the Digital Knowledge Ecosystem (DKE) and are responsible for the 'self' actuating sustainability mechanism of the conceptualised DKE environment. The presence of a number of KOs can be used as an evaluation parameter to project the lifecycle of any knowledge network functioning as a DKE.

The second paradigm to analyse the collaborative and communication structures in open knowledge spaces is the knowledge network and its linkages. These links are supposed to already exist in the form of mutual relationships within a community, termed as social capital. From previous research, it is evident that 'social capital' when provided with appropriate ICT enabled virtual networking infrastructure having purposeful strategic orientation, strengthen virtual network links and create new ones resulting in the addition of more knowledge actors into the network. Chapter 5 addresses the importance of social capital from an economic perspective and its role in the development of agriculture. It presents a theoretical framework of transformation of Communities of Practice into a Digital Knowledge Communities resulting and issues related with the ICT intervention in the Indian Agriculture in the context of developing a digital ecosystem. The cases discussed in this paper include the impact analysis of a previous initiative DEAL (Digital Ecosystem for Agriculture Livelihood) which shows the improving social relationships in the community network after ICT intervention. The other case discussed in this paper is of **agropedia**, a pioneering initiative to create an open knowledge space which can play multiple roles for development of knowledge based services in the agriculture domain. It has presented **agropedia** as a semantic knowledge repository, a 'platform for networking and interaction of agricultural communities', for knowledge creation and innovation, and as an initiative for regional development. The paper describes the transformational phases of the past few agriculture initiatives e.g. Digital Mandi and DEAL launched by IIT Kanpur and its strategic evolution towards the inception of **agropedia**, demonstrating how the feedback from one initiative can lead to defining a more appropriate collaborative structure for knowledge creation.

Finally, chapter 6 is the documentation of the "making of **agropedia**", an open access knowledge based digital platform to serve the needs of the agriculture community, which illustrates how the initiative was formulated and how the platform evolved over time including technology choices that were made. **agropedia** is a noble initiative for collaborative knowledge creation and sharing on an ICT based virtual platform for any entity related to the agriculture

domain. It has been developed through a series of technological development phases, from alpha version to beta version, with many features added at different times to promote separate spaces for online interaction among different knowledge sharing entities. **agropedia** is still in its intermediate phase of development and yet to launch its social networking application, a pioneering service in the Indian Agriculture Domain equally accessible to all the individuals and organisations belonging to the global agriculture community. The entire development process is documented in Chapter 6. The socialising efforts, or promotional drives to create awareness among the agriculture community all across India and train them to use the technological tools provided by agropedia so that users can participate in content creation and use has been chronologically documented. These training and workshop campaigns always had a feedback component to collect data about users' difficulties while communicating with agropedia, and recorded their additional requirements. Even small incremental developments in the open knowledge space are lucidly recorded and documented in this chapter

1.3 UNDERLYING THEMES

The entire work presented in this deliverable can be summarised into the following threads of enquiry and thought which have been interwoven through chapters two through six to develop a coherent understanding of the types of communication networks and community structures which will facilitate a mutually reciprocative and open-ended process of knowledge creation and exchange.

i. Conceptualising an online networked knowledge community where individuals are encouraged to participate and become driving members of that community. This would involve creating a virtual community structure that is neither too organic and informal nor too rigid and hierarchical. By developing a structure that connects localized knowledge clusters with each other we can build on knowledge flows and knowledge spillovers between them. Motivational aspects that encourage individual actors to enter the digital knowledge network need to be clearly understood and inorporated in the design of the open knowledge system.

ii. Taking Indian agriculture scenario, and **agropedia** as the context of research, so as to test theoretical insights in a living laboratory, in a sector that has enormous potential for regional development, and yet poses critical barriers such as lack of infrastructure and capacity (illiteracy). The purpose is to overcome the barriers and failures of traditional information system mechanisms and develop a digital knowledge ecosystem infrastructure for actors who are empowered to participate in the open knowledge space.

iii. Make an online open knowledge space (OKS) for agriculture knowledge where anyone from any part of the world can access the online knowledge repository, can create and contribute knowledge, or take and use the available knowledge without any restriction. The knowledge created and shared on the OKS should be relevant globally, and yet, it should be possible to get detailed, region specific pertinent information for the remotest corner of India as well. As food security itself is becoming a critical concern in the context of climate change, it is important to create open spaces for thought leaders to communicate and find solutions for agriculture

iv. Encourage the community members to participate and interact with the OKS created. This involves understanding and putting into practice the process of collective learning and the creation and sharing of knowledge among actors who interact with each other on the basis of commonalities of interest using a digital ecosystem-like ICT platform. To create novel and useful knowledge nuggets often requires divergent viewpoints and even some degrees of conflict between agents. A multi-scalar geography – a combination of horizontal and vertical networks, could overcome the shortcomings in local knowledge by converting each local (spatial) cluster into a node in a global network. Local interaction coupled with interaction through networks with other nodes would result in a dynamic process of knowledge creation.

v. Innovate in the process of communication and make it more appealing. Thus, there is a need to use all available means of technology enabled audio visual tools for interaction, so as to give the user an experience that is as close to face to face communication as possible. At the same time, the tools must be simple enough to use so that network actors are not deterred from participating in the OKS because they do not know how to. At the same time, all communication processes must have an element of trust embedded in them.

vi. Tap the potential of social capital in the knowledge network. It is clear, both from literature and our limited experience with developing digital knowledge ecosystems, that bonding between actors as a result of social ties and established relationships can go a long way in the formation of both strong links and weak links in a digital ecosystem. Weak links are formed through referrals and extension of trust among actors, while mutual reciprocity enhances strong links. A digital knowledge network must align itself with and leverage the existing social capital if it wants to be sustainable in the long run.

vii. Address the development need through ICT intervention. Understanding user needs and providing relevant, pertinent and specific information is critical for a digital knowledge database to transform itself into an ecosystem. The push-pull boundary of perceived knowledge needs versus actual knowledge requirements must be treaded on carefully, so that the ICT intervention is not viewed as “their system” in contrast to “our system”. The need for semantic capabilities of the **agropedia** OKS, coupled with very granular information, created by practitioners stems from this theme.

viii. Finally, the objective of our endeavour is the creation of a self fulfilled and self sustaining agriculture community, which is empowered and able to find real time solutions for its problems. To this end, it is important to ensure that accepted international standards such as agrovoc are painstakingly followed, and to encourage and enable multilingual capabilities in the agropedia OKS. Other barriers in the knowledge supply chain, such as issues related to hierarchy, infrastructural inadequacies, insufficient human capability to participate etc have to be consciously addressed and removed to the extent possible, to ensure free unhindered flow of knowledge so as to stimulate collective creativity.

2. INFORMATION NEED ANALYSIS OF FARMERS, KVK SCIENTISTS AND AGRICULTURE TRADERS

2.1 OBJECTIVES

The objectives of this study are:

to assess the agriculture related needs of farmers

to understand the present sources of information and identify networks

to identify the needs of the KVK scientists and their willingness to contribute to the co-creation of knowledge

to examine how effectively KVKs are able to cater to the needs of the agriculturists and identify the gaps

2.2 METHODOLOGY

The study was carried out in the hinterland of two KVKs - Dileep Nagar, Kanpur and Fatehpur. The KVK at Dileep Nagar caters to two districts of Uttar Pradesh, namely Kanpur Nagar and Kanpur Dehat. The KVK Fatehpur serves district Fatehpur only.

A total of 14 villages were selected from the hinterland of the two KVKs. Location of the survey village is given in Appendix I. Out of these, 7 villages were those where KVKs had already performed some extension/training activities, and rest of the 7 villages were those that have not been selected by KVK in recent years for any programme. The coverage of the districts is shown in Table 1. In each of the sample villages, 15 farmers were interviewed. In addition, a total of 12 Kisan Mitras were also interviewed. Two sets of structured schedules were used for interviewing the farmers and Kisan Mitras/Progressive Farmers. The items on farmers schedule dealt with background characteristics, agricultural practices and problems faced regarding seeking information. Several questions were asked to probe the ICT networking that takes place. On the schedules prepared for Kisan Mitras/Progressive Farmers, questions pertained to the village environment and practices, and information networking. The sampling of farmers was done in such a way that there is adequate representaiton of all categories of farmers, i.e., large, medium and small size farmers. Besides this unstructured discussions were held with a large number of villagers, farmers, officials and scientists.

TABLE 1: COVERAGE OF DISTRICTS

District	Block	Gram Panchayat	Village
Hinterland: KVK Fatehpur			
Fatehpur	Malwa	Okhara Kunwarpur	Kunwarpur
Fatehpur	Malwa	Mauhar	Mauhar
Fatehpur	Bhitaura	Alampur Narhi	Kundepur & Alampur
Fatehpur	Bhitaura	Makanpur	Fareedur
Fatehpur	Haswa	Sarki	Sarki
Fatehpur	Devmai	Gangchauli Buzurg	Gangchauli Buzurg
Fatehpur	Teliyani	Aladatpur	Bastapur
Hinterland: KVK Dileep Nagar			
Kanpur Nagar	Shivrajpur	Ratanpur	Jaravarpur
Kanpur Nagar	Shivrajpur	Nadiha Buzurg	Gazaffarpur
Kanpur Nagar	Chaubepur	Gabdaha	Gabdaha
Kanpur Nagar	Bidhnu	Hajipur	Hajipur
Kanpur Dehat	Maitha	Aurangabad	Aurangabad
Kanpur Dehat	Maitha	Kashipur	Salempur
Kanpur Dehat	Sarvankheda	Duari	Duari

Table 2 shows the sample size covered for each district. In addition to the above, two exhibitions were covered. Indian Institute of Pulse Research (IIPR), Kanpur had held a Farmers Exhibition on 21 and 22 February, 2008. A team of five researchers visited the exhibition on both days and talked to farmers and scientists present in the exhibition. The team also visited Akhil Bhartiya Kisan Mela Avam Krishi Udyog Pradarshini, held on 3 to 5 March, 2008 at CSA Agriculture & Technology Univeristy (CSAATU) Kanpur. During this exhibition visiting farmers were interviewed, and feedback was sought from leaders, agriculture traders and officials. It helped understand information networking processes. Thus, the study employed both quantitaive and qualitative methods to gather data pertaining to the information needs and flows of the agricultural community in the selected KVKs.

TABLE 2: SAMPLE SIZE

Respondent Group	Fatehpur	Kanpur	Total
Farmers	105	105	210
Kisan Mitra / Progressive Farmer	6	6	12
Agriculture traders	11	10	21
KVK	1	1	2
Farmers at exhibition	--	--	65
Scientists	--	--	11
Others	--	--	25

2.3 RESPONDENT CHARACTERISTICS

Table 3 shows the profile of the respondents included in the survey. It shows the following:

An overwhelming majority of the respondents are males and they are in the age group 26 to 50 years.

There is a good representation of all castes. The sample has 37.62 percent farmers from general caste, 43.33 percent from OBC and the rest from SC/ST. However, the sample of Kanpur has more OBC respondents. It is because that some of the villages surveyed had OBC as predominant caste.

Nearly half of the farmers interviewed were High School pass or more. More educated farmers got represented in the sample as they were often more articulate and were able to discuss the issues pertaining to ICT networks.

Majority of the respondents are APL because they have land. The BPL respondents are mostly landless and are working as agriculture labour. Field visits showed that when some of them work as share croppers the major decisions are taken by the owners of the land and, therefore, the laborers are not so much interested in information. Therefore, the wage laborers were not selected for the survey.

Most of the farmers are going for double cropping (65.24 percent) and only a few take three crops (27.62 percent). There are some (7.14 percent) farmers who take only single crop.

2.4 FINDINGS OF THE SURVEY

The findings of the survey are presented in the form of information networking that exists, sources of information, role of KVK in information dissemination, role played by KVK scientists and barriers to seeking information. The study has attempted to explore the realm of indigenous knowledge and how it can be linked to scientific knowledge base.

2.4.1 RURAL NETWORKS

Studies show that social dynamics and networks have a crucial role to play in information seeking behavior. Respondents were asked if they are members of any formal network(s) through which they seek information. Table 4 shows that majority of farmers covered in the survey were not part of any network. Some of them seek membership of societies from where they purchase agriculture inputs (21.90 percent). Few are networked with CSAATU. Only 1.34 percent farmers have membership of the farmers committee of CSAATU. Some of them regularly come to Kanpur for the monthly meeting. 13.33 percent of the respondents are SHG members. Thus the membership of farmers in any community or social level organisation is quite low and there is a need to promote it. There has not been enough effort to develop grass root level organisations and using them for ICT.

TABLE 3: CHARACTERSTICS OF THE RESPONDENTS

Variable	Fatehpur		Kanpur		Total	
	number	percent	number	percent	number	percent
Gender						
Male	104	99.05	103	98.10	207	98.57
Female	1	0.95	2	1.90	3	1.43
Total	105	100.00	105	100.00	210	100.00
Age						
18-25 years	7	6.67	12	11.43	19	9.05
26-50 years	64	60.95	63	60.00	127	60.48
51-75 years	34	32.38	30	28.57	64	30.48
Total	105	100.00	105	100.00	210	100.00
Caste						
General	51	48.57	28	26.67	79	37.62
OBC	35	33.33	56	53.33	91	43.33
SC	17	16.19	17	16.19	34	16.19
ST	0	0.00	3	2.86	3	1.43
Minority	2	1.90	1	0.95	3	1.43
Total	105	100.00	105	100.00	210	100.00
Literacy						
Illiterate	7	6.67	9	8.57	16	7.62
Literate	18	17.14	9	8.57	27	12.86
5th Pass	13	12.38	13	12.38	26	12.38
8th Pass	22	20.95	16	15.24	38	18.10
10th Pass or more	45	42.86	58	55.24	103	49.05
Total	105	100.00	105	100.00	210	100.00
Occupation						
Self Employee	5	4.76	0	0.00	5	2.38
Farmer	97	92.38	104	99.05	201	95.71
Service	2	1.90	1	0.95	3	1.43
Agriculture labour	0	0.00	0	0.00	0	0.00
Non agriculture labour	0	0.00	0	0.00	0	0.00
Other	1	0.95	0	0.00	1	0.48
Total	105	100.00	105	100.00	210	100.00
BPL status						
BPL	11	10.48	33	31.43	44	20.95
APL	94	89.52	72	68.57	166	79.05
Total	105	100.00	105	100.00	210	100.00
Land size						
Marginal farmer (>0 & <2.5 acres)	50	47.62	38	36.19	88	41.90
Small(>2.5 & < 5 acres)	20	19.05	30	28.57	50	23.81
Large(>5 acres)	35	33.33	37	35.24	72	34.29
Total	105	100.00	105	100.00	210	100.00

TABLE 4: MEMBERSHIP IN COMMUNITY ORGANISATIONS

Membership	Fatehpur		Kanpur		Total	
	number	Percent	Number	percent	number	Percent
PRI	7	6.67	6	5.71	13	6.19
NGO	2	1.90	0	0.00	2	0.95
CBO	0	0.00	0	0.00	0	0.00
Kisan Club	3	2.86	0	0.00	3	1.43
Cooperative Society	27	25.71	19	18.10	46	21.90
Kisan Vidhyalaya	3	2.86	3	2.86	6	2.86
SHG	18	17.14	10	9.52	28	13.33
CSA Samiti	2	1.90	1	0.95	3	1.43
Other	5	4.76	8	7.62	13	6.19

2.4.2 SOURCES OF INFORMATION

Photo: Farmers at a seed shop purchasing

Farmers could seek information from many sources - NGOs, scientists, extension workers, traders, other farmers, social networks, Kisan Mitra, relatives and mass media. In absence of NGOs the farmers depend more on their own experiences, hearsay, relatives and caste and kinship networks but their dependence on seed sellers is highest. The survey shows that agriculture traders selling inputs are the most popular source of information for farmers (Table 5). 93.81 percent of the farmers rely on seed sellers for purchase of seeds, information and advice. The seed sellers not only sell seeds and other agricultural inputs, they also provide information and advise to farmers about which inputs to select, how to use them, and help make technological choices. On the other hand, farmers do not trust these agriculture traders. Many of the farmers told researchers that the seed sellers cannot be relied upon because they push products that give them higher margins. They generally prescribe over dosing of pesticides and fertilizers. A large number of agriculture traders also indulge in selling spurious chemicals and supplying poor quality seeds. Clearly, farmers dependence on them is because they do not find alternative sources of information that are conveniently available to them and are reliable.

The other important source of information for farmers is progressive farmers of their respective villages. 75.24 percent of the respondents said they talk to the other farmers of the village who know better. If there are progressive farmers in a village, people respect them and discuss with them problems they face and closely observe their agricultural practices. They can be very important in motivating farmers. The culture of chaupal does not exist in rural India any more,

but farmers talk to each other in informal settings, and exchange information including agricultural information.

In addition, nearly one-third farmers (32.86 percent) get information from state agriculture universities (SAUs). Less than one-third farmers (26.67 percent) turn to extension workers and KVK scientists for information. KVKs, through their extension activities, are able to reach out to only 10 to 12 villages in a year. Most of the farmers of the district do not connect directly to scientists. They use indirect sources to gain new knowledge. There is complete ineffectiveness of public extension system. In the survey villages it was clearly observed that even when KVK made a technological intervention through demonstration or gosthi, only a selected few were benefited.

TABLE 5: SOURCES OF INFORMATION

Source of information	Fatehpur		Kanpur		Total	
	number	Percent	number	percent	number	percent
Progressive farmer	78	74.29	80	76.19	158	75.24
Kisan Mitra	33	31.43	17	16.19	50	23.81
KVK	30	28.57	26	24.76	56	26.67
SAU	34	32.38	35	33.33	69	32.86
Seed seller/ Agri. traders	95	90.48	102	97.14	197	93.81
Radio	54	51.43	54	51.43	108	51.43
TV	23	21.90	20	19.05	43	20.48
Kisan Helpline	6	5.71	2	1.90	8	3.81

2.4.3 KVK'S AS INFORMATION PROVIDERS

KVK has been assigned the pivotal role in the Indian agriculture system in dissemination of information to farmers and providing a bridge between agriculture laboratories and rural India. In the study respondents were asked if they have heard about KVK. The survey shows that half of the farmers have never heard of KVK or have seen their activities.

In 7 of the survey villages where KVK had performed some intervention in the last one to two years period, about 20 percent of the respondents said they are not aware what KVK is. In village Aurangabad (Maitha block) KVK has done several demonstrations and training activities in last 2 to 3 years. However, when the researchers visited people from a low caste hamlet, they got complains about they not being informed about the KVK activities taking place in their own village. According to them KVK officials prefer to go to houses of Yadavs and all benefits of government schemes are taken by them. It was observed that some KVK staff members prefer to go to people of their own caste only because they have greater confidence in them. Due to such types of social barriers in communication, a large section of community is unable to access information, even when it is available.

TABLE 6: RESPONDENTS WHO HAVE HEARED ABOUT KVK

Respondents who have heared about KVK	Fatehpur		Kanpur		Total	
	number	percent	number	percent	number	percent
Have heard	49	46.67	56	53.33	105	50.00
Have not heard	56	53.33	49	46.67	105	50.00
Total	105	100.00	105	100.00	210	100.00

The respondents who received services of KVK were asked about the nature of services they got. Table 7 shows the analysis of data on usage of services.

TABLE 7: USAGE OF SERVICES OFFERED BY KVK

Facility	Fatehpur		Kanpur		Total	
	number	percent	number	percent	number	percent
On Farm Trials	1	2.04	0	0.00	1	0.95
Field Level Demonstrations	7	14.29	16	28.57	23	21.90
Training	9	18.37	4	7.14	13	12.38
Gosthies/ Meetings	18	36.73	22	39.29	40	38.10
Free seeds distributions	11	22.45	12	21.43	23	21.90
Demonstrations	6	12.24	7	12.50	13	12.38
Tour / Exposure trips	10	20.41	7	12.50	17	16.19
Consultations with scientists	6	12.24	11	19.64	17	16.19
Others	1	2.04	8	14.29	9	8.57

KVKs organise gosthi/meeting before rabi and kharif crops. These gosthies are well attended by farmers. Some of these are conducted in villages, while many are held at block level or at KVKs. It was observed that many of these programmes organised at KVK can be quite exclusive. People coming from disadvantaged sections of the society face discrimination in obtaining services and information. One farmer told the researcher "we were invited for a meeting at KVK and were asked to stay over for lunch. After the VIPs and bade log finished their lunch we were asked to proceed to the lunch area but by then the food packets were over. We felt very humiliated". The same respondent added "I hesitate to ask questions in these meetings because once I was ridiculed by other for putting up a stupid question".

KVK is viewed as provider of freebies. Only powerful and well off are networked to them, and the benefits reach them. In Salempur, same Yadav person was given the free seeds for trial, his farm was chosen for OFT, he was given the zero tilling machine for free and he was invited for meetings. The information has to be made easily available to all sections of society. It also has to be made more accessible to everyone.

The KVK scientists are a frustrated lot. Lack of administrative support, delays in salary payments and lack of work culture have left them quite frustrated. They are not keen to solve the problems of farmers but are managing to meet their targets. In most of the villages where the KVK had carried out On Farm Trial (OFT), the team found that only seeds were given to a couple of farmers. The scientists visit the fields when the crop is ready, to get photographs clicked.

In one village the beneficiary was given seeds of mustard. At the time of survey the crop was ready. When the farmer was asked about what variety of mustard it was, he said "sahab nein bheja tha. hame nam nahin pata (the officer had sent the packet and I do not know what variety it was)". They do not know the name of variety sown and were not even explained the method of cultivation. Though farmers were impressed by the high yielding variety, they cannot replicate the successful experiment.

The approach to agriculture planning is from top to bottom. The policy planners in Delhi decide what technologies are suitable for the country. Farmers, scientists and the local extension workers are not consulted. The result is that some of the technologies about which the scientists and extension worker are not convinced, have been thrust upon them for promotion. Zero till technology is one example of this (see case study in the following section). KVK has aggressively promoted this technology but their own scientists feel that it is not suitable for the region. Non-involvement in the planning process has lead to frustration amongst scientists.

Another gap in the extension system is that there is no effective method of taking feedback and collecting field level information after programmes are launched. The scientists and policy planners remain unaware of the problems faced by beneficiaries and the issues concerning farmers.

The ineffectiveness of KVKs is quite evident from the study. The scientists are frustrated and generally disinterested in contributing to new knowledge. They have not been involved in extension planning process, their salaries are not disbursed on time and they do not have adequate administrative support. There is politicization of organization and like other officials the KVK scientists are also busy pleasing their bosses and manipulating transfers. The demonstrations and OFTs are actually not performed. There is a complete failure of the system and it does not appear that the KVK scientists can play the role of change agents that the knowledge society requires.

2.4.4 CONTENT

Farmers are in need of a variety of information – weeds on fields are one of big problems for which they look for information. Other emergency need for which farmers require information pertain to insecticides and pesticides. On these subjects there is an information overload on farmers and they find it hard to make a choice. Farmers are in dire need of advise that they can trust. They require simple solutions that can be easily executed.

Photo: A farmer taking out weed (mama) from his field

The study shows that depending on the nature of problems faced, farmers choose source of information. For instance, for weather related information radio and TV are the popular choices (Fig 1). Farmers are quite keen to know about government schemes and programmes, but learn about them mostly from

progressive farmers (Fig 2). The formal public information network of Kisan Mitras and extension workers is not accessible or reliable. For the information pertaining to new varieties of seeds farmers mostly take advice from seed sellers and progressive farmers of the village (Fig 3). Most farmers know that pure varieties can be purchased from agriculture universities/ block offices, but only few go there for doing purchases. The reason being this mode of service delivery is also exclusive- only those who are well networked with scientists get to know when seeds are available. Such information is not put up in any public domain that a common person can access.

The role of progressive farmer is important in information dissemination as fellow farmers observe their agriculture practices and trust their advice. When the pests attack the crop then farmer rushes to the nearest seed seller and picks up whatever is sold to him (Fig 4). The dependence on seed sellers is so high that farmers even seek advice about agriculture technology from them (Fig 5). In the nutshell, the seed sellers have become the source of new knowledge. Farmers are seeking information from indirect sources and the public information and extension system have proved to be quite ineffective.

2.4.5 SOIL TESTING

The concept of scientific soil testing to optimise use of fertilizers, nutrients and select varieties of crops has been promoted for decades in the country. In the study soil testing has been taken as an indicator of effectiveness of public information system and impact on farmers practices. The study shows that two-third of the farmers never got soil testing done. 19.05 percent farmers gave soil samples for tests and are awaiting results. Thus so far only 14.76 percent farmers have benefited from testing.

TABLE 8: PERCENT OF RESPONDENTS WHO GOT THEIR SOIL TESTED

Soil tested	Fatehpur		Kanpur		Total	
	number	percent	number	percent	number	percent
Got soil testing done	17	16.19	14	13.33	31	14.76
Did not get soil testing done	77	73.33	62	59.05	139	66.19
Got soil testing done, results awaited	11	10.48	29	27.62	40	19.05
Total	105	100.00	105	100.00	210	100.00

Table 9 shows major factors behind farmers not opting for soil testing. 51.4 percent farmers are not aware about soil testing. For a few of the respondents, distance and costs are inhibiting factors. But the reality is that even when free testing is performed majority of farmers do not come forward. They either do not know about soil testing, or are not convinced about its usefulness.

TABLE 9: DISTRIBUTION OF RESPONDENTS BY REASONS FOR NOT OPTING FOR SOIL TESTING

Reasons for not using soil testing	Fatehpur		Kanpur		Total	
	number	percent	number	percent	number	percent
Not aware of soil testing	48	54.55	44	48.35	92	51.40
Testing facility is too far	3	3.41	3	3.30	6	3.35
Do not see any use of testing	24	27.27	9	9.89	33	18.44
Cost	0	0.00	3	3.30	3	1.68
Other reasons	5	5.68	9	9.89	14	7.82

Note: Multiple response possible

Fig 1: Weather

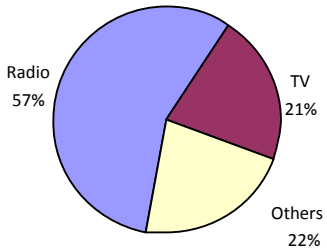
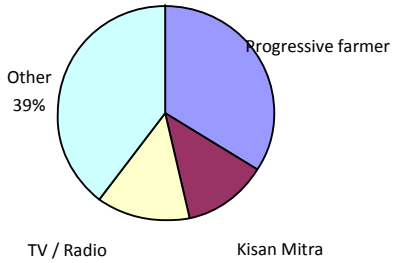


Fig 2: Govt Scheme / Programme



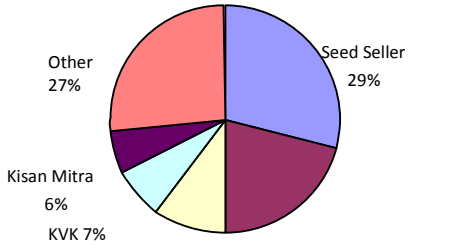


Fig 4: Pesticides

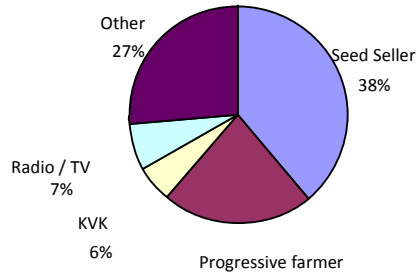
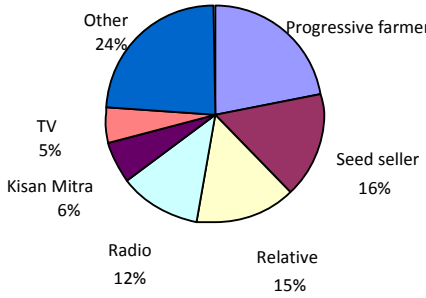


Fig 5: Agriculture technology



2.4.6 EXHIBITIONS AS A SOURCE OF INFORMATION

The researchers took the opportunity of visiting farmers exhibitions held at Kanpur to learn about their effectiveness in dissemination of information. IIPR, Kanpur had held a Farmers Exhibition on 21 and 22 February, 2008. A similar exhibition was held at CSAAUT, Kanpur on 3 to 5 March 2008. Some of the findings are discussed here:

2.4.6.1 NATURE OF EXHIBITION

The exhibitions were held for providing information to farmers for the upcoming jayad crops. Both the exhibitions had stalls of SAUs, private seed sellers and machinery suppliers. There were lectures by scientists and policy planners, and farmers were encouraged to walk in the demonstration farms.

The organizers had put advertisements in local dailies. However, according to them the attendance of such exhibitions is quite low. They are compelled to hire buses and offer pick-up service and free lunches for farmers. Some more findings:

It was found that about one-third (35.38 percent) of the farmers paid for their own transport to visit the exhibition. For the rest of them visits were arranged by the organizers. It can be concluded that only one third of the farmers visiting the exhibition were really keen at it. This shows the low level of demand for information seeking.

10 percent of the farmers surveyed received information about the exhibition through newspapers. Rest of them learnt about it through word of mouth, NGOs operating in their area, radio, etc. showing that the latter sources of information are much more effective among the farmers than newspapers.

Kisan Mitra sent information to only a selected few who were known to them and invited them to participate. Each Kisan Mitra selectively contacted a few farmers from each village and collected a crowd of 60 to 80 to get a bus load. According to a farmer 'humaka pakad laye. kahan lage ke buddha log aisan karyakram main theek lagat hain (I was forced to come because Kisan Mitra said a few older people will look graceful". The Kisan Mitra was able to find some young boys also but they were keen to come for exhibition for a free ride and food and were unconcerned about the exhibition. His preference was for old people who could add sobriety. The interest of active farmers was not of any consideration.

TABLE 10 : DISTRIBUTION OF FARMERS BY SELF MOTIVATION

Variable	**CSA**		**IIPR**		**Total**	
	number	percent	number	percent	Number	Percent
Self motivated to attend exhibition	12	38.71	11	32.35	23	35.38
Officials invited/arranged vehicle	14	45.17	17	50.00	31	47.69
Came to attend under pressure	5	16.12	6	17.65	11	16.92
Total	31	100.00	34	100.00	65	100.00

2.4.6.2 WHAT WERE FARMERS LOOKING FOR?

Overall, 38.46 percent of farmers said they came to seek information and 21.54 percent said they came to purchase seeds. 6.15 percent reported that they had come for picnic. Overall, the sponsored farmers were happy with free ride and free food, and were hardly interested in gaining knowledge. When farmers were probed about nature of information they were looking for only 26.47 percent could specify their information needs. Yet, all the farmers who came by their own means had clear purpose of visit. These were:

(a) to see new varieties of moong, chana, matar, oilseeds, other pulses; A few progressive farmers said the information provided by scientists was very useful and exact. The seed sellers take them on a ride. By coming to exhibition they learnt about what are good varieties and are able to cross check the information given by seed sellers.

(b) to learn about new machinery/equipment that are introduced in the market

(c) to find out about new methods of cultivation in dry area and water conservation methods

(d) to find out better methods of cultivation to increase farm yield

(e) to find out about government schemes, crop and animal insurance

(f) to find out solution for specific problems they faced. These pertained to plant diseases, lowering of productivity and farm management

TABLE 11: REASONS FOR ATTENDING EXHIBITION

Variable	CSA		IIPR		Total	
	number	percent	number	percent	Number	percent
Came for picnic	1	3.23	3	8.82	4	6.15
Came for seek information	5	16.13	20	58.82	25	38.46
Came for purchase seeds	9	29.03	5	14.71	14	21.54
Came for other	17	54.84	6	17.65	23	35.38
Total	31	100.00	34	100.00	65	100.00

Many of the farmers came to the exhibition under the impression that seeds and equipment would be available for purchase at subsidized rate. They were disappointed. Farmers are looking for freebies and are not excited about stalls disbursing information.

2.4.6.3 WHAT DID FARMERS TAKE FROM THE EXHIBITION?

Some farmers came to seek answers to the problems they were facing. However, they could not get suitable forum to ask questions. The formal environment in the seminars was intimidating to people from rural areas. They are generally more comfortable in a one-to-one interaction with scientists but exhibitions do not provide that opportunity. Most of the farmers who visited the stalls, simply walked through. They could name some of the items displayed. But when probed further they admitted that they did not stop to understand anything. 'Sukshma jankari to nahin leyai (we did not take detailed information)' said a farmer. Often, it a casual walk through the

stalls and the absorption of information was very low. The stall carrying information on organic manure was quite prominent. Many of the farmers interviewed said they visited the stall yet, none of them could answer anything that was being told at the stall.

The stalls of private seed sellers were flocked by farmers. Farmers were comfortable in asking questions and purchasing. It was observed that stalls of private sellers were more attractive than those run by SAUs. Farmers enjoyed the walk to the demonstration farms. For them seeing is believing. They were impressed by healthy crop that was ready in the farm. Some said they saw the benefit of line sowing and raised bed sowing. A typical response was: “the medium used for display boards was English and I could not even get the name of variety sown". It is clear that information is best absorbed if it is demonstrated or given in an interactive session in a friendly environment. Only a few farmers took published literature with them. The use of literature and display material failed to make an impact to the uneducated farmers.

Some of the progressive farmers and Kisan Mitras used this platform for networking. Meeting dignitaries and welcome by scientists made them feel happy.

Photo : Demonstration farm at IIPR, Kanpur

2.4.6.4 SCIENTISTS TALK TO SCIENTISTS AND NOT FARMERS

Photo: Farmers complained about the use of technical language and english in the exhibition

It was observed that in the exhibition the organisers did not have farmers in mind. The language used in lectures and seminars had English words and technical terms. For instance a scientist in a Question-Answer session explained the dosage for pest control like this 'point zero seven percent ka ghol banakar daliya' i.e use zero point seven percent concentration of the recommended dose. The dosages given should be in terms that layman can understand. The printed material was in English. Also, they used

technical terms that farmers were unable to understand. One farmer from Jalaun wrote in the feedback form 'kisano ko sada bhasha mein baat bataiye' i.e please give us information in printed form, in very simple language.

Photo: The instructions in the farm are written in english.

2.4.7 BARRIERS TO INFORMATION

The study shows that there are gaps in information and not everyone is able to access and use ICTs. Some of the barriers in information seeking are:

Language of communication: Since large proportions of farmers are illiterate, information should be provided in pictorial form that farmers can easily understand. Even those who are literate require the literature to have simple non technical language. Many farmers said they listen to radio and TV programmes but do not understand the language used by experts. For the communication to be effective local language and tradition have to be incorporated.

Social barriers such as caste and community; women and disadvantaged people lag behind when it comes to accessing information.

Content provided by extension officers and KVK scientists often fails to interest farmers because information given is often irrelevant and presented in a drab fashion. For example at the farmers exhibition held at IIPR, Kanpur, farmers group from Bundelkhand region wanted to know about farming techniques and crop varieties that require less water. Their information needs were not catered to.

The information provided about some of the technologies has been incomplete and incorrect. This was observed in village Kuwarpur village of Fatehpur were vermi composting was being introduced. Farmers could not follow the steps and failed to take necessary precautions. The literature provided was too difficult to understand.

Farmers hesitate in asking questions unless they find environment reassuring that it is OK to do so. Except a few young and educated farmers, none of them had the courage to stop at stall and ask questions; they just walked through and those interested collected pamphlets. Virendra Singh, a farmer said: “The charts and displays on organic manure were good and I am keen to

reduce urea consumption. But I could not understand how to do it. I have collected a pamphlet that my son will read to me".

Farmers want information to be closer to their homes - many of them were demanding that such exhibitions should be held in their block also. Obviously, information will be more useful if it is available easily to them.

Cost and time; a large number of farmers are unable to afford the cost and time involved in accessing information.

Poor information infrastructure at the public offices: There is a lack of government initiative to develop agriculture civil society organisations and using them effectively for information dissemination. The private extension services are taking off in other parts of the country but there is no service in this region.

Field visits show that there are problems from both sides. On the one hand extension workers have not made much effort to contact all sections of society and on the other hand people too are not much attracted to extension workers when they go to a village for information or demonstration. There is a tendency among people not to show interest in purely information related matters. They think that workers have come to village for khanapuri and carry nothing with them to help people. Lack of credibility of the government workers is the main problem behind this. If they know that some government workers have come to village to give them some tangible benefit (seeds, gypsum, fertilizer etc.) they will all assemble to meet them but if they learn that some workers have come to provide information they show no interest in meeting them. In this milieu the workers too find themselves in awkward situation often and tend to contact those with whom they can communicate better, for example, people of their own caste. The village society is highly divided – both vertically and horizontally. Thus to help the farmers through new information requires dealing at several levels – social, cultural, economic and political. The information has to be made simple and short. Ramswarup of Hardolpur (Fatehpur) puts it like this: "kisan to chapau paper deo. ee deo ke kaun fasal mein kitna beej, kaun keetnasak kitna dia jay", i.e., the farmers need information in simple form that they can easily understand.

2.4.8 PEOPLE'S KNOWLEDGE

Farmers have a rich tradition and knowledge base. They pick up scientific knowledge, do experimentations and constantly do innovations to arrive at their own solutions. This knowledge is referred as Jandhara. An understanding of Jandhara provides an opportunity to scientists to learn about successful practices and improve learning. Farmers were asked about their decision making process and the type of information that exists in the Jandhara. To get a glimpse of the indigenous knowledge systems, participatory approach was used and several unstructured interactions were held. The findings show that there is a repository of knowledge with farmers that has been collected over centuries. This knowledge is passed on through generations through proverbs and folklores. Some of the examples are:

A) HOW FARMERS KNOW THAT RAINS ARE ARRIVING

A bird named as Bater starts rolling in soil
Ants start moving out of ground with their eggs in the mouth
The voice of crow changes just before the arrival of rains
The algae deposit on the pond starts cracking
Some sayings –
jab bhoo lot chale purvai tab jano varsha ritu aai
jahan tahan khanjan param puhar tab jano varsha ritu aai

B) HOW FARMERS LEARN IF DROUGHT IS IN THE OFFING

In the month of Jeth (May-June) the easterly winds start flowing. A saying goes like this "Jab jeth ritu chale purwai tab sawan dhool chatai"
Bater bird starts bathing in water instead of rolling on soil

C) HOW FARMERS LEARN THAT IT IS END OF RAINS

Local grass kans absorbs water and swells then it is a signal of end of rains. A local proverb says "phule kans jagat mein bhai, varsha gai sharad ritu aai" and "Lakshman dekho kans phul aai aab jano varsha halkai"
When you see flock of Baune bird flying in one direction, it signals end of rains

D) HOW FARMERS LEARN THAT THERE MAY BE A HAIL STORM SOON

When during sawan season westerly winds flow, it is an indication of cold and bad winter
When clouds rise from the south-west direction, there is a good possibility of hail storm

It was observed that farmers experiment in their own ways - mixing some scientific information that he receives from scientists and extension workers, with what they already have in their indigenous repository. However, the scientists and extension workers do not have much regard for this rich heritage. During the survey none of the KVK scientists could list farmers practices that inspired them. Generally the believed that farmers know little and have to be told what to do and how to do. Such perceptions are dangerous and they curtail the process of indigenous learning. The scientific information should address the existence of the indigenous knowledge system for it to be acceptable and useful

2.5 CONCLUSION

The study shows that the information needs of the farmers are in plenty. On the cultivation front the information needs range from seed variety, pesticide and weedicide selection, weather and cultivation technology. Often, farmers are presented with a range of technological options and they need assistance in selecting appropriate technology. Many a times the scientific knowledge

does not assimilate with the indigenous knowledge system, thereby creating gap in its acceptability and usefulness.

The public information system is neither available nor accessible to all farmers. KVKs and extension workers are selective about the villages and farmers they pick to bestow benefits. These decisions are generally based on convenience, caste and the capability of farmers. Only a selected few feature in the list of beneficiaries year after year. Rest of them are dependent on the second hand information that comes to them through other farmers, relatives or seed sellers. Kisan Mitras have not played their role effectively. The study has shown that the seed sellers are the most important source of information. However, they generally misguide farmers and prescribe overdosing of pesticides and fertilizers. Farmers do not have direct access to new knowledge.

There is a significant amount of lateral learning also that takes place amongst farmers - they learn from each other. The top-down centralised approach in agriculture planning and non involvement of rural stakeholders in programme and policy formulations has left a wide gap between the need of people and the type of information being supplied. The technologies developed are often not suitable, and the inference that is incorrectly drawn is that farmers are not interested in knowing more and changing their methods, The ICT should integrate with local media and traditions, and provide information that farmers need for it to have a wider appeal.

This multicriteria survey among Indian farmers in and around the Kanpur area of India paints a vivid picture of the interdependencies between knowledge power, democracy and ICT in rural India. In this backdrop, our observations and learnings from implementing **agropedia**, presented in this deliverable and in D11.5, clearly link economic and social development in rural India with digital knowledge ecosystems. For further insights in this area, weekly data on agropedia usage is being fed into the EVEsim framework developed by SUAS as well as the social network analysis framework developed by our partners ate IPTI. Interesting results from these analysis should be evident in Phase 3.

3. IDENTIFYING AND CAPTURING KNOWLEDGE FROM NETWORKED KNOWLEDGE SPACES: THEORETICAL INSIGHTS AND APPLICATIONS[3]

3.1 INTRODUCTION

Knowledge Management (KM) has emerged as a new discipline of organizational management in recent few years. Knowledge itself has different forms and nature which are either existing around or created through innovation and transformation for the purpose of application. Sustainability and growth are among the critical issues in business as well as social organizations where KM can play a pivotal role (Clark, 1999). KM refers to a systematic and organizationally specified process for acquiring, organizing and sharing both tacit and explicit forms of knowledge within and across the organizations (Scarbrough & Hislop, 1999). More specifically KM is defined as achieving organizational goals through the strategy-driven motivation and facilitation of knowledge workers[4] to develop, enhance and use their capability to interpret data and information (by using available sources of information, experience, skills, culture, character, personality, feelings, etc.) through a process of giving meaning to these data and information (Beijerse, 1999). The multiple perspectives covered by KM are evident from multiple combinations of two specific terms: knowledge and management as shown below:

- Management of Knowledge, which implies an idea of a process through which knowledge is managed as a product.
- Knowledge of Management, which suggests an idea of static state of intellect of an individual or an organization where skill of management is potentially stored.
- Practicing Management with the help of Knowledge, which sees knowledge as the key input element for management practices.
- Acquiring Knowledge by the practice of Management; which means knowledge gradually evolves with time and experience within the organization.
- Accomplishing some task with the help of Knowledge and Management; here both are used as tools to achieve a given set of objectives.

Here, in all the perspectives, knowledge is perceived as a fundamental object to which the subject of management is applied to obtain some specific set of goals. Management itself requires some level of knowledge and hence KM can be viewed as a recursive process having interactive communication between the two distinctive elements 'Knowledge' and 'Management'. Knowledge is the key object and is an input resource for both KM as well as Organizational Management. Before going deeper into the different paradigms of KM, the

[3] This chapter was presented as a paper in the OPAALS conference at Tampere 2008 (Amritesh and R. Sarkar, "Identifying and Capturing Knowledge from Networked Knowledge Spaces: Theoretical Insights and Applications", *Proceedinsg of second international OPAALS conference on Digital Ecosystems*, October, 2008, pp. 9-21.)

[4] Knowledge workers are employees of a knowledge society, who are the owners of tools of production (Drucker)

basic building blocks of conceptual model of KM: 'Knowledge' and 'Management', have to be understood explicitly with respect to various conceptualizations.

The literal meaning of 'knowledge' as defined in the Oxford dictionary (2000) as 'the state of possession of information, understanding and skills that one acquires through education and experience: practical, medical or scientific'. Knowledge taxonomies are described in more detail in the next section. The term 'management' basically means 'business management', because large scale business was the first of new organizations to become visible (Drucker, 1994). In literature, 'Management' is synthesized as the strategy-driven motivation and facilitation of people, aimed at reaching organizational goals (Beijerse, 1999). Management is now seen as distinctive as well as an essential organ of all kinds of organizations irrespective of their nature, size and operations. The recent literature about KM relates it with information management systems which use a robust ICT infrastructure. Just like information is generally manifested in the knowledge when it moves up in the hierarchy, information management systems are transformed into knowledge management systems requiring more attention. KM requires four basic processes: creation, storing and retrieving, transfer, and application. The application of IT to KM initiatives reveals three common applications: coding and sharing of best practices, creation of corporate knowledge directories, and creation of knowledge network (Alavi & Leidner, 2001). Successful KM requires a skilful blend of people, processes and ICT, which can facilitate the evolution of a self sustainable digital knowledge ecosystem[5].

The level of intellectual capital[6] of any organization is primarily dependent upon the way knowledge flows inside and across the boundaries of the organization. Knowledge transfer depends basically upon four factors:

- Nature and forms of knowledge,
- The knowledge spaces,
- The network of transmission, and an
- ICT supported environment

Nature and forms of knowledge are not only important for the organizational outcomes they generate, but also important while developing a network based system for knowledge transfer. The nature of knowledge can be assessed by examining its evolutionary and applicability features. These include tacitness, explicitness and factors such as individual, social, declarative (know what), procedural (know how), causal (know why), conditional (know when), relational (know with) and pragmatic. Forms of knowledge describes state and structure in which knowledge exists, e.g. data and information, state of mind, object, process, conditions and capability (Alavi & Leidner, 1999; Alavi & Leidner, 2001; Wissens Management Forum, 2003; Beijerse, 1999; Kogut, 2000; Shariq, 1999; Shariq,1997).

[5] An organic system, which fosters ICT enabled knowledge exchange opportunities among individuals and communities, and allows dynamic knowledge exchange to evolve as environmental circumstances require.

[6] Intellectual Capital comprises two major elements: human capital (skilful people) and intellectual assets (codified knowledge) (Sullivan, 1999).

The emergence of rapidly expanding technologies for distribution and dissemination of information and knowledge has brought to focus the opportunities for development of knowledge-based networks, knowledge dissemination, knowledge management technologies and their potential applications for enhancing productivity of knowledge work (Shariq, 1997). Network perspective of knowledge transfer provides two models of KM: the cognitive network model and the community network model (Scarbrough & Hislop, 1999). The cognitive model discusses the information processing view of the firm where valuable knowledge is located inside people's heads is identified, captured, stored and processed via the use of IT tools so that it can be applied in new contexts and the aim is to make knowledge inside people's heads widely available to reduce the threat of valuable knowledge assets literally "walking out of the door". In the community network model the approach is to share knowledge through active networking within and between occupational groups. The community network model emphasizes dialogue and sense making occurring through active networking (partly or fully enabled by IT), and the critical factor is trust, and collaboration. The cognitive model emphasizes linear information flows through static IT-based networks with the critical factor being technology. In both the cases, conceptual integration of network is the critical tool and application of information and communication technology (ICT) provides strength, stability and effectiveness to conceptually integrate the network. From the perspective of actor-network-theory (Tatnall & Gliding, 1999), a knowledge network can be viewed as connected composition of heterogeneous knowledge actors. Here knowledge actor may be considered static in the form of individuals or nodal institutions of a network, or dynamic and seen as carriers of knowledge e.g., humans and products[7]. In knowledge communities, Nodal Institutions are identified as observable unit of analysis in a knowledge network (Leydesdorff, 2003). The social process, its context and regulations are embedded within the knowledge space, ICT supported environment and networks. From the social perspective, these static nodes are viewed as members who develop relationships among themselves as a result of mutual interaction. These relationships can be mapped as direct and indirect links joining the member nodes through which they interact with each other. Physical and virtual form of transactions can easily be observed, measured and controlled by focusing attention upon theses links. Knowledge develops operationally at the level of such links in terms of reconstruction between the nodal institutions. Managing a knowledge network requires integration of managers in the system as one of the management nodes within the network from where these key nodes can facilitate efficient and smooth flow of knowledge objects.

Knowledge when separated from its originating space becomes a free and abstract object, and by the time it is captured by some other space, it does not remain in its original form. Some part of it is lost and some additional contents stick to it either as unintentional and undesired noise, or as intentional and desired 'quality' for the purpose of application. Transformation always happens when the knowledge is transferred between nodes (Shariq, 1999). Transformations can occur at either the sending or receiving nodes, or at the level of links connecting those nodes. Knowledge transfer is inherently interactive and dynamic and an adequate explanation of the basic building blocks requires the understanding of the cognitive processes happening at the nodes during knowledge transfer.

[7] Humans and products carries the knowledge in the form of mental constructs and physical constructs (embedded features) respectively.

Social perspective on knowledge transformation focuses upon four basic and cyclic phases of knowledge transformation: socialization, externalization, combination and internalization; these are also known as knowledge spiral (Beijerse , 1999; Kazi, Wohlpart & Wolf, 2007; Nonaka & Konno, 1998). Internalization and externalization can be recognized as one the basic phases in the process of knowledge transformation specifically occurring at the nodal level. Member nodes and knowledge actors can be recognized as the drivers. 'Accessibility' and 'absorptive capacity' are two critically important characteristics of member nodes that play a crucial role in transfer of knowledge within the network (Scarbrough & Hislop, 1999). Besides these, 'emissive capacity' of the nodes can also play a vital role in knowledge sharing.

ICT can be viewed as a foundation platform as well as one of the possible vehicles for the Network based knowledge system. Technologies equip the network with the capacity of mitigating the negative outcomes as well as to capitalize on the positive opportunities. Use of ICT provides a strongly favourable environment and acts as a boost to the process of knowledge transfer. In fact most of the ICT enabled networks act primarily as a medium of transfer for the codified knowledge. Explicit or codified contents can be captured and communicated much easier through wired network. The resulting digital network can be further developed in the form of a digital ecosystem, which display associative and autopieotic properties (Sarkar & Rajgopalan, 2007). The integration of knowledge in this system generates the concept of a 'digital knowledge ecosystem'. Any ecosystem can be viewed as an organic system with changing environment where interactive communication takes place among heterogeneous organic members. Here knowledge is the fundamental element whose recognition and systematic channelization in the network is much emphasized for imparting usefulness to the knowledge.

This chapter is organized into six sections. After this introduction to 'knowledge management', the second section is aimed at understanding the 'presence of knowledge' from various perspectives. Section three discusses the embodiment of knowledge under existing social spaces and its mapping with significant network spaces. Section four compares informal and formal networks with two opposite viewpoints: mechanistic and organic, and the role of ICT at various levels. In section five we study a illustrative case of a knowledge management project in the Indian rural domain with the help of synthesized theoretical framework of a networked digital knowledge ecosystem. The focus is on leveraging from knowledge resources by using a hybrid system design which involves adoption of ICT. The chapter concludes by pinpointing the potential role of ICT and networking in capturing existing knowledge and creating new knowledge.

3.2 IDENTIFYING KNOWLEDGE

Identity requires Existence. Existentialist thinking represents protest against alienation of 'knowledge', its loss of identity and its transformation into an object. Knowledge is identified as a key resource outside the human and social system. Human awareness, observation and interpretation of its surrounding results into a certain set of mental constructs embodied into human mind (Beijerse, 1999). These mental constructs can be detached and codified and presented as social constructs (Donald, Mason, Robson, Lefrere & Collier, 2003), in the form of data and information. Information moves up in a hierarchy and is transformed into

knowledge (Alavi & Leidner, 1999) when its utility is provided value and weight by users. While managing knowledge, it is important to discuss how the knowledge is identified, i.e. whether 'X' is stamped (recognized) as 'knowledge' or 'knowledge' is stamped into 'X'. Knowledge can be perceived as a virtual organizational object which can influence the internal and external environment of the system and dictates the subject of management. It has specific characteristics, which can be easily identified only if associated with some conscious or unconscious physical means. The physical manifestation of knowledge can be recognized either as an embodied state (Hovland, 2003) inside a manufactured product (Hedlund, 1994) which describes its external design, physical features and sense of utility, or as schedules and steps of operations happening within and across the organizations on which organizational performance depends.

Acting as a prerequisite of human action, Knowledge is intrinsically linked to people and created dynamically through changes to cognitive structure (Wissens Management Forum, 2003). Apart from this psychological categorization, knowledge can be categorized into 'tacit' and 'explicit' forms on the basis of articulability (Kazi, Wohlpart & Wolf, 2007; Nonaka & Konno, 1998; Novak & Wurst, 2005). Tacit knowledge is embedded in individual actions and derived from embodied experience, ideals, and values of the individual. It is highly personal, hard to formalize and difficult to communicate. Explicit knowledge is the codified form of data, information, scientific formulae, specifications, manuals etc., which can be easily captured and transmitted formally and systematically. Alternatively we can say that explicit knowledge is derived from the tacit knowledge process by categorized context and specifications (Figure 1). The 'Declarative' context describes the 'know about' phenomena, and answers the questions starting with what, which, who etc. 'Procedural' context describes the process, 'Causal' context describes the reasons and justification, 'Conditional' context describes the prerequisites for happening of any event and 'Relational' context defines social and professional the relationships between the participating entities (Alavi & Leidner, 2001). Thus explicit knowledge is implicit knowledge, better articulated through defining the context and setting. Explicit knowledge requires immediate capture and stored and eventually owned by some entity. The 'ownership' may be individual or collective, each having their respective features and identity of knowledge (Figure 2). The control of an 'object' appears to be the key characteristic of the phenomena of 'ownership' (Cummings, 2003). 'Knowledge' as a static object can be recognized as a 'state of mind' within the individuals. At a certain level, 'state of mind' turns out to be a 'capability' to perform some task. A set of capabilities are recognized as a 'condition' for accessing the resources and authoritative power. At certain instances, knowledge is owned 'collectively' by a social group or an 'organization' and recognized as a key 'asset' responsible for the organizational economic growth. Economic perspective identifies knowledge as a 'value' based technological or intellectual asset, which is either incorporated within any product or individual of the organization and constitutes a part of 'Intellectual Capital' (Kazi, Wohlpart & Wolf, 2007; Lai & T'sai-hsinChu, 2000; Shariq, 1997; Sullivan, 1999). The value of intellectual capital is often intangible.

Hence knowledge is evolved as a critical form of 'resource' which can either be protected by Intellectual Property Rights (Kazi, Wohlpart & Wolf, 2007; Randeree, 2006), or can be brought over to the open access platform (Suber, 2004) based on the respective business and social requirements. 'Resource' perspective of Knowledge requires short term and long term strategic planning as a part of management. The standardized process of management can be recognized as a 'systematically codified strategy' (Shin, 2004) of an organization,

which can again be seen as high quality knowledge. Thus, knowledge can be the key economic variable of the firm and is expected to create two basic functions for generating intellectual capital: value creation and value extraction (Wissens Management Forum, 2003; Cummings, 2003; Despres & Chauvel, 1999; Shin, 2004; Sullivan, 1999). Knowledge is said to be sticky in nature. The key properties of knowledge include: tacitness, dispersion, context, specificity, transferability, reception or absorption and complexity (Quintas & Jones, 1997).

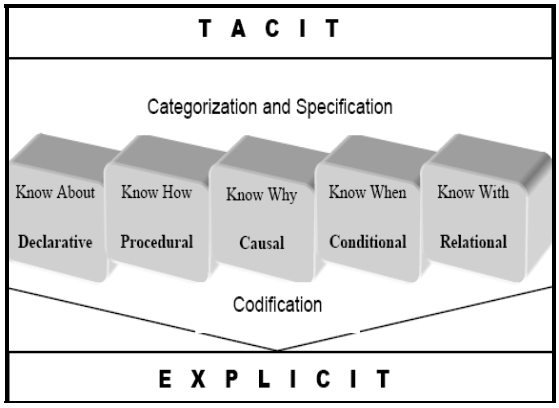


Figure 1.Transformation of knowledge from 'Tacit'to 'Explicit' form.

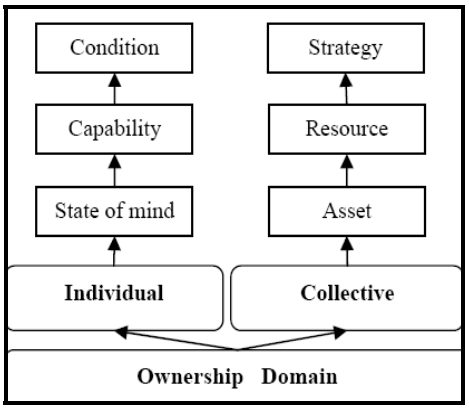


Figure 2. Defining knowledge based on ownership

After the discussion about the recognition of existing knowledge, it is important to look out for opportunities for sharing as well as creation of new knowledge. Studies reveal that the construction and sharing of knowledge is an inherently social process in which the learner actively constructs meaning, through a process of information exchange and social interaction with the people (Cummings, 2003; Donald, Mason, Robson, Lefrere & Collier, 2003; Kazi, Wohlpart & Wolf, 2007; Novak & Wurst, 2005; Tolsby & Kirkebak, 2007). As a part of knowledge management, creation and sharing of knowledge requires ideal and favourable knowledge spaces supported by integrated technology.

3.3 IDENTIFYING EXISTING AND POTENTIAL KNOWLEDGE SPACES

These are the spaces or regions where knowledge remains intrinsically embedded as a virtual object. While navigating through the 'knowledgescapes'[8], we can find specific isolated or integrated spaces, which can be categorized according to the activities concerned with knowledge e.g., creation, storage, sharing, transfer and application. Knowledge spaces are closely associated with the nature and form of knowledge as discussed in the earlier section. Tacit knowledge is highly personal; it originates and exists within the minds of the individual and specific collective practices of the organization. While explicit knowledge can be found in codified documents, research literature, books, journals, blueprints, yellow pages, template, virtual memories of computers and databases, etc. These are unconscious static storage spaces where one can access and retrieve knowledge. Any naturally existing unconscious

[8]Knowledgescapes refers to the cognitive spaces, we humans navigate as we pursue and are pursued by knowledge (Shariq, 1999).

substance or manufactured product can also be perceived as an embodiment of information and acts as a repository of knowledge. From these static knowledge storage spaces knowledge can be accessed, retrieved and processed by users through the interaction of their internal and external cognition (Scarbrough & Hislop, 1999), resulting in the construction of new forms of knowledge. Knowledge Construction may happen either at an individual level or at the collective level. Collective participation always promotes innovation and sharing of knowledge across multiple members of the group. The group can be recognized as a set of individuals, or a group of organizations working together and exchanging knowledge across their formal boundaries via interactive communication. Such groups are often termed as 'Knowledge Communities' (Assimakopoulos & Yan, 2005; Prothmann, 2006) or Communities of Scholarship (Bendersky & McGinn, 2007). Knowledge Communities are groups of people with a common passion to create, share, and use new knowledge for tangible business purposes (Prothmann, 2006). Community of Scholarships can be understood as inter-disciplinary organizational bodies, where cross disciplinary understanding stems from the sharing based foundation of knowledge itself. In a much broader social perspective, such communities are identified as 'Community of Practice (CoP)'. CoP are commonly constituted through shared work practice over a period of time where soft knowledge is transferred through situated learning and all the participants have a common understanding of collective practices and goals (Prothmann, 2006). Such communities are supposed to create and share knowledge under certain systems for their mutual benefit. The physical locations accommodating the activities carried out by these communities can be named as 'intellectual geography' (Sawayer & Rosenbaum, 2000).

In the context of knowledge sharing, knowledge spaces can be related with the Japanese concept of 'Ba' (Nonaka & Konno, 1998), which is thought as a shared space for emerging relationships and promotes easy knowledge transfer. This space can be physical (e.g. office, dispersed business space), virtual (e.g., e-mail, teleconference), mental (e.g., shared experiences, ideas, ideals), or any combination of them. Such spaces are often seen as the repositories and carriers of intellectual assets and organizational culture. Within these social spaces, it is quite easy to find the knowledge transformations spaces where cyclic events of socialization, externalization, combination and internalization occur (Kazi, Wohlpart & Wolf , 2007; Nonaka & Konno, 1998) (Figure 3). Knowledge spaces, when viewed in the domain of a knowledge network, contain two basic elements of consideration: 'knowledge nodes' and 'transferral links', each having their specific characteristics (Figure 4).

The 'knowledge nodes' can be seen in the form of a conscious element, like an individual, group, organization or a community of organizations. Nodes can be perceived as fundamental knowledge-actors who can actively control the knowledge creation and its flow across the network. The 'transferral link' is the basic travel path of information and knowledge in various forms. It can be either virtually embedded in the form of 'social relationships' or physically constructed as wired transmission lines. Such links can also be viewed as a collective platform or as a different kind of 'intermediate node' in the network where the rest of the knowledge nodes can interactively participate to perform activities like knowledge creation and sharing.

Knowledge spaces when viewed from the activity viewpoint can be categorized according to the importance of roles of either nodes or links (Table 1). Activities where characteristics of nodes play an important role are: origination, construction, absorption, adoption, adaptation

and application of knowledge. Activities where links are considered important players are: accession, transmission, sharing, and transformation of knowledge. However some degree of overlap can also be observed in some activities where both nodes and links contribute. For example, absorption rate of knowledge by the node is highly influenced the rate of knowledge flow across the links; Sharing and transmission through the link is highly dependent upon emissive and absorptive capacity of the participating node.

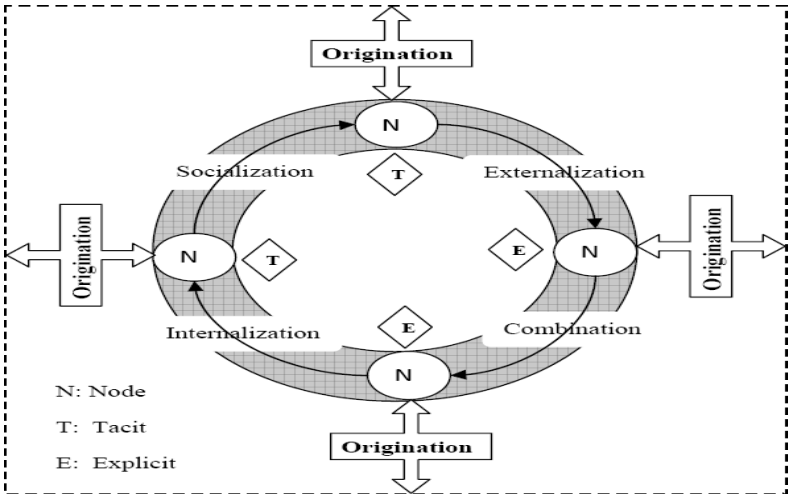


Figure 3. Social Spaces In A Network Perspective[9]

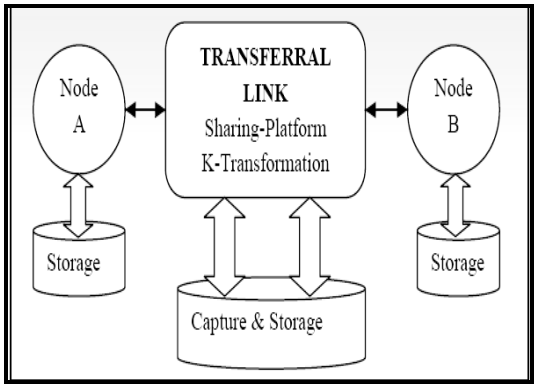


Figure 4. Network Spaces for Knowledge

[9] Developed from Nonaka's Knowledge Spiral (Nonaka & Konno, 1998).

Table 1. Categorizing Activities at the Network Space

Activity-Space	
Nodes	**Links**
Origination Creation/ Construction Emission Absorption Adoption/ Adaptation Application	Accession Transmission Sharing Transformation (Socialization, Externalization, Combination & Internalization)

3.4 NETWORKING OF KNOWLEDGE SPACES AND SIGNIFICANCE OF ICT

Knowledge networks can promote innovation and construction of new knowledge from existing knowledge. It requires a suitable environment and proactive knowledge spaces, which can be framed again as future source of knowledge creation and also encourages knowledge sharing (Kazi, Wohlpart & Wolf , 2007; Novak & Wurst, 2005; Tolsby & Kirkebak, 2007) and organizational learning (Hovland, 2003). During the process of networking the knowledge spaces it is essential to see the expected nature of communication between the knowledge nodes. The consideration can be given on two basic methods of communication: 'Arrow approach' and 'Circuit approach' (Clampitt, 2001). The 'arrow approach' sees communication as a one way activity and focuses on the sender of the content, while the 'circuit approach' can be seen as a feedback based network loop and a dynamic interplay between sender and receiver nodes. These approaches can be compared with top down push and bottom up pull and contrasted with fundamentally distinguishing assumptions; "Effective expression is effective communication" and "Good Understanding is effective communication" in respective cases. Effective expression requires internal willingness and ICT supported emissivity of the knowledge nodes for knowledge sharing while understanding requires accessibility and absorptive capacity of the receiving knowledge node. Besides these nodal requirements, transferral links should possess adequate flow capacity and support the communication. Despite acting as a foundation and nodal interface, ICT can have enormous potential to widen the flow capacity and provide knowledge transfer opportunities to the participating knowledge nodes in the network; as a result the quantity of technologically pushed knowledge contents sometimes exceeds the requirements of a strategically pulled knowledge requirements (Katsoulakos & Zevgolis, 2004). Therefore, from an economic point of view, it is important to match the flow capacity of the links with the emissive capacity and the absorptive capacity of the knowledge nodes. Networks can be seen as a means of collaboration between organizations and groups in production, retention and dissemination of knowledge with a common vision. Dissemination of knowledge requires some 'time' from its

inception to implementation. ICT is one of the effective foundation platforms which can facilitate e-collaboration and shorten this 'time' and economically justifies itself (Ortiz) ICT uses powerful networking and interactive tools like e-mailing, video-conferencing, instant computer to computer messaging systems, mobile telephony, voice chats, etc. Studies have already revealed that the use of internet not only supplements the mutual interaction among the people (Wellman, Haase, Witte & Hampton, 2001), but also results into the strengthening of weak ties and creates newer ones (Rajagopalan & Sarkar, 2008) as a positive externality (Clark, 1999; Clampitt, 2001) contributed by the concerned social network.

The nature of the network has a critical influence upon knowledge transfer and its transformation across the transfer channels. Communication, exchange and activities within the networks may be undertaken either through formalized channels and procedures, or in an informal and unstructured way, or a combination of both at certain levels. Locally based networks are likely to be informal in nature where personal exchanges take place between the interdependent members predominantly based on trust and commitment. Within these networks, Knowledge exchange is supposed to be constructed by dynamic interplay between the members. Global networks are generally formally constructed (Ruskulis, 2002). Formally established networks are obliged to communicate in a formal way where nodes are contractually positioned under compliance in a vertical hierarchy with consistent conditions, pre-assigned tasks, pre-specified outcomes and static relationships (Table 2). Including alien nodes in the network from geographically distant and unseen regions is a critical factor for ensuring trust and commitment levels in an informal local network. In contrast, global networks with preconditioned contractual obligations from the respective nodes, alien or familiar, ensure its' own stability and sustenance.

Table 2. Mechanistic Vs Organic Network

	Mechanistic/Formal	**Organic/Informal**
Conditions	Stable, Consistent	Changing, Creative
Network Nodes	Highly Specialized, Independent	Interdependent
Links	Depending upon functional relationship, Static	Continuous adjustments through interaction, dynamic
Structure	Vertical Hierarchic,	Lateral Hierarchic,
Sharing	Contractual	Trust
Location of Knowledge	Reinforced at the hierarchic positions	Spread everywhere in the network
Knowledge representation	Static, Pre-specified	Dynamic, Constructed
Flow Control	Compliance	Commitment
Outcomes	Pre-specified	Innovative

3.5 APPLICATION LINK: THE NAIP-KNOWLEDGE MANAGEMENT SYSTEM

In an effort to promote technology-led-pro-poor growth, and diffusion of new technologies for improving agriculture yield and rural livelihood in India, a multipronged effort has been initiated by Indian Council of Agriculture Research (ICAR), with the assistance of World Bank, called the NAIP[10]. One of the many objectives of this project is to create a knowledge management system with the agriculture domain experts and practitioners from the agriculture extension system[11] based in the villages throughout the country. The NAIP's approach is to create a knowledge organization and facilitate knowledge management that allows the development of highly integrated approaches between agriculture research and education sector with established extension processes such as Krishi Vigyan Kendra (KVK), emerging actors in private sector extension and with organizations promoting rural information access centers. Knowledge communities of practice from geographically and culturally disparate research and academic institutes having common interests in agriculture come together using a digital ecosystem-based IT infrastructure which has a hybrid network structure between mechanistic and organic. The network created by the knowledge nodes is supposed to develop new and revived linkages between research and education sectors with agriculture extension, through the use of ICT mediation and contemporary practices of knowledge management.

3.5.1 NETWORK SEGMENTATION: CONTENT COMMUNITY AND TARGET COMMUNITY

The adopted process under NAIP-Knowledge Management project is to blend the multidisciplinary technological and research oriented knowledge organizations in order to connect the users through a series of software interfaces to enable multi-mode delivery. This group of knowledge organizations can be termed as the 'content community' who are responsible for assimilation of static knowledge and certifying dynamic knowledge or practice based knowledge from 'target communities[12]' (discussed later). The member institutions of this community are functionally clustered into three main groups with different roles and responsibilities. The first group[13] consisting of IITK, IITB, IIITM-Kerala and NAARM-Hyderabad, is supposed to play the role of ICT resource institutions. Private sector partners including NGOs in applied IT development are expected to be brought on as consultants/contractual service providers for short term requirements of the partners. As digital knowledge ecosystem develops, it is expected that such partners would voluntarily participate based on mutual benefits. The second group of institutions consisting of G B Pant University of Agriculture and Technology and University of Agricultural Sciences-Dharwad, supposed to provide agriculture information and learning resources. The third group

[10] National Agriculture Innovation Project, http://www.naip.icar.org.in/

[11] For example, Kisan Vigyan Kendra (KVKs) for providing scientific knowledge to the agriculture community.

[12] The terminology 'target community' and 'content community' has been developed by the authors in an effort to characterize the different nodes in the network.

[13] IITK: Indian Institute of Technology, Kanpur; IITB: Indian Institute of Technology, Bombay; IIITM: Indian Institute of Information Technology and Management; NAARM: National Academy of Agricultural Research and Management.

consisting of ICRISAT-Patancheru[14] and NAARM-Hyderabad would facilitate interaction among agriculture research scientists and educators as well as among the technology developers. So we can see there are many separate nodes and group of nodes of similar functional area working together as a community of practice and acts as a significant source of 'explicit knowledge'.

In addition, there is tacit content which is contributed by 'target communities' who are at the receiving end in the form of KVKs and other deployment partners, where farmers and agriculture workers can interactively communicate, access and exchange knowledge content. The 'target community' is responsible for dissemination of knowledge to the farming community who would apply the learning in their daily practices. Most of the tacit content is supposed to be provided by the rural local communities at the receiving end enabling dynamic information to be captured in the digital knowledge ecosystem (DKE). Thus, while this 'target community' is predominantly the 'user group', they are also the knowledge creators through their active participation and sharing experience in the DKE. 'Mutuality' in knowledge sharing is the motivation for participation of both the communities within and between themselves. This network is formed only on the grounds of 'common' interests. Content and target communities are identified, not selected and so because of the existing nature of the respective communities.

3.5.2 POWER DISTRIBUTION AND CREATION OF HIERARCHY

One of the most critical issues in knowledge sharing in the network is distribution of power across the actor nodes to control knowledge flow. Power structure, which decides the nature of hierarchy and direction of flow across the network links, can be addressed by balancing the context of 'open access' (Suber, 2004) and content security implications (Randeree, 2006). Putting access pre-conditions upon knowledge content may pose barriers to the flow and restrict the undesired diffusion of knowledge, which is a critical aspect from 'security' vantage point, while open access strategy is critical from the 'sharing' vantage point within the network and can promote intentional 'effusion' of knowledge.

Considering the hierarchical dimension of the knowledge network, nodes can be clustered into two operative segments; a cluster of 'content community' which predominantly acts as constructor and controller of the knowledge flow; and a cluster of 'target community' who are predominantly users of the created content and are being controlled by the former cluster. Content sharing is supposed to be the obvious process within the 'community' as reflected from its concept of origination into its existing form, while security is critical to the content transfer across the boundaries of different communities. There may be certain nodes in both the segments, which have the role of both sender as well as receiver and communicate with each other in order to create knowledge content within the boundaries of their respective clusters. In an effort to create a functional e-community of practice among experts and practitioners in the agricultural domain to promote a process of autopoietic social learning, we propose a network structure which contains a combination of both lateral (within the

[14] ICRISAT: International Crops Research Institute for the Semi-Arid Tropics

community) as well as vertical (across the community) hierarchy in the knowledge network depending upon the nature of knowledge flow (Figure 5).

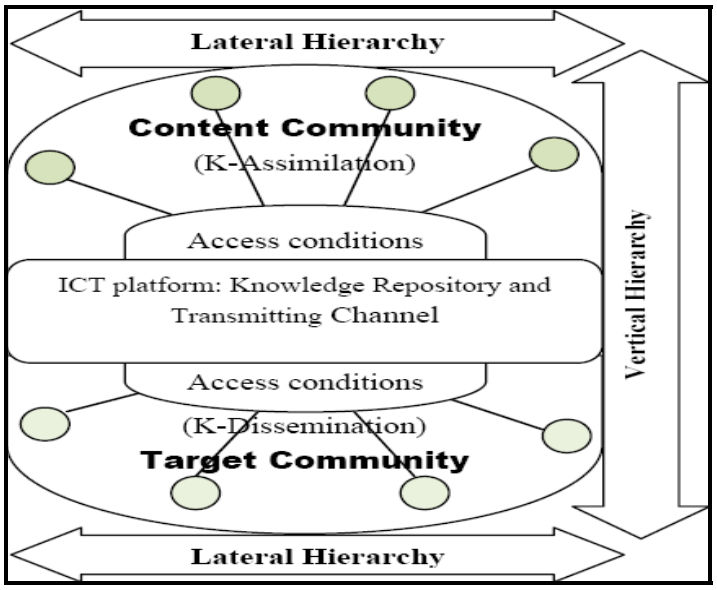


Figure 5. Proposed Knowledge Sharing Network.

The interactive interface and medium of content transfer is provided by an ICT enabled foundational platform, which acts as a repository of knowledge content and also as a virtual administrative body. Knowledge nodes under the respective communities have to possess certain conditions to enter the network and to use the content stored in the integrated knowledge repository. Communication within the network has the potential to follow both arrow and circuit approaches according to the position and responsibility of the respective nodes. However, in order to proceed from ICT enabled network spaces towards a digital knowledge ecosystem (Bray, 2006), there is a continuous requirement of exploration and exploitation of knowledge to develop a dynamic, organic, and demand led knowledge sharing system. Such a network transformation can minimize the strategic influence of arrow approach and maximize the influence of circuit approach of communication. Incorporating the existing and easily grasped depictions of cultural patterns within the communities into the network practices can essentially foster inclusive learning, and participative knowledge sharing. Communications of the informal networks can also be systematically embedded and formalized into a standard knowledge sharing platform integrated with the formal knowledge network using semantic tools.

The NAIP-KM knowledge sharing platform is now being formalized through extensive interactions with all its stakeholders, the content and target communities, as well as other potential nodes such as corporate bodies involved in rural business and rural development bodies including NGOs. Understanding the social value creation is critical at this stage of the NAIP-KM endeavour.

3.6 CONCLUSION

Knowledge, communication and social networks constitute the central dimensions of knowledge management. Knowledge management has been transforming from information management mechanics to a social sharing culture, enabling the organization to consistently create new knowledge, disseminate it through the organization and manifest it into technologies and products. At the same time, it is critical to also bear in mind the risks involved in the treatment of knowledge as a resource that can actually be "managed". This is why knowledge spaces are the nodal elements of the knowledge network and ICT is the key enabler to foster capacity generation at the links and facilitate flow across the knowledge nodes. Sharing of knowledge including existing and potentially identified knowledge spaces within network structures is the initial step to capture knowledge.

Appropriate networking of knowledge spaces is essential to develop an organic knowledge architecture assuring the smooth flow of captured knowledge with secured and controlled diffusion. ICT plays a foundational, embedded as well as complementary role for transforming the knowledge from existing static form to the fluid state and enables it to flow to the unreached positions of the network. The structure of network embedded with socio-technical characters has many critical aspects of its sustainability. A network having organic structure and decentralised control has the presumption that all the members are actively and complementarily playing their roles and capable of dynamically changing their functions and responsibilities responding to the change in network environment. The chapter tangentially acknowledges the role of power or hierarchy in stymieing knowledge flow, which complements the research presented in D12.10. To qualify for entering into the organic network, actor nodes have to possess high level expertise and multifunctional flexibility to adapt to the dynamic conditions. Organic state is characterized by its fluidity and dynamism, and actor nodes having aforesaid features provide sustainability to the whole network. Thus the network within the 'expert' content community discussed in this paper appears comparatively more efficient and sustainable while the network formed within the 'naive' target communities seems to be unstable in nature. However, the network created between the two communities certainly diffuses the character of sustainability and stability through the sharing of knowledge and experience.

The ultimate aim is to have a changed knowledge management scenario, where poorly informed spaces became knowledgeable proactive knowledge sharing nodes, demoralized knowledge actors transformed into motivated and absorptive ones, and dispirited mechanistic organizations reinvigorated into organic learning systems. The approach towards one such effort in the Indian agriculture domain has been briefly described in this paper, after synthesizing the pre-requisites of such a system from literature.

4. CONCEPTUALIZING 'KNOWLEDGE ORGANISMS' FOR A SUSTAINABLE DIGITAL KNOWLEDGE ECOSYSTEM[15]

4.1 INTRODUCTION

In the present scenario of a digitally connected and globalized world, knowledge and information sharing has become a critical element for collective benefits of the intellectual community and practitioners. In order to promote knowledge sharing, creating digital networks among social groups has been one of the initiatives to form a knowledge-based system. Knowledge is an object which is socially constructed by group interactions and collective brainstorming (Nonaka and Konno, 1998). To organize the process of knowledge creation, and make the created knowledge accessible to a large number of user groups, it is essential to conceptualize a 'self' powered knowledge sharing system which can develop, grow and sustain itself. Within this system, a balanced combination of technology and social relationships among the knowledge actors results in a socio-technical network which further passes through a series of systematic growth cycles and evolves into a digital knowledge ecosystem (DKE). While studying the knowledge based digital ecosystem has been a common concern for many scholars (Rajagopalan and Sarkar, 2008; Amritesh and Sarkar, 2008), the search and analysis of the internal mechanism of sustained growth and development has been neglected. Therefore we follow an evolutionary framework where one system transforms into other having the having comparatively better set of capabilities and a more prolonged lifecycle. The transformation in the system characteristics is always accompanied with a synchronous transformation of the actors' characteristics that constitutes the system mechanism.

4.2 FROM LEARNING COMMUNITIES TO KNOWLEDGE SHARING NETWORKS

There is a significant difference between learning and sharing the knowledge that has been learnt. The basic driver of forming a 'community to learn' differentiates it from the drivers to create a 'community to share'. Although the process of collective learning can diffuse the knowledge outside the community, this process cannot be considered equivalent to knowledge sharing and the scope is narrowly limited to the concerns of the members of single community. On the other hand, the spirit of intentional sharing (different to unintentional diffusion) of knowledge results in a the creation of an open inclusive environment where people from any community can willingly join the common space and participate in it as a contributor of knowledge on a voluntary basis for a large number of recipients, who may not be from the same community. Connecting people and organisations in a digital network from geographically distributed locations across the world having a shared vision and common purpose is the prerequisite to creating a knowledge sharing environment. From a social perspective, the

[15] This chapter was presented as a paper in the IEEE-DEST conference at Istanbul 2008 (Amritesh and R. Sarkar, "Conceptualizing 'Knowledge Organisms' for a Sustainable Digital Knowledge Ecosystem", Third IEEE International Conference on Digital Ecosystem and Technologies, 2009)

networks are formed within communities where individuals and groups having similar interests come together, interact and exchange their ideas, thoughts and beliefs. Normally, people at one geographic location can easily form their local network for their mutual benefit. Such networks are often seen as 'Communities of Practice (CoP)' when their purpose is to learn together as a social system (Wenger, 1998). When people of CoPs residing at different parts of the world are linked through ICT enabled knowledge sharing platforms, these networks are conceptualised as 'knowledge networks' (Seufert et al, 1999; Prothmann, 2006).

CoPs are characterised by three basic elements: 'shared domain of interest', 'forming community network to stay connected' and 'repeated collective actions for mutual learning' (Wenger, 1998;2009). During the process of learning, the members of CoP continuously interact, exchange their ideas and consequently create new knowledge. Subsequently, they share it for mutual benefit. CoPs don't specify any membership criteria, rather they are driven by a collective motivation to learn and practice similar subjects. Besides having a collective sense of informal identity, the members of the CoP might be recognized as distinct entities of their organization and have the potential to infuse or diffuse their learning to their immediate environment. When they are connected to the network, they get an opportunity to use their potential to disseminate their knowledge to the linked members and organisations. Members of CoP form knowledge nodes for interpretation and exchange of knowledge inside a network. From a broader perspective, the network created among the CoPs, or among the people who are the members of CoPs, can have a huge potential to accelerate the process of interaction and knowledge exchange through intentional infusion or unintentional diffusion[16]. Knowledge communities are social groups with a common passion to create, share and use knowledge, and are characterised through shared values and common commitment that create sense of belonging, trust and openness amongst their environment (Prothmann, 2006). Such communities, when enabled by ICT to connect geographically distributed knowledge actors are known as virtual knowledge communities (Dickinson, 2002). Fully functional CoPs can easily be formalised, networked and spiritually transformed to become a substantial part of any Knowledge Community. 'Knowledge Communities', despite having a lot of similarity with CoPs, have a significant theoretical difference which moulds their pattern of behaviour. Prothmann (2006) further distinguishes them as follows.

CoPs originate from informal groups shaped by circumstances with its boundaries rarely visible, while 'knowledge communities' are purposefully formed to shape future circumstances with its boundaries clearly visible. According to the functional perspective, the CoPs are practice based communities, while Knowledge Communities are based on sharing of acquired knowledge. The collective learning environment of CoPs creates innovative ideas and knowledge which is presumably diffused unintentionally to their practise environment. But a Knowledge community intentionally creates a flow of knowledge to form a collaborative environment of mutual sharing and exchange. Knowledge Communities, despites having the functionalities of identification, creation, dissemination and transfer of knowledge, also have the potential to re-construct its own organisation and network structure. Such social groups when networked through ICT supported digital infrastructure and brought to the common interactive platform, forms an active

[16] **Infusion** is the act of introducing a certain modifying element or quality; **Diffusion** is dispersion of something from an area of high concentration to low concentration.

knowledge network (Seufert et al, 1999). The knowledge network consists of knowledge actors as its nodal elements and a set of social relationships under which they are mutually connected.

4.3 CONCEPTUALIZING A KNOWLEDGE BASED NETWORK ENVIRONMENT: THE DIGITAL KNOWLEDGE ECOSYSTEM

The source of motivational and commitment spirit, and the coherence of objectives to learn together and share reside in the individuals of the respective community networks. The networked environment highly reciprocates the characteristics reflected by the nodal members, and in turn influences, transforms and shapes their individual characteristics. For the purpose of description and analysis, here we are assuming two separate variables: 'system' and 'actor', both of which get influenced by each other. The system consists of a physical network of actors, which are formed either by existing informal social relationships, or by imposed formal relationships. Such relationships initiated with weak social ties are further strengthened by ICT enabled networking (Rajagopalan and Sarkar, 2008a) which is also an essential part of system infrastructure. ICT enabled networks provide a sense of recognised identity to each individual and make their actions visible to the other entities of the dispersed community.

The ecosystem based approach is often invoked and widely accepted in various domains of research frameworks (Amritesh and Sarkar, 2008; Nachira et al, 2007; Lavrin and Zelko, 2006; Rajagopalan and Sarkar, 2008b). Natural ecosystems are said to be composed of living organisms and their interaction with the physical environment. Although the entire natural ecosystem is interconnected and interdependent, one can define the boundaries depending upon the nature of study and classify them into various specific domains, e.g. aquatic ecosystem, terrestrial ecosystem, agricultural ecosystem, etc.

In the network context, an ecosystem can be visualised as a set of biotic nodes and structured interconnections according to their level of interdependence. Biotic communities are considered as the heart of the ecosystem and therefore are the central focus of the study to understand the behavioural and functional characteristics of the ecosystem. These include producers and consumers at different trophic levels. An ecosystem continuously keeps transforming energy and this process remains independent of the birth (or entry) and death (or exit) of organisms.

Analogous to a natural ecosystem (Odum, 1988), a Digital Ecosystem (DE) possesses similar characteristics e.g., associative and autopieotic features, capability of self organisation, self sustenance, capacity to enlarge its boundary through heightened inclusion of heterogeneous actors, and diversified scope of the network. The concept of DE is well adopted for sharing information and knowledge in business networks (Nachira et al, 2007). In the context of business, a DE provides a virtual networked environment where all the business stakeholders including suppliers, manufacturers, government authorities etc are the nodes, which result in a regional business digital ecosystem (Lavrin and Zelko, 2006).

When the purpose of the ecosystem concentrates upon the activities of knowledge co-creation, assimilation, storage, dissemination, transfer and transformation; and when the mode of communication across such knowledge flow networks is constructed by digital infrastructure, then the entire system tends to convert into a 'Digital Knowledge Ecosystem (DKE)' (Amritesh and Sarkar, 2008). The DKE is a knowledge based system where knowledge acts both as the

initial element and as the final element to be focused upon. It is independent of the entry or exit of knowledge actors, whose movement does not disturb the knowledge transfer across the nodes. It is understood that a DKE is composed of three distinct and explicit entities:

1. Social groups which may include CoPs, local communities having shared interest, knowledge networks (KNs), etc.

2. Operational activities and transactions among the knowledge actors who can learn, construct, manage and share knowledge; and

3. A digital infrastructure catalysed by ICT which is composed of multilayered client-server hardware architectures, software, storage and database, wired/wireless networks having high bandwidth, middle ware etc.

4.4 THE SYSTEM DEVELOPMENT HIERARCHY

We categorize the knowledge-based social systems into three levels of depending upon their level of stability, maturity, sustainability and reproducibility. The three levels are categorised as CoPs, Knowledge Networks (KNs), and Digital Knowledge Ecosystem (DKE). In CoPs, the relationships among the members are mostly informal and based on their common but essentially individual needs. In KNs, the relationship between the connected actors is based upon common needs which are composed of partially individual but essentially social requirements. At this stage, digital networking result in getting the members connected, but members are not habituated to use the digital infrastructure in their own favour; rather they follow the technical system and adjust themselves according to the ICT's functional requirements and constraints.

One can enter into the knowledge network not only to learn, create and use knowledge, but also to share it across the network and eventually to form an 'open knowledge space'[17] (OKS). The OKS provides the highest level of accessibility potential to all the connected members and encourages them to construct, share and use the collectively contributed knowledge. DKEs are at the highest level of the knowledge based social system hierarchy, which is not only able to adjust its own organisation and network configuration, but also able to enlarge its boundaries and develop with time. In this system, the networked knowledge actors are supposed to be the domain experts and controllers of the digital infrastructure of ICT, and they not only can adjust their organisational configuration to fit into the technical requirements, but also they can customise the technical environment and make it suitable for their collective organisational structure. This is a system which has a visible physical organization and conscious spirit to develop and adapt itself according to the changing network environment.

The level of system intelligence would gradually become higher as the group transformation proceeds from CoP to KN and finally towards DKE, as represented in Figure 1. Here ICT is the most critical element of the DKE, failure of which would lead to the entire network and organization getting disrupted and the collective potential created among the members remaining unused and gradually lost. What follows is a brief description of the transition of actor

[17] The concept of OKS is taken from OPAALS philosophy of knowledge sharing (http://www.opaals.org/)

attributes as the knowledge based social systems of which they are a part transform as discussed in this section

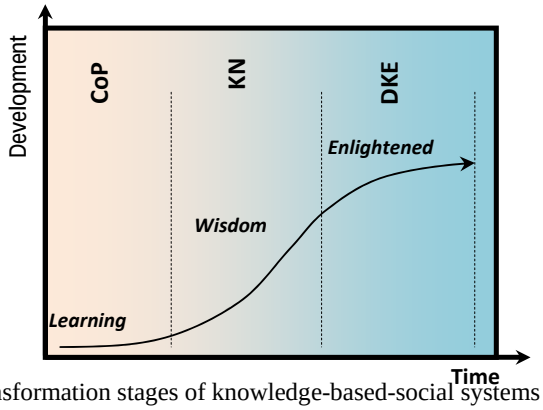


Fig. 1. Transformation stages of knowledge-based-social systems

4.5 THE ACTOR GROWTH HIERARCHY: FROM DISPIRITED ACTORS TOWARDS PROACTIVE KNOWLEDGE ORGANISMS

It is quite apparent that the mechanism of system dynamics influences the behavioural and functional characteristics of actors within the system. Another obvious observation is that every system is driven forward only by the active involvement of living actors. The system and its actors both influence each other depending on their capacity of influence and power to dominate each other. Here, in case of an emerging DKE, which is a unique system of its kind, it can be taken for granted that the driving power comes from the collective spirit of individual actors who are trying to create a new kind of system, which, apart from managing its own operations, also keep adding a new set of active knowledge actors to take care of the sustainability of the system. The characteristics of system actors are also different for different kinds of systems. In the earlier section, we discussed three different systems: CoPs, KNs and DKEs; and their transformation stages within the system hierarchy (Figure 1). When one system tries to transform itself, then the characteristics of the actors are also supposed to transform. According to the system requirements, the levels of intelligence and functional capabilities among the members are also quite different. Table 2 summarises the characteristics of the actors at different stages of transformation of knowledge based social systems.

Wenger (2009) has explained the life cycle of a CoP in the form of a bell shaped curve having five progressive stages: Potential, Coalescing, Active, Dispersed, and Memorable. Each stage reflects the changing interest and frequency of involvement of the active members. Stage 1 (Potential) is the time when needs are felt between the individuals and reason is created to form a community. In the second stage (Coalescing) they start forming the community and start growing together. The next stage (Active) brings them to the level of maturity and after cultivating expertise, they start adapting with changing conditions. Up to here, their frequency of interaction gradually keeps on increasing, and hence their ability to create new knowledge is also at a peak. In the fourth stage (Dispersed) the members reach the level of stewardship and provide consultancy support to fresh incomers. Here, although the lifecycle of the CoP is on a decline, the 'intelligence' of the node is still active but not frequently practiced in the same community. In the last stage the CoP is almost dead, members are not in collective practice but the community is still alive in memorable stories.

The actors of a CoP, as long it is in the active stage of its lifecycle, are primarily supposed to be in learning state most of the time when they are frequently participating in the community. In contrast, in the case of knowledge networks, actors have achieved certain levels of wisdom and are beyond the state of learning and have evolved to a state where they observe their learning conditions which influence their external environment of learning. They also become capable of exercising control their environment with the help of the ICT enabled digital platform. At this level, they are not only domain experts, but also have substantial skills of ICT. At the highest level in a knowledge ecosystem, the actors reach the ideal state of enlightenment by attaining complete awareness of their expertise, their system, and what is needed to extend the current state of knowledge and start utilising ICT to meet these collective requirements. The actors have attained the power to optimise their performance as well as to create similar other actors for inclusive enlargement of the system boundary. At this stage, the actors have a collective consciousness and their collective actions guide the entire system to create an open knowledge space. We define this enlightened state of an actor as a 'knowledge organism' (KO). We describe the KO in more detail in the next section. Such KOs are not only experts of their knowledge domain, but also of their digital environment where they can get the ICT tools to adjust to their needs and collective vision of sustainability rather than the other way around.

4.6 CONCEPTUALISING A KNOWLEDGE ORGANISM

The ecosystem, or ecological system, is considered to be a unit of biological organization made up of all of the organisms in a given area (that is, "community") interacting with the physical environment so that a flow of energy leads to characteristic trophic structure and material cycles within the system (Odum, 1969). The management paradigm has been shifting to learn from the self maintained natural ecosystem and efforts are being made to replicate such kinds of systems in various other domains including business, organization and management. Organisms are the key role players of any ecosystem and are responsible for several activities like creation, diffusion and transformation of substances from one to another. Organisms are also considered as engineers of the ecosystem wherein they directly or indirectly control and modulate the availability of resources by physical state changes in biotic or abiotic materials and consequently modify, maintain and create habitats(Jones et al, 1994, 1997). According to the scale, magnitude and nature of impact, they are categorized into 'Autogenic' and 'Allogenic' engineers (Jones et al, 1994). Autogenic engineers bring changes to the environment and hence to the entire ecosystem by changing their own physical structures, while Autogenic engineers impact by transforming the external environment by some external or mechanical means.

Certain common phenomena like capability hierarchy and domination are supposed to prevail across all the organic species. There are some organisms whose presence or absence can have a substantial cascading effect on the entire ecosystem. Any organization driven by individuals and groups possessing the character set of such organisms are supposed to be more sustainable. The actors with such organism like characteristics are further empowered by ICT mechanisms in these organisations.

In the context of a DKE, such organisms are comparable to 'knowledge activists' (Krogh et al, 1997), who are made responsible for catalyzing, connecting and establishing a vision for knowledge creation and sharing initiatives. Their functional characteristics are highly coherent with the Allogenic engineers of natural ecosystems. Knowledge activists with allogenic

engineering skill, when added with autogenic features and further equipped with ICT skills, form the ideal 'Knowledge Organism' (KO). The KO plays multiple roles, which includes Knowledge Creator, Assimilator, Disseminator, Manager, Users etc. according to the requirements of the system architecture and collective needs. Other contrasting features of KOs with respect to knowledge actors are summarised in Table 2. The creation, organisation, maintenance and sustainability of a DKE will depend greatly on the relative number of KOs among the knowledge actors. One can easily predict and make approximate judgement about the long term performance of a DKE by just observing the number of fully functional KOs consistently present over a period of time.

Table 1. Distinguishing features of knowledge actors

Actor	Short Description of Characteristics
Learning (CoPs)	Individual need based collectivism Knowledge exchange only for learning Awareness of mechanism lies only at a level of partial abstraction of the practice domain No usage of ICT
Wise (KNs)	Shared need based collectivism Knowledge exchange for learning as well as sharing Partially aware of mechanism and have better abstraction of the practice domain Able to observe, measure and exert control over the system variables Started adopting ICT, but in an unempowered state and inability to customise the ICT platform for meeting practice domain requirements
Enlightened (DKE)	Collective need based collectivism Knowledge exchange for learning, sharing and sustaining knowledge flow. Fully aware of functional and growth mechanism, with ability for complete abstraction and influence of practice domain Able to optimize the knowledge ecosystem performance by imposing collective control Fully adapted to and adopted use of ICT, can customise ICT platform according to the practice domain requirements and sustainability

Following the energy transfer and transformation principle of natural ecosystems (Odum, 1988), the KOs take part in knowledge transfer and transformation in DKEs. The DKE consumes knowledge as its seed (energy) and produces much more refined knowledge after continuous transformation from one form into another (Tacit-Tacit, Tacit-Explicit, Explicit-Explicit, Explicit-Tacit) by the natural engineering activities performed by the KOs according to their needs, capabilities and aspirations (Nonaka and Konno, 1998). The digital network supported by ICT provides almost a complete picture and full abstraction of the DKE to the KOs, which further empowers them to track the lifecycle of their system and take essential steps when they find that their habitat (DKE) is in the state of malfunction or declining. All the functional features of the KOs collectively result in a DKE which appears to be self originating, self organising, self managed, self maintained, and self sustainable. The DKE, empowered with the superficial appearance of a 'Self' happening system is fundamentally created by the collective and 'proactive' contribution of the KOs.

4.7 MAPPING THE INTELLIGENCE CURVE: ACTORS AND SYSTEM

A comparison of the functional characteristics of knowledge actors of the three progressive knowledge based social systems are summarised in Table 1. The consistent presence and persistent contributive participation of members is not only a sufficient, but an essential condition for instilling sustainability in a DKE. The members of a DKE may be individuals, or CoPs having a collective identity, or even a formal institution or organisation. A DKE must also posses the feature of being independent of entry or exit of the constituent members and have the ability to reproduce and enlarge its boundary through recurring inclusions. The process of evolution of a DKE and its sustainability thereafter, as related to communities of practice entering and exiting the DKE, is represented in Figure 2. At any one stage of a DKE (after it is formed), there are multiple CoPs that enter or exit the ecosystem. Figure 2 depicts three such COPs, with bell shaped curves characterising their lifecycles (Wenger, 2009). As the actors in the first CoP evolve from the learning stage (L1) to becoming wise (W1) and then enligtened (E1), the CoP evolves into a small DKE and further move up to be the part of a larger DKE. As the lifecycle of this CoP is on decline, it produces and leaves another intelligent CoP. When actors attain the W1 level in the first CoP, they engage with and develop a second COP, which merges with the DKE at an accelerated pace. As the first COP dies, the 2nd COP has already taken its place and is engaging with a third COP. The group L1-W1-E1 represents the interaction between the members at different intelligence levels in a CoP. Similarly L2-W2-E2 and L3-W3-E3 are for other CoPs respectively. As the members' stage of intelligence improves, they acquire the potential of influencing and teaching the relatively unintelligent members of their own community and also of other CoPs. W1-L2, E1-W2, W2-L3 etc are some of such kind of inter-CoP interactions in digitally networked learning environment. Some lateral interactions like L1-L2, W1-W2, E1-E2 etc are also possible in a densely connected network infrastructure where individuals of any level can have access to all the levels.

In reality, there may be many CoPs at a single intelligence state (learning, wise or enlightened), and to understand the complexity of interaction dynamics of a DKE, we would have to add a third dimension to Figure 2. This dimension could depict the number of CoPs participating in the DKE at any particular instant, their intelligence states and how they are influencing each other. A similar situation happens within the members of a CoP as they advance from learning to a learned state in the collective learning environment with expert guidance from the comparatively learned members who are at a higher level stage in Wenger's (1998) curve.

The emerging intelligence within the members of one community potentially create more intelligent members within as well as in the other networked communities and make them available to be a part of the DKE. The opposite should also follow, i.e., the learning members must be committed to rise higher in the intelligence hierarchy, become aware of the vision of collective knowledge sharing, and ultimately commit to be a part of the DKE.

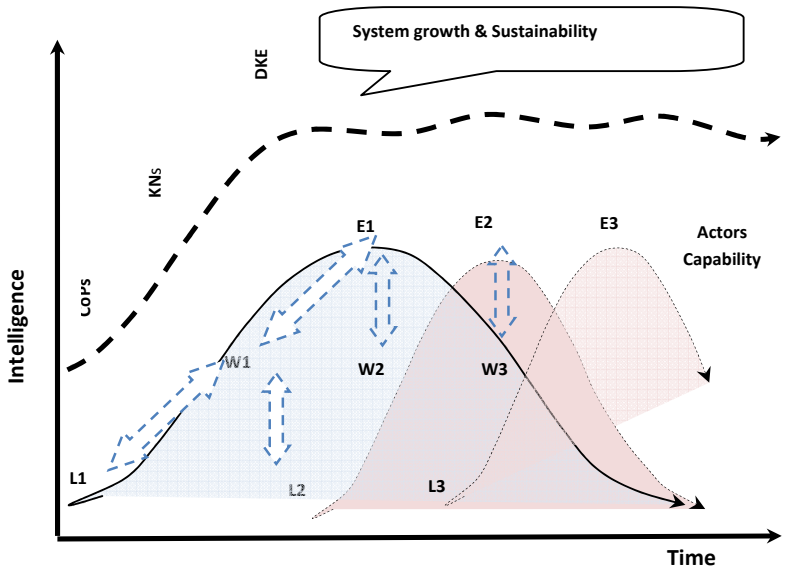


Fig. 2. Creating Intelligent Knowledge actors for a sustainable DKE[18]

4.8 CONCLUSIONS

The common need of learning and the common will of sharing are fundamentally different spirits which collectively drive the creation of a knowledge based system and take account of its lifecycle and sustainability. A DKE is not only a conglomeration of knowledge actors working together, but it is driven by a sustained collective spirit. This paper asserts that this spirit evolves when the knowledge actors transform into knowledge organisms. The presence of KOs and the extent of KOs can determine the path that a DKE will follow. Thus, the concept of 'knowledge organisms' can be further developed as a parameter to analyse and assess the operational effectiveness and sustainability of a DKE. It must be noted that for this chapter we have looked at the DKE system as a whole and a single unit, which is distributed and decentralized. Then we have gone a step further to characterize individual nodes (actors) of such a DKE. We have not attempted to look at the organization of the DKE, which has already been in the previous chapter.

[18] L→ Learning, W→ Wise, E→ Enlightened.

5. LEVERAGING SOCIAL CAPITAL TO TRANSFORM COMMUNITIES OF PRACTICE INTO DIGITAL KNOWLEDGE NETWORKS: THEORETICAL INSIGHTS AND EXPERIENCES[19]

5.1 INTRODUCTION

'The term social capital is here to stay ... as a useful metaphor to draw attention to those *particular institutions serving economic life that might otherwise go unnoticed. Once attention is drawn to them, we need to try to understand them and find ways of improving them or building around them.'* Dasgupta (1999). Deriving from this quote and the premise that social capital is being seen as a driver of economic growth (see Dinda (2008), Knowles (2005), Eiji (2008), for example), this paper forwards an approach to strengthen development projects by leveraging existing social capital in the Indian agricultural domain. Specifically, we illustrate how information and communication technology (ICT) tools can result in increasing community participation to better leverage common resources, so as to further the aggregation, creation and sharing of agricultural knowledge among the various actors. The role of ICT as only process enhancing, a mere tool to speed up the transaction without altering the structure or nature of relationships, has changed. Social relations with the associated concepts of trust, reciprocity and cooperation, as denoted by membership in formal and informal networks used by an individual in entering both market and non market transactions (Labonne and Chase, 2008), are linked to the success of any ICT initiative. At the same time a successful ICT initiative to transform existing offline communities to vibrant online ones can foster existing social relations as well as build new relationships (Hopkins and Thomas, undated).

Before reporting on the experiences in implementing this approach, the paper situates the concept of social capital in economic discourse, attempts to understand some measures of social capital in section 5.2 and takes stock of the changing nature of social capital in Indian agriculture in section 5.3. A presentation of two live case studies, documenting our experiences in implementing ICT initiatives comprises section 5.4. Section 5.5 concludes by summarizing the implementation approach which leverages social capital and fosters it, as has evolved through our practical experiences.

5.2 SOCIAL CAPITAL

Social capital is a relatively new concept in the field of economics, which attempts to bring to the fore "*intangible social dimensions to economic activity such as trust and community*" (Spies-Butcher, 2003). Its importance in understanding and promoting long term and inclusive models of local economic development has attracted the attention of policy makers and social scientists alike (Evans and Syrett, 2007). Social capital can be defined as a set of associations, both horizontal and vertical, governed by networks and norms which foster social trust and are

[19] This paper was presented by Runa Sarkar at a seminar at Indian Institute of Management Calcutta in February, 2009

capable of working for the mutual benefit of the group by fostering cooperation and co-ordination (Collier 1998). On an institutional level, social capital is a formation of assets that allows and facilitates certain action while it restricts others. On an individual level, it is a resource that opens up access to (embedded) assets while requiring solid action to maintain. Greve et al (2006) referring to Burt (1992) argues that "*The value of social capital depends not only on how many contacts an actor has, but also on the structure of his relations within the network*". The processes that turn the individual social capital into institutional capital encompass the creation of normative systems, allocative mechanisms and linkages. Therefore, social capital is a broad notion of both individual and collective levels rather than a one-dimensional resource. While a comprehensive review of conceptual frameworks for and an annotated bibliography of social capital is available in Feldman and Assaf (1999), in the paragraphs that follow some of the key contributions on social capital as they relate to communities of practice and economic development are presented.

Bourdieu (1985) delineated '*social capital as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition*". Coleman (1990) defined social capital by the effect of its absence: "*…social organization constitutes social capital, facilitating the achievement of goals that could not be achieved in its absence or could be achieved only at a higher cost.".* Bebbington (1999) posits that social capital is closely related to the notion of access. Woolcock (2001) defines social capital as the norms and networks that facilitate collective action. Further, he calls social capital a precious '*resource*; arising out of an individual's kin, friend and associate ties which comprise the asset. Connections among individuals, referred to as social networks, result in norms of reciprocity and trustworthiness (Putnam, 2000). Interactions among groups of individuals are central to Ostrom's (2000) definition of social capital. This is true of Knack and Keefer (1997) as well as the World Bank (2005).

Durlauf and Fafchamps (2004) focus on the effects of social capital when they posit that "*social capital generates positive externalities for members of a group, which are achieved through shared trust, norms and values and their consequent effects on expectations and behavior. The shared trust, norms and values, themselves arise from informal forms of organizations based on social networks and associations."* While describing the process of formation of social capital, Lin (1999) defines social capital as "*the investment in social relations (individual level) and networks (group level) through the utilization of which the entrepreneur gains access to embedded resources and enhance returns*". Sobel (2002), who has critiqued the concept in great detail, defines it as "*circumstances in which individuals can use membership in groups and networks to secure benefits*." It is important to note that social capital is a measure of the capacity for self-enforcement, or voluntary group enforcement as opposed to third party-enforcement. An exhaustive summary of definitions of social capital is tabulated in Knowles (2005) who extends the compilation by Durlauf and Fafchamps (2004), and likens it to informal institutions as put forward by North (1990).

Searching through definitions, some keywords appear to be particularly popular. *Norms, rules or procedures* along with *resources* and the matter of *access* emerge as the driving notions of the discourse on social capital. Scholars present *trust and reciprocity* as enablers (as well as restrictors) of social capital. *Networks and relationships* serve as the platforms on which every social capital exertion takes place. Thus, most definitions of social capital include the concept of trust, networks and group memberships, and a shared set of co-operative norms.

5.2.1 SOCIAL CAPITAL AND ECONOMIC PERFORMANCE

Woolcock and Narayan (1999) identify four distinct approaches to understanding the role of social capital as it pertains to economic development, as represented in Table 1. They conclude that the synergy view, with its emphasis on incorporating different levels and dimensions, and its recognition of the positive and negative outcomes that social capital can generate, has the greatest empirical support relating social capital and economic growth. Existence of social capital results in the resolution of collective action problems, without recourse to government intervention, a greater likelihood of revolving credit schemes being successful, less time spent monitoring workers, greater innovation, and a greater number of transactions taking place (Knowles, 2005). However, there are also arguments to suggest that social capital can act as a brake on economic development. For example, some sets of norms discourage the introduction of new techniques and ideas. Beugelsdijk and Smulders (2004) conclude that for Europe, bonding social capital results in reduced bridging social capital which in turn reduces regional output growth. It is quite possible that farmers may be reluctant to introduce new techniques that would improve productivity, because this would go against the established way of doing things. For example, Rogers (1983) discusses the example of a Peruvian village whose inhabitants largely refuse to boil their drinking water because, according to local custom, only the sick are permitted to drink boiled water. Social networks, such as guilds, cartels, the mafia, political organizations and lobbying groups may provide benefits for members, but this can often come at the expense of non members (Ogilivie, 2004).

Table 1. Four Views of Social Capital. (Source: Woolcock and Narayan, 1999)

Perspective	Key Actors	Policy Prescriptions
Communitarian View: Local associations	Community groups, Voluntary sector	Small is beautiful' Recognize social assets of thepoor
Networks View Intra ('bonding') and inter ('bridging') community ties	Entrepreneurs, Business groups, Information brokers'	Decentralization Creation of enterprise zones 'Bridging' social divides
Institutional View: Political & legal institutions	Private and public sector	Grant civil and political liberties Transparency, accountability
Synergy View: Community networks and state-society relations	Community groups, civil society, firms and states	Co-production, complementarity, Participation, linkages Scaling up' local organizations

Nevertheless, researchers have shown statistical associations between high levels of social capital and a range of benefits, including the development of pluralist democracy, improved physical health, self-rated happiness, public safety and enhanced economic performance and efficiency. The degree of social capital promotes efficiency improvement and capital accumulation at the same time, in contrast to human capital only enhancing efficiency improvement (Eiji, 2008). For a firm, while existence of social capital improves the learning effect in developing stages, human capital drives learning in later stages of maturity and social

capital could have detrimental impact. The more people interact with each other, the better the information they will have about each other, improving the flow of information about best practice techniques, making the introduction of new technologies more likely, and hence increasing the level of productivity. Networks and membership of groups may also help overcome the impediments to information flows due to social divergence.

Some of these associations are merely correlational, while others are almost certainly causal (Johnson et al., 2005). A high degree of trust(worthiness) is required to ensure that members do not free ride, and individuals who are well networked will have good information about other potential members of the scheme (Narayan and Pritchett, 1999). Community-based institutions may also be formed to manage common property resources. In a low-trust environment, entrepreneurs will assume that workers will shirk unless closely supervised, so to reduce this risk supervisors will be hired, reducing productivity. Paldam and Svendsen (2000) argue that a lack of social capital prevents small firms growing into large firms in many parts of Africa for this very reason. With regards to transaction costs, Fafchamps and Minten (2002) argue that when trust is present agents can "*lower their guard and economize on transaction costs such as the need to inspect quality before buying, or the need to organize payment in cash at the time of delivery*." They go on to argue that trust "*enables agents to place and take orders, pay by check, use invoicing, provide trade credit, and offer warranty*", noting that these features of markets are taken for granted in developed countries, but are often lacking in developing countries. Fafchamps and Minten (1999), in their research about Madagascar traders, measure the direct benefits of social capital in terms of value added and in total sales of traders; screening in the labor and credit markets, reduction of the search costs for market opportunities, improvement of the diffusion of information on innovations as well as on bad payers or cheaters and finally the reduction of risk, Moreover, Tsai and Ghoshal (1998) derive the conclusion that intra-firm social capital facilitates the creation of value by spreading techniques and enabling innovation. Wallis et al.(2004) summarize the impact of social capital by stating that "(it) *makes a measurable contribution to economic performance and human wellbeing, particularly in developing countries."*

The most significant outcome of social capital utilization is the access to an aggregation of embedded resources. In an entrepreneurial environment, Portes (1998) presents examples of such embedded resources related to economic activity; such as access to credit, obtaining valued credentials etc. The arguments discussed so far tend to suggest that social capital will affect the accumulation of *other* factors of production, or affect the level of total factor productivity, rather than social capital being a new factor of production in its own right. It can leverage physical and human capital and reduce transaction and monitoring costs. For example, if social capital leads to the establishment of informal credit markets, this will facilitate the accumulation of physical and human capital. When social capital helps resolve collective action problems, efficiency is increased. If social capital reduces transaction and monitoring costs, or leads to the introduction of new technologies, this will increase the level of total factor productivity.

5.2.2 COMMUNITIES OF PRACTICE

Economists view the community both as something that can be explained by economic phenomena and as an explanation for economic outcomes; that is, the community itself can be the object of interest, or the nature of community can help to explain other objects of interest

(Johnson et al, 2005). Social capital is used as a measure of strength and weaknesses of the community. The construction of communities or social networks, defined as "*each one's reticulations, and the fabrication of institutionalized group relations"* need various investments of economic and cultural capital (Portes, 1998) as well as time and skills (Lin, 1999). Social networks result in reciprocity expectations and the group enforcement of norms that guarantee that the investments bring back returns (Coleman, 1988). Social networks are usually formed among people in proximity of each other who share commonalities of interest (Hopkins and Thomas, undated). In the context of agriculture, such networks, communities of practice are among the farming community, trading community etc, with livelihood comprising the common interest.

A community of practice comprises members and the links between different members and different groups in a community, forged through various media, whether digital or in person. The community grows as there are more reciprocal interactions among the members, and as some members form link nodes to other communities of practice. In the rural context, an instance of formation of such link nodes could be marital connections in geographically disparate villages. Since such interactions lead to reduced transaction costs for economic activity, social capital is enhanced both by the deepening of the network (bonding social capital[20]) and widening (bridging social capital[20]). However, communities with too many reciprocal ties as compared to ties with other communities of practice run the risk of group-think (Dasgupta, 2003), which then has a negative impact on development, and would represent a reduction of social capital. Several factors have led to a destruction of social capital including neoliberal ideology, unchecked markets, unemployment and technological change (Leicht, 1999). With human resources becoming increasing mobile, maintaining social capital, embodied in communities of practice or social networks is becoming increasingly challenging. One way to overcome the challenge is to create virtual links for communities of practice in addition to the face-to-face mode of communication that they are used to. If this process is implemented in a manner so as to not disturb the existing social capital, then at the very least, networked communities of practice could use the greater reach of the ICT initiative to reach out to other communities of practice and enhance their weak links if not deepen their existing links. We refer to these networked communities of practice as digital knowledge communities, alluding to the knowledge capital that is embedded in these communities.

There is little clear theory on how individuals or communities get more social capital. Although there are suggestions that communities need to build or re-build their social capital, but there are few concrete suggestions for how to enhance it (Clair, 2005). Paldam and Svendsen (2000) summarize some lessons related to building social capital. Bottom-up trust building communities of practice, formed voluntarily based on risk sharing, tend to grow slowly, but have a longer life as compared to top-down third party-enforced communities of practice. These can be built quickly, but tend to have a short life. Whether communities of practice are successful or not varies from location to location, sometimes because of initial differences in social capital.

[20] Woolcock (2001) defines bonding social capital as links with family, friends and neighbors, bridging social capital as ties that are slightly more distant, such as with workmates and acquaintances, and linking social capital as the ability to benefit from ties with those outside one's immediate group of contacts

5.2.3 BUILDING DIGITAL KNOWLEDGE COMMUNITIES

While trying to build digital knowledge communities, social capital is of interest in the way in which it affects information flows and cooperation within a group and how it affects economic transactions. The '*embededdness*' of economic transactions in social networks was first discussed by Granovetter (1983). He noted that economists abstract social ties away from transactions and assume social order as given, when in reality social order depends on trust, and trust can exist only in the presence of the ties which economists have assumed away. The key to utilizing social capital is to make it a part of the system rather than try to formalize it. The process of social arrangement, or else social interaction, moves under the effect of (1) necessities or bargains imposed by threats and opportunities of the external environment and (2) the internal dynamics of the social group (or social environment) to which the agent belongs. This process creates social capital, which can be quantified through the economic benefits that the relational aspects offer.

When understanding how ICT can be integrated in the development projects, it is reasonable to expect that outcomes are dependent on *"social contexts of design, implementation and use"* (Rosenbaum, 1999). Studies have shown that outcomes of ICT implementation and use in different real world settings, be it in an organization or an educational community, are difficult to predict or replicate, and that the "*contextually dependent nature of ICT's suggests that similar ICT's can have different outcomes in different situations*" (Kling,et al, 1998). We interpret this social context as related to the nature and strength of ties in a social network, and the effects it has on various market and non-market transactions. Thus, the benefits intended by ICT interventions for a community are moderated by the existent social capital in the community and whether the intervention is built on this capital or independent of it. This explains the failure of most ICT interventions to correct social exclusion in the rural communities in India, as in the case of IVRP or ARISNET. (Rajagopalan and Sarkar, 2008a, Sreenivasulu and Nandwana, 2001). In the case of eChoupal, caste barriers prevented lower caste farmers from participating in the network (Bhatnagar and Schware, 2000). Social capital can be used to explain this failure in terms of the various groups that are embedded in the community, and the network ties and norms, or the social enforceable behavior that they are governed by. Specific norms within the group, (not permitting different castes to mingle socially, for example) can nullify the benefits of enhanced availability of information. Improving access to information can thus end up not significantly empowering marginalized members of society

There is a large body of literature that posits that connecting communities using ICT lead to a reduction in social capital (Grootaert, 1999). The general argument in those papers runs as follows. Given the positive role of weak ties on enhancing economic growth, and the propensity of ICT to promote these ties, the proliferation of weak ties moves the individual out of the ambit of his immediate social group and alienates him from his surroundings. Also, when dealing with members outside one's community, the basis for trust is reduced, and the effectiveness of social capital does not translate directly online. At the same time there are papers which admit finding a link between social capital and economic development, but question the direction of causality (Miguel et al (2003), Knack and Keefer (1997), Zak and Knack (2001)).Others suggest that interventions results in bonding social capital being replaced by bridging social capital[1] (see Labonne and Chase, 2008, for example, on evidence from a large scale intervention program in the Phillipines). Yet other papers report the positive impact of ICT based interventions on social capital (Baliamoune-lutz, 2005, Leicht, 1999). What is clear from most of these papers is that

the success of an initiative is highly context dependent, and the ability to align the initiative with existing social capital, which itself is an elusive concept. Before moving on to sharing some experiences of the IITK team, I now discuss the context in which their ICT interventions took place.

5.3 INDIAN AGRICULTURE

Agriculture directly and indirectly continues to be the occupation and way of life for more than half or India's population. Ensuring a thriving agricultural economy is critical for India's global competitiveness to be "inclusive". A globally competitive Indian economy must be based on a knowledge driven transformation of Indian agriculture because in many ways Indian agriculture has already reached the physical limits of land and water (Rai, 2006). Further sustainable enhancements in production must enhance productivity and biological yields on existing land with similar physical inputs. This necessitates a tremendous thrust to revamp India's agricultural extension services.

This would require a dynamic ICT infrastructure that will ensure quick dissemination of technical information from the agricultural research system to the farmers. The one-way route of the conventional Indian agricultural extension system already suffers from maladies such as remarkably low uptake of information because of time lags and provision of generic information for specific problems. There is a need for rapid transformation of this extension system to a real time and adaptive knowledge exchange network. This network needs to build real time feedback routes from the 'fields to the laboratory' and can derive necessary traction from other industrial and business knowledge management technologies and processes like user to user exchange, expert to expert exchange and KM oriented standards for information storage, retrieval and aggregation with analytics.

With increased mobility into urban areas as well as the increasing reach of formal institutions, informal networks among the farmers appear to be weakening. It is also well documented that social capital, which has interpersonal complementarities, falls sharply with physical distance (Glaeser et al, 2000). Thus, existing informal institutions need immediate strengthening. Considering that there are nearly 700,000 villages (farming- hubs) in India or, at a more aggregate level, 6000 administrative blocks with more than 100 million potential farmer/trader/agro-industry users of such a knowledge-network, it is surprising that this domain does not attract as yet, sufficient attention. Collaborative research attention from information science, social science, knowledge management professionals and academicians is an urgent need to understand the effective path towards autopoietic knowledge networks and the proclivity of users to become co-creators.

However an over emphasis on technology may drag us back to the pitfalls of modernization theory (Schech, 2002). The primary concern of 'modernization theory' in terms of 'imparting knowledge' and 'transfer of technology' from 'us' to 'them' may soon corrupt an agricultural knowledge network and seek undue resources to remain sustainable. Pilot ICT initiatives that aim to create their own parallel infrastructure to overcome the problems of the existing agricultural network have also experienced problems of high resource intensity and sustainability.

Around 2003, the project team at IIT Kanpur conceived and developed the "*Digital Mandi*", with funding from Media lab Asia. This was a trading platform to enable farmers to circumvent village mahajans and get fair prices for their produce. Moreover, such a mandi had the potential to eliminate geographical barriers, as well as insure the farmers using sophisticated instruments such as futures contracts. The intent was to involve banking and para-banking institutions in the endeavour so as to also address the liquidity crunch that farmers usually face. Despite being released with great fanfare[21] the project failed to take off and attain a critical mass of users. The reasons for the failure could be that perhaps the concept was too new at that time, or perhaps, the *digital mandi* platform was an additional institutional arrangement introduced into the villagers existing social and institutional framework, and the alignment was not synchronized.

5.4 EXPERIENCES

Given the failure of several well meaning ICT based initiatives in agriculture, we propose adopting a more community centric design for developing an Information System for rural communities. Working in a manner that enhances social capital, rather than undermining it can ensure that users "buy in" to the concept, which improves project sustainability. Moreover continued involvement and use leads to the evolution of a more complex and multi functional ICT enabled socio-technical system. The digital ecosystem (DE) is one such paradigm (Dini and Nachira, 2005).

A DE for a social system needs to deal with heterogeneity and greater variations in actor's abilities and resources to participate in the network. As seen in the case of rural ICT deployment, differences in participants are induced by social and economic factors (caste, income group), level of education and exposure and so on. The vision of a DE as network that finally evolves into an "*agent-based, loosely coupled, domain-specific and demand driven interactive communities which offer cost-effective digital services and value-creating activities that attract agents to participate and benefit from it",* (Dini and Nachira, 2005) makes it capable of accommodating these variations by encouraging the co-existence of different species. This description also underscores the critical importance of participation to the success of a DE – in terms of growth, sustainability and inclusion. It is essential that rather than make recipients of assistance dependent on the provider, the providers should create the right digital environment where recipients can exercise their choice on the nature and extent of assistance they require. A big asset of a DE, in this context, is that it is intrinsically designed to be self sustaining. A DE functions independent of the entry or exit of individual actors. This is achieved by functioning as a platform fostering various economic (business) and social networks involving a multiplicity of actors engaged in dynamic and amorphous interactions. There is no single entity guiding or directing activities and information flows. Instead, all actors share the responsibility of running the network, by sharing information, resources and interacting with others, making the system robust and less resource intensive. What follows is a brief exposition of two experiences of ICT interventions for rural development which have consciously adopted a community centric approach so as to keep social capital intact.

[21] http://www.iitk.ac.in/news/digitalmandi/

5.4.1 DIGITAL ECOSYSTEMS FOR AGRICULTURE AND RURAL LIVELIHOOD – A KNOWLEDGE NETWORK[22]

Conceived by the IITK team and funded by Media Lab Asia, Digital Ecosystems for Agriculture and Rural Livelihood (DEAL)[23] is an ICT enhanced network built on an existing framework of tele-centers in rural institutes, village schools, village level agriculture extension centers (KVKs[24]) and other deployment partners. This framework enhances the coherence and inter-operability of digital content created by different stake holders and thus supports efficient and effective archiving and reuse of knowledge in the domain of Indian agriculture & rural livelihood development

The project aims to create a digital social network by the diffusion of knowledge in the agriculture domain. The stages of the project therefore involved developing a network, transforming it into communities of practice and then to a digital knowledge network. The focus is on understanding the underlying trajectory through which a group of actors transforms from a Community of Practice to a self sustaining digital community. The moderating node in this system is the OPAALS laboratory at IIT Kanpur providing the collaboration and collation technology platform, skills and resources to assist knowledge flows through the network. The presence of Government agencies helps build trust. Agricultural experts and educational institutions are responsible for verification of content generated. Actors (nodes) involved in the project can be seen in associated papers[25].

Field deployment of the DEAL project was between December 2006 and June 2007. Following this, a study was conducted at the 4 partner KVKs in September 2007 to assess the effect DEAL has had on information flows. A total of 20 agricultural scientists from across KVKs and 5 project team members from IIT Kanpur were interviewed. We elicited responses from actors how exposure and use of different facets of the DEAL project altered their relationships with existing nodes, or if there was a deletion / addition of new nodes. Each KVK scientist was asked to describe the existing links each KVK had with different actors in the extension system, and how they viewed the potential of DEAL in enhancing their access to information flows in the network. The questions about DEAL were open ended and unbiased, and respondents were encouraged to give their honest impressions and opinions about the project, its strengths and weaknesses, the potential for forming new associations, the benefits thereof and lacunae in implementation.

Table 2 lists key members who are part of the network (actors), both before and after the DEAL intervention with their respective role. An exhaustive list of all actors involved is too long wended and does not provide significant additional information.

[22] This section has also been reported in D 7.3. The network analysis done here represents how social capital among these actors was reinforced as a result of this ICT intervention.
[23] http://opaals.iitk.ac.in/deal/
[24] At present, in Indian agriculture, best practices in agriculture are disseminated through a top down agricultural extension system, where the Indian Council of Agricultural Research connects to farmers through agriculture extension centres called KVKs, which are located in rural areas, each KVK serving several villages
[25] Please refer Rajagopalan and Sarkar (2008b) for more details

Table 2 Key Actors in the DEAL Network

ACRONYM	ACTOR DESCRIPTION
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Services
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IIPR	Indian Institute of Pulses research
NSI	National sugar Institute
CSA	Chandra Shekar Azad Agricultural University
NDU	Educational Institution
ZCU	Zonal Co-ordination Body
KVK	Krishi Vigyan Kendra
KVK(P)	KVK at Pratapgar
KVK(D)	KVK at Dileepnagar
KVK(R)	KVK at Rae Barelli
KVK(K)	KVK at Kannauj
SAC(P)	Scientific Advisory Committee
IITK	Indian Institute of Technology Kanpur
PNU	Pant Nagar Agricultural University
KV	Kisan Vidyalaya
NBFGR	National Bureau of Fish Genetic Resources

The following network diagram, prepared in NetDraw[26], represents the ties that were present before the implementation of DEAL. The thicknesses of lines are representative of the extent of interaction (strong or weak ties) between the actors. For example, the link between agricultural experts within the same KVK, or between a farmer and his respective KVK are examples of strong ties, while links between KVKs and NGOs are examples of weak ties. In the course of the analysis, we refer to pre-existing, structure based links that individual nodes supply information to or draw information from (or both), as 'strong ties'. By this definition, all links sanctioned by the structural framework of the agricultural extension system are denoted as strong links, and is termed as linking social capital (Woolcock, 2001). However, in practice, most of these channels are too infrequently used by the nodes to be significant. To tighten our definition of strong ties, the agricultural scientists at each KVK were asked to indicate which of the available structural links were mandatory. Apart from that, they were asked to list the nodes in the said network that they had received information inputs from. In theory, all KVKs can, by the extension structure, seek the help or advice of any national research or educational institute that are in the same zone, through the Zonal co-ordination unit. Thus, the potential for extended links is inherent in the system, but without frequent use these remain links only on paper. Similarly, there exist links between the KVKs and educational institutes like PNU and NDU, but these links are more or less dormant.

[26] Software from Analytic Technologies

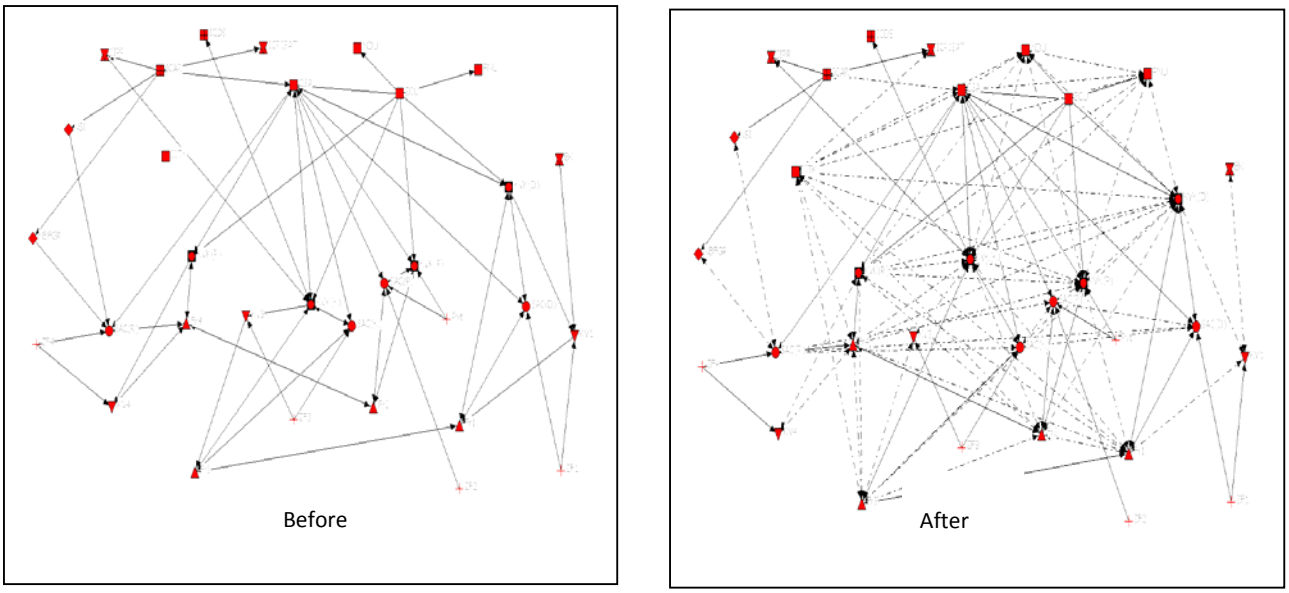


Fig.1: Network Ties before and after implementation of the DEAL initiative

The network shows information flows within and across the community. Here, the community is understood in terms of the village unit. So, within community linkages are those between actors in the same village – for example, between the farmer of a village and the respective village KVK, while across-group links includes links between actors from different villages. In the above network diagrams, we have represented the different flows of agricultural information and the interrelations, both formal and informal. Formal links are characteristic of the reporting relationship between actors, for instance, in the case of a KVK and a ZCU (Zonal Co-ordination Unit), and informal links are characteristic of the social relations between actors, like relations between farmers of adjoining villages.

We can characterize the reporting relationships between members into different layers, administrative, academic and functional. One observation here from the network diagram representing the pre-DEAL scenario is that while there are well established and clearly defined relationships between members from different layers, there are very few formal ties between members of the same layer. For example, the relationship between the ZCU and a KVK, or between a KVK and farmer is close and well directed, but there exist no direct links between the 4 KVKs. Communication is routed through the ZCU, and is conducted face to face at periodic zonal meetings.

After the implementation of the DEAL project, IITK is the only completely new actor introduced into the framework. Its integration into the network is represented by the arrows between it and other nodes, signifying an increase in information flows. The dotted lines represent ties that have been formed due to content co-creation and sharing by partners facilitated by IITK through DEAL, while the solid lines represent the preexisting network ties. By implication, ties formed through DEAL are mostly weak links (voluntary interaction). These are voluntary clusters of members who are from different groups. Linking together all the actors in dynamic relationships helps retain both strong and weak ties.

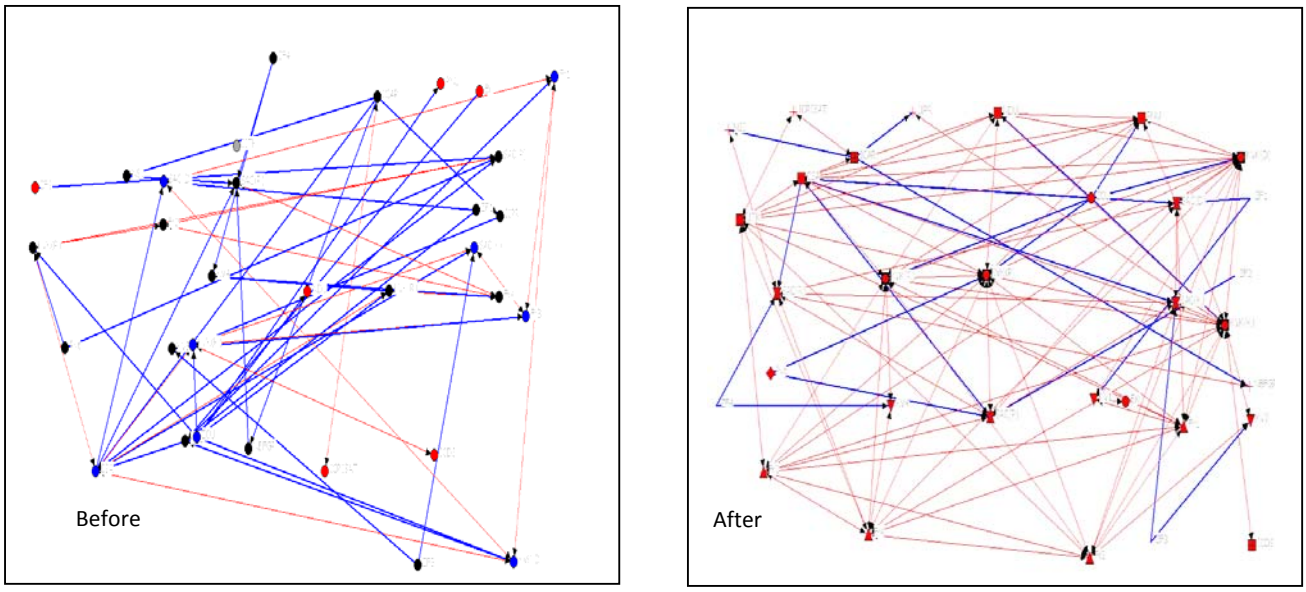


Fig.2: Reciprocal Ties before and after implementation of the DEAL initiative

Salient results[27] from our data from 25 interviewees using analytical tools provided by Ucinet[7] indicate that the total number of ties within this network increased from 77 to 183, and no old ties were displaced. This is also clear from Figure 1. No old actors in the network were deleted after implementing the DEAL initiative, while only one completely new node (IITK, the implementer) was added. Several weak links were introduced between existing nodes, signifying greater interaction (and hence innovation), and a deepening of community relations. A quantitative indicator of this increased interaction is the group reciprocity measure increasing from 0.3585 to 0.7745 from the pre DEAL to the post DEAL scenario. Thus, we can conclude that the ICT intervention has led to the enhancement of social capital (Granovetter, 1983, Coleman, 1988). Figure 2 depicts the state of reciprocal ties between members across different layers. The red lines denote reciprocal ties and the blue lines the non reciprocal ties.

As already discussed, in the pre-DEAL scenario, except for the informal links between farmers of neighboring villages, the other links are structurally determined. There are very few reciprocal ties between members of the same layer, for instance, the links between PNU and IIPR are both indirect and non-reciprocal. This lack of reciprocity across layers reflects the top-down nature of the reporting ties between actors from different layers, like in the relationship between the ZCU and a KVK. While a top-down approach is time and cost effective for information dissemination, in an extension setup it causes the network to become more centralized. However, studies in network architecture have shown that a centralized network is ineffective for knowledge sharing

[27] Details of study available at IITK Deal site

(Fahey and Prusak, 1998; Markus, 2001) as it is resource intensive, error prone and more crucially, does not potentially encourage re-deployment of the stored content.

In the Indian context, with the Government reducing public investment in agricultural extension as well as privatizing its input system, there is a need to make extension and the overall technology transfer system more demand-driven and responsive to farmer needs. To achieve this, a more bottom-up approach is needed which empowers farmers and allows them to more effectively articulate their problems and needs to the research-extension system. The DE design of the system places special emphasis on voluntary participation, and as more members access the network, the number of mutual and voluntary ties increases, increasing reciprocity. After the implementation of DEAL, there is an increase in reciprocal ties (red lines), with a simultaneous decrease in the number of non reciprocal ties (blue lines). Increased reciprocity has a positive impact on content creation, while increased collaboration between members further enhances reciprocity.

Next, the impact of implementing DEAL on information flows within groups and between groups is explored. Unlike conventional ICT interventions, which adopt either a top-down or bottom- up approach, DEAL uses a community centric 'social capital aligned' approach, focusing on increasing ties between members in the same layer, while also building links across the different layers. Figure 3 illustrates the links within and between groups in before and after the implementation of the DEAL initiative. The blue lines represent ties within groups and the red show ties between groups

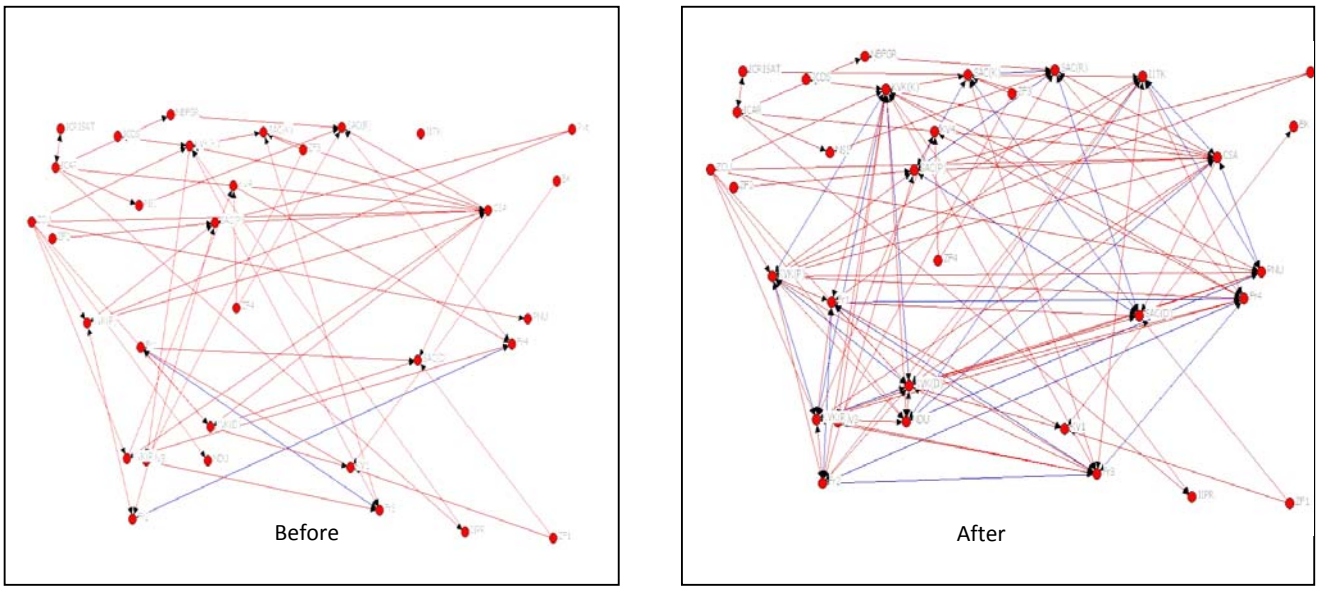


Fig.3 Links within and between groups before and after implementation of the DEAL initiative

In the pre DEAL scenario, as the interviews revealed, there are very few direct informal links between individual KVKs. Majority of the relationships that a node (actor) has is with members

from the same geographic community, but has very few ties with other members having the same role in the network, impeding horizontal information flows. Thus, the local social capital stays locked into the local loop keeping it out of the network.

After the implementation of the DEAL initiative, it is evident that there are now several weak links between different nodes, which are at the same horizontal level. For example, DEAL had provided a platform for different KVKs to share their extension experiences with each other through hosting a website for each of them. Horizontal ties between farmers from disperse geographical areas are enhanced through the use of multiple communication media. The "kissan blog", a mechanism through which farmers can record their experience in audio mode and share it with all the nodes in the network, resulted in building new horizontal ties. Such novel mechanisms for sharing agricultural experiences strengthen existing strong ties while building weak ties across geographically dispersed communities. This is a distinguishing feature of a digital ecosystem as creating these ties would ultimately lead to the creation of shared norms and values.

Early results seem to indicate support for this approach at a conceptual level, though more field reviews are needed to confirm these results. Criticisms against DEAL include lack of access to computers and internet connectivity, inability to use the machines and/or portal and very bookish (as opposed to practice oriented) content. This is because most of the content was created at IITK, because of the inability of most other actors to add content.

5.4.2 AGROPEDIA – A DYNAMIC KNOWLEDGE REPOSITORY OF "ALL THINGS AGRICULTURE"

agropedia is an Agriculture Knowledge Repository of universal Meta models and localized content for a variety of users with appropriate interfaces, built in collaborative mode in multiple languages. Conceptualized by IITK, and funded by the National Agricultural Innovation Project[28], agropedia aims to develop a comprehensive digital content framework, platform, and tools in support of agricultural extension and outreach. It aspires to be a one stop shop for any information, pedagogic or practical knowledge related to extension services in Indian agriculture – an audiovisual encyclopedia, to enchant, educate and transform the process of digital content creation and organization completely. Rather than target the farmer, who does not have access to as much ICT, may not be inclined to harness knowledge through unfamiliar media, and would trust the local seed seller more, agropedia aims at empowering the agents involved in extension, including the local seed seller, who, as a result could share more pertinent practices with the farmer. At the same time, the user can gain peer recognition by engaging in dialogue with other such users from geographically disparate regions, resulting in a win win situation for all. Horizontal networks established and strengthened as a result will ensure the retention and braod basing of social capital, which in turn would render no actor indispensable and the system would continue to function efficiently even if some of the nodes drop out.

[28] http://www.naip.icar.org.in/

There are three dimensions along which agropedia is being developed. The knowledge model dimension provides a mechanism to represent the domain knowledge in a manner that the computer can understand. Having such a domain model, it is possible to attach semantic attributes to all the material in agropedia, which facilitates indexing, semantic searching, as well as can support a host of decision support applications. The other two dimensions are the content dimension and social networking dimension, both of which depend on the standardized framework that the knowledge model dimension provides for structuring knowledge nuggets. Figure 4 provides a birds-eye view of agropedia.

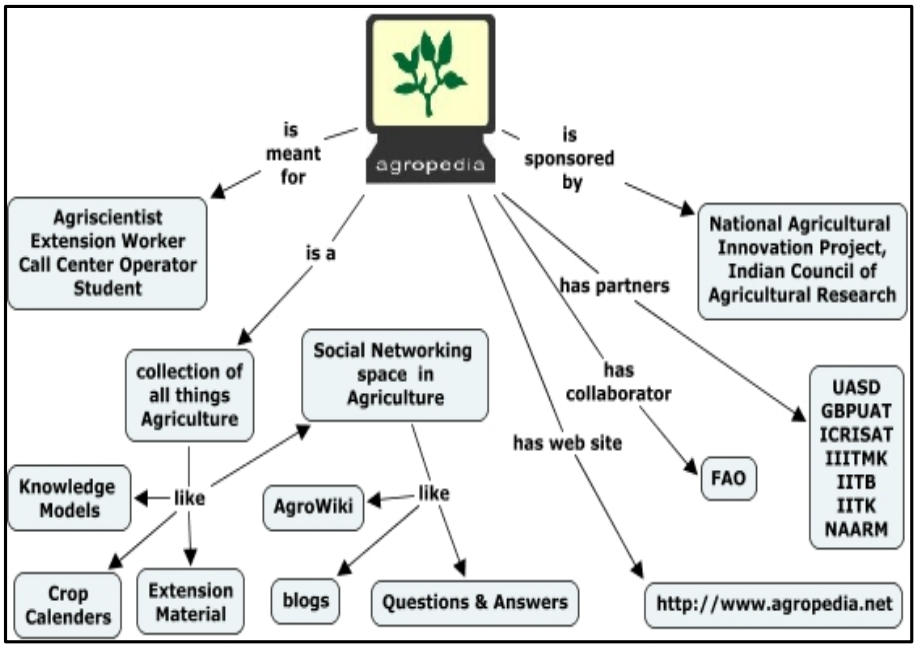


Figure 4 – A Concept Map of Agropedia

Using state of the art practices and techniques of the semantic web, agropedia is a platform where both specialists in the agriculture research and education domain and students and others interested in agriculture can make lasting contributions to the vast knowledge base. The specialists have a choice to contribute towards the *gyan-dhara* (certified content) or participate in the interaction space to contribute to *janagyan* (emergent knowledge). While g*yan-dhara* is related to the content dimension discussed earlier and can be populated only by other consortium partners[29], knowledge is captured in the social networking dimension by leveraging social capital, which is *janagyan* or emergent knowledge. Here, users co create content through their participation in the agrowiki, agro-blog, agro-forum and agro-chat like interaction spaces. By involving all possible stake holders in positions of responsibility, identifying the information flows that would benefit them and giving currency to these flows creates avenues for collaboration between members and encourages participation. Thus, the users of agropedia are the architects of the knowledge, which is the lifeblood of agropedia, and they do this through an easy to use, entertaining and intellectually stimulating web interface.

[29] See www.agropedia.net for details on the consortium implementing this project

agropedia is an ongoing initiative. The knowledge models and the technology platform for content addition and social networking were released on January 14, 2009. Till date, more than 12 workshops have been conducted across the country, many of them devoted to hands-on training, to 'socialise' agropedia. As on 20th February, 2009 there are around 200 pages on content (*gyandhara*), 32 blog entries, and several wiki pages created. The agroforum and agrochat features are yet to become functional.

The interest in agropedia is evident from its media coverage in Science and Development Network[30], Guardian[31] and Outlook[32]. More specific results about interest in agropedia, as mined by google analytics are as represented in figure 5.

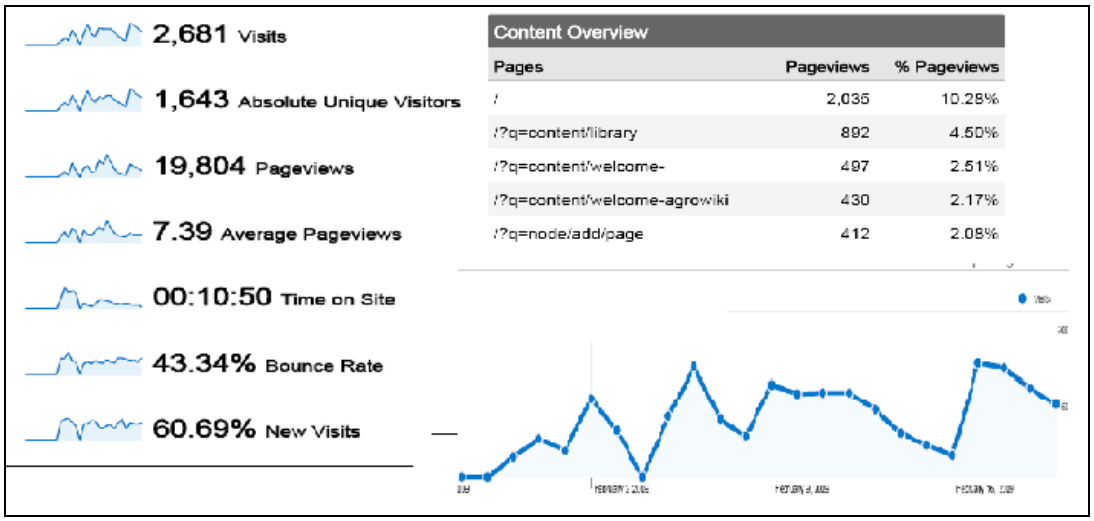


Figure 5 – Some Statistics on agropedia, as reported by Google analytics as on 21st February 2009

5.5 CONCLUSION

From the experience of the digital mandi to DEAL and agropedia, there is a clear evolutionary path that emerges, as illustrated in Table 3. Our experience so far has resulted in the development of one approach to preserve, create and leverage social capital using ICT to further agricultural knowledge. The process is community centric, and attempts to incorporate past experiences as well theoretical insights gained from literature.

In this chapter, I started by situating social capital and community networks in the economic discourse and then went on to share some experiences where social capital has been leveraged to build online community networks. The necessary and sufficient conditions to ensure the sustainability of online community networks include adequate infrastructure and embeddedness

[30] http://www.scidev.net/en/news/india-debuts-agricultural-wikipedia-.html?utm_source=link&utm_medium=rss&utm_campaign=en_news
[31] http://www.guardian.co.uk/environment/2009/jan/22/network-india-agricultural-wikipedia
[32] http://www.outlookindia.com/full.asp?fodname=20090223&fname=Farmers+%28F%29&sid=1

of the intervention in existing social structures, which result in the creation of new norms and networks.

Social capital is defined as the density of trust (Paldam and Svendsen, 2000). I reinterpret Putnam to propose that the growth of social capital can be derived from the pattern and intensity of networks among actors within a single community of practice which is not geographically bound. Using that premise, I demonstrated that the approach followed by the IITK team to build digital knowledge communities is indeed a social capital enhancing mechanism.

Table 3 – Milestones along the Path to agropedia

Year	Initiative	Comments
2003	Digital Mandi – A trading Platform for agricultural Produce	Unsuccessful – an idea whose time had not come
2005	DEAL – Digital Ecosystems for Agriculture and Rural Livelihood An ICT enabled platform for content on multiple dimensions of agriculture and livelihood, created by communities of practice in agriculture including the farmers. Literacy independent ICT tools were developed including audio blogs and innovative user interfaces	Very successful, as long as the central node, IITK, is in the picture. Sustainability remains a concern in the backdrop of limited capacity and delays in infrastructure provision
2007	**agropedia** – a knowledge platform for agricultural knowledge, that not only incorporates the content dimension from DEAL, but adds two orthogonal dimensions. Standardized knowledge models (using global standards) are developed to index and add semantic attributes to the content, and a domain specific social networking site is created to promote the addition of social content, building on the success of web 2.0	The initiative is still being rolled out. Till date, it's knowledge models and social spaces have appealed to domain specialists worldwide (ref), as well as in India Sustainability issues are addressed through (a) setting up self sustaining social spaces, (b) using the existing social capital to deliver the service and (c) limit the reach of the project to extension scientists who have access to relatively better infrastructure

However, change in social capital is a slow and dynamic process, and a lot depends on whether there is a central node championing the ICT intervention. Also, to evaluate if the ties between members in a community of practice have a long term effect and what their impact will be on the existing social capital, in terms of evolution of new norms for interactions or change in

network structure, we need to continue observation into atleast a few more time periods. Over time, new norms and networks are expected to emerge within the digital knowledge network which could lead to very different economic outcomes. Since social change is an evolutionary phenomenon requiring time in the order of decades to manifest significantly, this is an area for further investigation.

6. agropedia - THE JOURNEY TILL MARCH, 2009[33]

6.1 INTRODUCTION

There is no debate about the need for the development of the agriculture sector in a country like India, where more than 60% of the total workforce engaged in this sector. The total agriculture budget outlay in five year planning has been going up as the plethora of government policies are in favor of the farmers. Despite these efforts, the condition of the farmers (specially marginal and poor) and productivity of land has remained at very low levels, even when compared to other South East Asian countries with similar land holdings. Side by side, more challenges have emerged such as climate variability, soil quality reduction, and water scarcity. The farmers have also been exposed to price variability arising from privatization of the agriculture sector and liberalization policies.

It has been recognized that one of the most serious back-logs in agriculture is in the process of information flows. To address this, special attention has to be paid to empower the agricultural extension system which serves as the research to farmer link. In the 60's and 70's this agricultural extension system played a crucial role in the advancement of food security through the Green Revolution. In addition to focussing on the broader issues of resource constraints and market opportunities, there is a need for re-orienting and reviving the extension process, and bringing the extension scientist up-to-date with the latest happenings in the field of agriculture through the use of ICT.

'Redesigning the farmer extension agricultural research/ education continuum in India with ICT mediated Knowledge Management' (ReFEARI-ICTKM) is a project under the umbrella of the National Agriculture Innovation Project (NAIP) to facilitate the Knowledge Management (KM) process in the agricultural domain. The NAIP has been initiated by Indian Council of Agricultural Research (ICAR) with the assistance of World Bank to accelerate sustained transformation of Indian agriculture. ReFEARI –ICTKM aims to bring together a community of practice through an ICT mediated Knowledge creating and organising platform with an effort to leverage the existing agricultural extension system. This would promote technology-led pro-poor growth and diffusion of new technologies for improving agricultural yield and rural livelihood in India. The NAIP-KM system allows the development of highly integrated approaches between agricultural research and education sector with established extension processes such as the Krishi Vigyan Kendras (KVKs), emerging actors in private sector extension, NGOs and with organizations promoting rural information access centers. Thus the main objective of this project is to create a back-end process mainly through introducing digital services with suitable access and delivery systems for different stakeholders in both online and offline modes to provide information support. The proposed access and delivery system can be through different channels including desktops, laptops, mobile phones, broadcast media or print.

[33] A more detailed version of this paper, along with its annexures is available from the agrpedia website

Under ReFEARI-ICTKM, a consortium of institutions of excellence in ICT research, state agriculture universities and agricultural research organizations have come together to build a comprehensive and integrated set of processes and platforms to support and promote knowledge flows and exchanges between different stakeholders in the agriculture domain. Overall, one could categorise these institutions into three groups according to their roles and responsibilities. The first group consisting of IITK, IITB, IIITM-Kerala and NAARM-Hyderabad, is playing the role of ICT resource institutions. Private sector partners including NGOs in IT development provide short term consultant/contractual services to the partners when required. The second group comprises ICRISAT, Patancheru, GB Pant University of Agriculture and Technology (GBPUAT), Pantnagar and University of Agricultural Sciences (UAS), Dharwad[34]. This group works as an information and learning resource provider. These two institutions are linked with two KVKs/agricultural research stations (ARS) each. Two KVKs in Maharashtra and Uttar Pradesh are also linked to the project through the IIT Bombay and IIT Kanpur network. The link with the extension centres ensures that suitable use cases can be generated for developing an appropriate knowledge management platform. ICRISAT-Patancheru and NAARM-Hyderabad, the third group, provide facilitation support for the agricultural research scientists and educators and the ICT4D actors.

IIT Kanpur, one of the IT resource organizations is responsible for creating the basic ICT platform for knowledge management, which hosts the ICT enabled services of other IT resource providers. This platform had been named Agropedia Indica[35] (at present agropedia). With the vision of agropedia as a comprehensive, seamlessly integrated model of digital content organization in agricultural domain, the ReFEARI-ICTKM project aims to alleviate the knowledge gap in Indian agriculture. The agropedia is just like an Encyclopedia in the agricultural domain. With the rapid development of creation, use and reuse of digital content, it is not very difficult to involve a large community of knowledge partners to create the knowledge contents. Taking into account the need of the different type of users, the knowledge nuggets could be represented in various textual, audio, video and hybrid formats and could be delivered through multiple interfaces. Agropedia Indica, on the other hand is a limited instantiation of the Agropedia vision, where the emphasis is on Indian agriculture (while scalability and standardization issues to make it globally applicable are kept in mind), with only the web as the delivery mode, and initially developed in English and Hindi.

6.2 THEORETICAL BACKGROUND

This section highlights some of the theoretical issues that underpin the present development of the agropedia.

Creation of Knowledge: Knowledge management (KM) literature identifies tacit knowledge as a vital source of knowledge that needs to be identified, captured, stored and processed via IT tools so that such knowledge can be applied further in a new context. Tacit knowledge is derived through experience, ideals and values. When this knowledge is categorized, specified and codified it is transformed into explicit knowledge. Other KM models suggest that knowledge is

[34] We started the project with UAS Dharwad as one of our consortium partners but the responsibility was taken over by the UAS Raichur.
[35] Initially the portal was started with the name 'Agropedia Indica' and from December' 08, it was renamed as 'agropedia'. In this document both these terms have been used interchangeably

shared and developed through active networking within and between groups. Thus, effective conceptual integration among the heterogeneous actors is essential for the development of knowledge, and the use of ICT can facilitate and strengthen this process of networking. The creation of new knowledge is based on the existing "knowledge spaces", that is, static, explicit content, as available in books or tacit knowledge in the mind of people which needs to be accessed, retrieved, and processed. In transformation of knowledge from explicit to tacit or from tacit to explicit it may change from its original form either intentionally or unintentionally for the purpose of application. Such changes may occur at the sending or receiving end or any level of the link. *agropedia* aims to facilitate this knowledge creation and transformation process in the agricultural domain.

Knowledge Transfer Approach: 'Good Understanding needs Effective Communication': The effectiveness of knowledge transfer is gauged by the extent of understanding and application, which in turn depends on the nature of communication among the nodes. The a*gropedia* approach is to build a dynamic interplay between sender and receiver i.e. to develop a feedback based network loop. The approach consists of a cyclical approach of top down push knowledge and bottom up pull information, because it is important to match the quantity and quality of the pushed knowledge with the knowledge requirement and the emissive and absorptive capacity of the knowledge nodes (users and contributors). In such a network based knowledge system, the use of ICT can significantly improve the process/power of accessibility by widening the flow capacity, facilitating e-collaboration, strengthening the network, and broadening the network area. Improved accessibility would have a positive effect on strengthening the capacity of the user nodes with repeated usage.

Knowledge Actors: Knowledge actors refer to various nodes that participate in the knowledge creation and transformation process. For agropedia, the knowledge actors can be broadly divided into three groups – Content Community (CC), Target Community (TC), and Actual Target Community (ATC). All the institutions who are working as the explicit knowledge providers (providing top down push knowledge), directly or indirectly, can be called as "Content community". The "Actual Target Community" on the other hand, is at the receiving (and bottom up push knowledge contributing) end such as farmers, agricultural workers, traders, retailers, self-help-group and intermediaries such as KVKs and scientists of state agricultural universities and the other deployment partners. The people of this community are the tacit knowledge holders by virtue of their practical experiences. Their knowledge is also dynamic as they are directly related to the practical field of work where the environment and the situation can change every moment. Their tacit and dynamic knowledge is also very helpful to the agricultural experts and researchers. So it is necessary to transform this knowledge to the explicit form through providing a means of communication.

Within the limited scope of the project, with current ICT infrastructure, literacy and language barriers, the actual target community of farmers, agricultural workers, traders, retailers, self-help-group etc. are represented through the extension workers, which are then classified as the target community. The target community thus has the responsibility to disseminate the knowledge among the farmers, and others who apply that knowledge in their daily practices, and collate knowledge from the ATC and channelize it into the KM system created in agropedia. Thus there is a cyclical knowledge creation, exchange and transformation path between experts

and farmers through the target community. This "target community" is thus the "Social Integrator" from sociological point of view.

Another way to understand the knowledge actors is by understanding their transactional roles. The purpose of the CC is to develop relationships within the community itself and between communities. If we think each community as a collective node, there are direct links between the CC and TC and between the TC and ATC; and indirect links between the CC and the ATC through the TC. Knowledge develops operationally through these interactions. The CC can be seen as the managing community of the knowledge network as this node manages, directs, and facilitates the efficient and smooth flows of knowledge objects. This knowledge community has a common interest to create, share and use knowledge for the development of the agriculture. All the participants have a common understanding of collective practices and goals and in this sense it can be seen as a community of practice (CoP). In this process of forming a knowledge CoP with geographically and culturally disparate researchers, experts, farmers, academic institutions, organizations and the others using ICT, each node is enriched by giving and receiving information and increasing the number of links. New and revived linkages between researchers and education sectors with agricultural extension are expected to develop through the agropedia platform.

Network structure: The structure of network communication is the combination of both the formal and informal according to the situation and need. While the CC and the TC are formally constructed within themselves; the ATC comprises locally based informal networks, predominantly based on trust and commitment. It is obvious that in a network with nodes from geographically distinct regions it is very difficult to ensure stability and sustenance of the developed knowledge community (may termed as knowledge ecosystem) with out some formal preconditioned contractual obligations from the nodes. The task of CC is to develop such a knowledge ecosystem which is trustable and at the same time user-friendly and informative.

But there is a problem in the context of 'open access' and 'content security implication' which needs to be balanced by the CC Open access is necessary to promote the diffusion and sharing of knowledge whereas security is necessary to ensure correctness and appropriateness of content and foster trust. In this project, the CC mainly acts as a constructor and controller of the knowledge flows and the TC are mainly the users of the formally created content, and contributors to the dynamic knowledge flow. All members of each group act as both senders and receivers, and create content and communicate with each other as and when required. Using ICT as the medium of knowledge transfer and sharing provides a platform for content organisation, acts as the knowledge repository, and also as a virtual administrative body. Every node has to posses certain conditions to enter into that network and for using it. The conditions are determined by the CC. In this sense, we can say, there are lateral links within the communities and vertical hierarchy across the communities in the knowledge network.

6.3 agropedia

Within the limited time frame of the project and others practical problems, it is not possible for the project team to consider the ATC in the project directly, and establish direct links between research-education-farmers as there is a large gap between these two communities from all

aspects. While the CC deal mainly in established and verified information, represented in textbooks and theory, the ATC has practitioner knowledge from the ground up, which has to be abstracted for wider applicability. So the CC needs a bridge to link to the ATC. As the views and problems of ATC can be easily captured using the TC as intermediaries, they can best serve the purpose of the CC. So in the agropedia project the user group has been taken to be the TC (hence the name). Now let us look at the features of the agropedia portal at first, and then the roles and responsibilities taken by the different institutions of the CC i.e. the different consortium partners from the point of view of Agropedia Indica.

6.3.1 MAIN FEATURES OF AGROPEDIA

The agropedia web site is the common platform for creating and sharing knowledge for agricultural experts and researchers as well as the agricultural workers. When designing the portal, it is critical to take into account the requirements of these users and the different types of difficulties they could face in handling the web process. This has resulted in a highly dynamic web portal, which has changed quite a bit since it was launched. As the ultimate aim is to build up an agricultural knowledge community and involve more and more users, the main attention is to develop this portal in such a way that it becomes as informative and user friendly as possible.

6.3.1.1 AGROPEDIA INDICA (AI) AS ON **AUGUST, 2008**

FEATURES

1. It is an agricultural knowledge repository which can be accessed by everyone.
2. The content would be the broad Indian agricultural domain; focus on some particular crops within.
3. It provides a platform where knowledge can be stored, created, exchanged and shared through Knowledge Models[36] (KMo), wiki, blogs etc.
4. The Agropedia Indica is developed using web 2.0 technology.
5. There are two ways of content creation in the platform. The partners can upload expert knowledge through the content management system (CMS) or use the 'wiki' for emergent knowledge. In Wiki anyone is allowed to write content on agriculture related issues. All the contents are uploaded and created for Agropedia Indica is stored in the CMS, powered by Alfresco.
6. The contents may be of various forms such as textual, audios, video images, and video clippings.

[36] Knowledge models are the structural representation of knowledge by using symbols to represent pieces of knowledge and relationships between them.

7. The knowledge is also stored in the form of knowledge representation schemes like ontology, concept maps, topic maps etc., so that semantic searching is possible.

8. At present AI is a web-based application.

9. Before entering and using the AI platform, registration is an essential condition.

10. In the **Agropedia Indica,** the home page is having the portlets as 'Home' (the Home page), 'Search' (search agricultural content), 'Upload' (upload agricultural content), 'Agrowiki' (wikipedia like concept for agriculture), 'Krishi Vigyan Kendra' (the local agricultural information by the KVKs and local farmers), 'Kisan blog' (The audio blog), 'About us' (provide phone numbers and address to contact with the IITK project team), and 'Team' (name and designation of the IITK project members with photo).

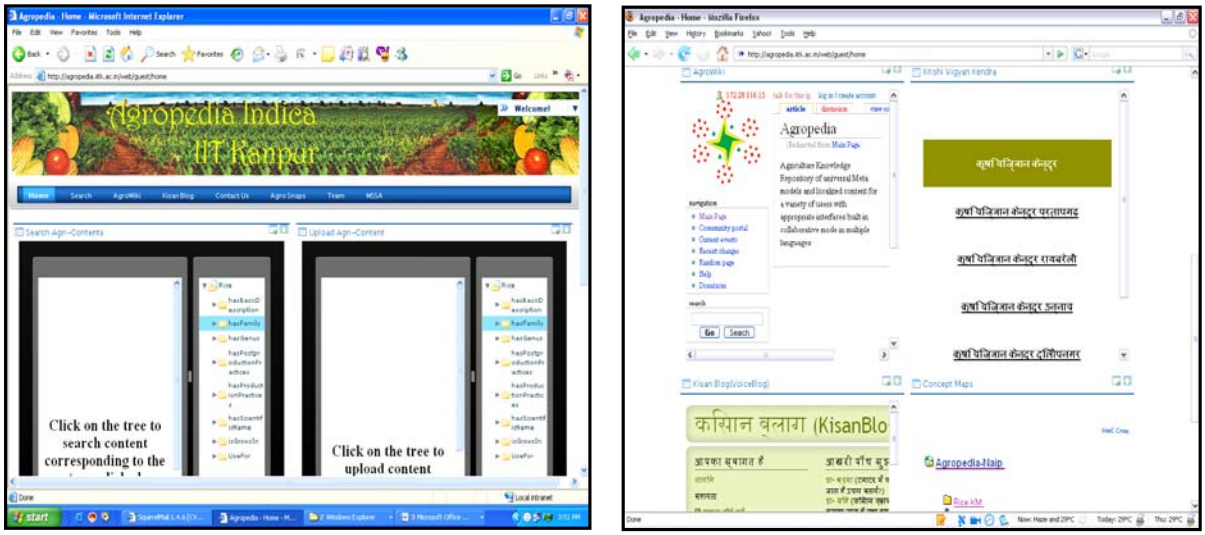
11. The home page consists of different components like 'Search Agri-Content', 'Upload Agri-Content', 'AgroWiki', 'Krishi Vigyan Kendra', 'Kissan Blog', and 'Concept Maps', as shown in figure 1.

PORTLETS

Search Agri-Content: In this component one can search anything related to agriculture in textual, images, audio, or in video format. When anyone searches a particular topic the CMS provides all the contents it has, related to that topic; and the actual source, the name of the creator, the time of creation are always shown with the content.

Upload Agri-Content: Here one can upload the agricultural contents through the CMS in textual, images, audio, and video form which ever he/she wants; but before uploading registration is an essential condition. The contents may be uploaded from some authentic books, magazines, journals, websites, and other sources in case there is no copyright issue. The details of the source and creator must be mentioned after uploading the content. Agri-experts can also add contents after doing some edition in the original contents. The word templates in which the agricultural scientists provide the textual content are supposed to call as 'Agris'. Videos should be small in size so that it would not take much time to download.

Figure 1. Grab-shot of Agropedia Indica Home Page, taken in August, 2008



AgroWiki: It is based on the concept of 'Wiki' where anyone can search and create content regarding agriculture. AgroWiki is using the 'media-wiki' technology, so one can visualize and upload images beside text. But as anyone can create the content, the problem of unauthenticity may present here.

Krishi Vigyan Kendra: It is the place for the KVKs related to this project. It contains the local agricultural information which is provided by the KVK experts and local farmers. If they have validated password then they can create, upload, modify and update their contents. The contents are mostly created from the practical experiences. An illiterate farmer can also contribute in content creation with the help of the KVK experts. The system and the tool they are using to create content was developed by the IITK, in its previous project of Digital Ecosystem for Agricultural and rural Livelihood (DEAL). Recently there are five KVKs (Pratapgarh, Raibereli, Unnao, Kanpur Dehat, Kannauj) working with IITK by providing inputs from their practical experience. According to their needs the IITK team is trying to build the system. In future they are supposed to work as implementing partners from where the IITK can get some more feedback.

KissanBlog: The 'Kisan Blog' is developed by IITK itself in its previous DEAL project. It was also developed in web 2.0 technology. Here it is used as a very important tool for enhancing communication through audio format (both hearing and speaking), so it is also called as the 'Voice Blog'. One can use maximum 10MB (5/6 minutes) for both question and answer in audio. Content can also be created in textual format. The process of uploading is given in details in the allotted space. After uploading any voice or text, one has to put his/her name and choose the content category; and the uploading content will show in the site only after checking by the experts to avoid undesired noises.

Concept Maps(C-Maps): Concept map is a diagrammatically presentation of a concept with arrow and nodes; where nodes present the related terms of the presented concept and the arrow shows the relations of that concept with the other terms or nodes. These C-Map tools are generally used here to develop Knowledge Models. The specific place in the portal are allotted for concepts maps where concept maps of some general and some specific agricultural concept are installed as a sample. This is just because of the better understanding and learning for the content creator as it is also a better way to define any new concept.

6.3.2 CHANGED FEATURES AS ON NOVEMBER, 2008:

The initial alpha version of AI portal was developed by downloading and modifying the open-source software, named 'liferay portal' while the present 0.2 version of AI portal, specially the user interface is developed by the computer experts of the project team by using html and JavaScript. The main objective behind changing the techniques is to reduce the time to open the portal. The work process is also going on for changing the 'user interface' (UI) to make it more informative and attractive. The changes in the UI can be noted as follows.

1. In the **Agropedia Indica,** the home page consists of different components like 'Search', 'Upload', 'Agrowiki', 'Knowledge Models', 'Kisan blog', 'contact us', and 'PhotoGallery. Figure 2 is a grabshot of the current portal.

2. However, there is no introductory page and the portal is open with the search portlet. Specific features and their changes are noted below

Search: There is no major change in this portlet, other than it becoming the opening page. Only the name has been changed from 'Search agri-content' to 'Search' and the entry in this portlet needs a user name and a password.

Upload: The 'Upload agri-content' is renamed as 'Upload'.

Agrowiki: Previously Agrowiki was available only in English. But now the Hindi version of Agrowiki has been created. So the users have an option to access Agrowiki in their preferred language.

Knowledge Models (KMo)[37]: This name has been introduced in the place of concept map as the KMo is developed in pur case by using concept map tool. This is the model in the form of maps presenting the knowledge through concept maps. No doubt the number of knowledge models, presented in the portal, increased more. Different partners and organisation as GBPUAT, ICRISAT, and TATA Chemicals, after the training sessions from IITK, have contributed a lot in developing knowledge models.

Contact Us: This comes in the place of 'about us'.

Photogallery: This is the place where the photographs related to the work process of the project team are presented. It includes the picture of different workshops, trainings, meetings etc. arranged and provided by this project.

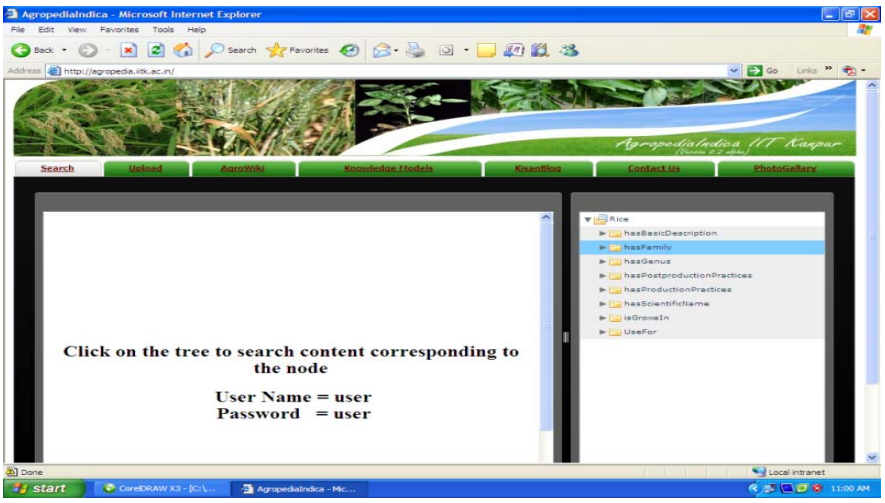


Figure 2. Grab-shot of AI portal taken on 10th Nov, 08

[37] KM stands for knowledge Management and KMo stands for Knowledge Model.

6.3.3 CHANGED FEATURES AS ON **DECEMBER, 2008**:

In the previous two versions, for different components of the Agropedia portal different techniques had to use. For example, the Content Management System (CMS) was using Alfresco which is based on Java; wiki was using 'Media wiki' which is based on PHP; and User Interface (UI) was using html and Java Script. The new version is developed by using 'Drupal', the open source software that provides all the techniques for the different components of the portal. So it becomes easy to access and also time saving for computer experts (to develop back-end technique and UI), agricultural scientists (to provide content and develop knowledge models), and users (to search for any specific type of content and create content).

The main aim of Agropedia is to develop a self regulating and self organizing portal. So the used mechanism (like Drupal) and the tools (in the form of wiki, blog, forum etc) should be effective in this aspect and at the same time it should make the portal ease to operate for the non-technical users.

This is the alpha 0.3 version of the Agropedia portal. The site is become 'Agropedia' from 'Agropedia Indica'. This was running at the IITK server in the month of December, 2008. Here, the home page is organized with the menus as '**Home'** (for homepage), '**Knowledge Models'** (to see the concept maps developed by the agri- scientists of the consortium partners), '**Library'** (having different types of content under 'Documents', 'Crop Calendar', 'Dos and Don'ts', and 'Publications' added /uploaded by the agri-scientists), '**Interactions'** (having 'Agrowiki', 'Blogs', 'Forums' like interaction spaces for agriculture related people), '**News'** (providing all types of agriculture related news by RSS feeder), '**About us'** (providing photographs and videos of the project related trainings and workshops and also the option to contact with the project Investigators for quarries). Documents contain document like contain including images, audios and video clips in the form of pdf, doc, jpeg etc.; 'Crop calendar' contains month wise package of practices of the nine agricultural crops; 'Dos and don'ts' tells the important information about what should and should not be done during crop production & allied fields; and 'Publications' contains the research paper, articles, and reports of the magazines, journals, institution reports, research thesis, etc.

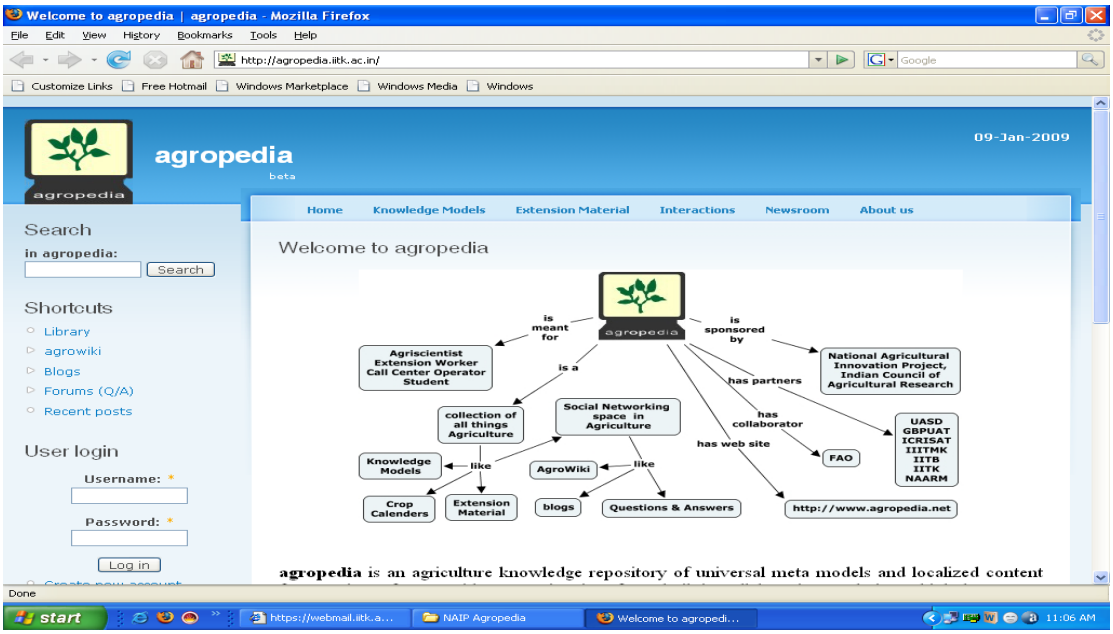
Grab shot taken on 8th December, 2008

From the search menu provided on the right hand corner of the home page, one can search for any type of content from the whole portal. Beside that every category of content- such as Knowledge Models, Documents, Crop Calendar, Do's and Don'ts, Publications, Agrowiki, Blogs and Forums, have the search and add content options. Everyone is able to search the contents but only the authentic users (presently the registered users) are able to add content; and his content will be published only when it is checked by the administrator. However, now the registration is free and one can easily register from the 'User login' space. Every registered user gets his/her own blog to share personal agricultural knowledge and experiences with the others.

To meet the general quarries of the users about this portal, it also provides a set of frequently asked questions and answers in the form of 'FAQ'. This is given in the left hand side of the portal under the shortcuts option. The shortcuts help to navigate directly with some of the important content category of 'Library' and 'Interactions'. There is also a shortcut option for 'Recent Posts' which provides a link for the contents posted recently after checking from the agropedia administrator with the name of topic, creator, and the time of creation.

However, there are two things to be noted—1. The knowledge models can be uploaded only by some selected agri-scientists, and 2. Any type of uploaded content (except the wiki-page) can be edited only by the creator.

6.3.4 CHANGED FEATURES AS ON **JANUARY, 2009:**



Grab shot taken on 8th January, 2009

This is the **beta** version of the agropedia portal. The technology and tools used in this version is almost like the alpha 0.3 version. The name has been changed from **Agropedia** to **agropedia** i.e. starting with small 'a' for agropedia become the identity of our site. The other small changes which have been taken place can be pointed out as:

1. In the home page, the current date is showing on the right corner of the portal.
2. Library is renamed as Extension Material.
3. The Documents (which was under previous Library) renamed as Library. The functionalities under Library also increases in this version- Add Content (to add content), Browse Content (to search content of the nine crops from the nine KMs), Search Content (to search content through keywords) and Help (providing instruction for how to use this library).
4. A new option named 'User Discussions' (i.e. agro-chat) is incorporated under Interactions menu. Though it is not working now. It is under progress.
5. News is renamed as Newsroom. Under this menu there are having two sub-menus such as 'News Feed' (providing agricultural news through feeder) and 'Events' (providing current events about the project).
6. Incorporated a new sub-menu 'Brochure' under 'About Us'. It provides an idea about the agropedia and the knowledge models.
7. In the left hand side there is 'User login' space and above it only a small number of shortcuts are provided for Library, agrowiki, Blog, Forum and Recent Posts.

6.3.5 CHANGED FEATURES AS ON **FEBRUARY, 2009:**

In this month, we only have some modifications in the terminologies and in the functionalities. For example, the Blog and Forum under 'Interactions' are renamed as 'agroblog' and 'agroforum'; the option 'Recent Posts' is shifted from the 'Interactions' part.

To get registration in this site now the user has to fill a page with his information. The format is provided in the site as 'User information' page. The page will open up when he wants to create a new account.

In 'Library' of 'Extension Material' now there are two types of search option under 'Browse Content'. By clicking on a particular concept of the KMs, by default, one gets the search result for tags. But if he/she clicks on the 'Search for Substring' option then it will give the syntactic type of search. Also under 'Search Content' option, the user finds both 'Search for Substring' and 'Search for Tags' options.

The first page of agroblog now gives the index of the user blogs instead of showing the recent blog entries. One can view the index in two ways- i) by name i.e. alphabetically by the user name and ii) by the no. of posts the users have in their blogs. By default, the page shows the index according to the no. of posts. The user having higher blog entries will be appeared in the first and to see the blog content one have to enter into that user's blog.

Under this agroblog a new option is incorporated namely 'KM blog'. This is a space for discussion on knowledge model. Here KM experts can share their comments and views. One can also enter into the same page by clicking on the shortcut 'Discussion on KM' or through the 'Discussion on KM' option under 'Knowledge Models' menu.

In 'About Us' another option is added there, named 'In News'. It provides the news in which there is a reflection of agropedia i.e. when the agropedia comes in news it will be shown under this section.

The number of shortcuts is increased as many new shortcuts are added here like 'My account' (provided options to the user to control his own user profile page and blog entries), 'Discussion on KM', and 'Unpublished post' (recently send content are kept before verifying by the agropedia administrator).

6.3.6 CHANGED FEATURES AS ON **MARCH, 09:**

There is one more option called 'Content Tree' added with the other four options as 'Add content', 'Browse content', 'Search content' and 'Help' under 'Library' of Extension Material. Actually, the 'Browse content' option is not compatible with the Internet explorer. So for this option we need to use Mozilla or other types of internet services. Under this option one can view the content of a particular topic just by clicking on the node of the KM, seen in the right hand side of the page. Under 'Content Tree' option instead of graphical representation like KM, the agricultural knowledge is presented in a structured way, just alternative to the KMs. Here also by clicking on the nodes shown in the left hand side of the window one can get the links of the relevant contents in the right hand side. If any word used to represent the relationship in the KM and one clicks on it from the 'Content Tree', instead of getting the content, he gets the massage,

'It is a relationship' in the right hand side of the window. In case, one is using Internet explorer and unable to see the KM under the Browse content option, he will get a link in that page to redirect in the 'Content tree' option. Here also one gets the two types of search- 'Search for tag' and 'Search for substring'. By default, the window shows the search result for tag.

Users are given options to add comment in text, audio or video format and in all types of contents including library, agrowiki, photo gallery and video gallery. Previously, they are bound to add new comment only through text format, but now they have choice to add webcam comment or audio comment or text comment for all types of contents.

6.3.7 CHANGING FEATURES AS ON **APRIL, 09:**

In this month the IITK technical experts mainly work to make the user interface of the agropedia portal more informative, attractive and user-friendly. The new UI of the agroedia portal is going to introduce very soon.

Also, one of the main attractions of our 'Interactions' space namely 'Users Discussion' is ready to work and may be incorporated in the site in this month. Here the registered users are able to discuss and share their opinion on any particular topic of agriculture and agropedia in group. So it can be synonymously called as agro-chat.

However, (we are still in the preliminary phases.) The portal may continue to be modified according to users' requirements and suggestions for improvement. (For example, a good introductory page explaining what AI is, and hand holding new users and interested browsers on how to use the different portals is the need of the day. We are currently working on this aspect.) New emerging technologies, if effective for the project purpose, can be embedded into it. Very soon we are introducing our agropedia portal with a new look which is hoped to be more understandable and user-friendly. (Therefore there is a long process ahead to give the user interface a standardized form.) But it will never be the final one, as continuous modification would be required to keep the portal current, live and applicable.

6.4 RESOURCE PARTNERS

agropedia is a collaborative project. The main aim of this collaborative effort is to develop an ICT based platform for sharing of knowledge and culture. The same topic can be interpreted differently by the people from different culture and different area. That is why a common platform is essential for getting a complete idea and hence knowledge on a particular topic. In the present context of agriculture, the IITK group wants to fulfill this aim by developing Knowledge models, creating a content repository in agricultural domain and by building an agri-knowledge community. In this project all the partners have their own roles and responsibilities to make this project effective and successful. The roles and responsibility of the partners, in the context of agropedia are detailed below.

Indian Institute of Technology, Kanpur (IITK): IITK is the main ICT developer and the host of the agropedia project. It takes the responsibility to build up the web-based portal for agropedia and the platform for knowledge exchange. It develops the mechanism for online content

organisation. Presently there are people from three broad areas –technical, agriculture, and social science, working together at IITK for developing the portal. The technical experts work on computer architecture and programming for developing the basic technological framework of agropedia portal. The agriculture experts focus on developing knowledge models using Concept-map tools, content organisation etc. Already they have prepared concept maps on basic description, production technology, protection technology, and post harvest management of selected crops (such as rice, wheat, Chickpea, green pea, pigeon pea, sorghum, groundnut, litchi, and sugarcane) in conjunction with GBPUAT, ICRISAT and Tata Chemicals. Moreover, they have been active with the technical counter part in mapping their knowledge and tagging content so that the information is semantically searchable (enabled). Two experts of information systems/knowledge models from FAO have come to assist the standardization of the process. Besides this, they translated and created new terms for '*Agrovoc' (the agricultural thesaurus*) in Hindi and started populating the 'agropedia' portal with seed content. Now they engage in editing and formatting the contents provided by the other consortium partners and the other registered users. The social scientists try to build the theoretical framework from socio-economic point of view and study the knowledge creation process.

This paper is a first effort at documenting the process so far. In this process the social scientists access whether the techniques deployed for network formation and strengthening are inclusive and sustainable, and whether the process provides the right incentives for the partners to participants and new actors to join. Moreover, it is important to ensure that the developing environment within the agropedia group in-house is fruitful and also suggest how best to tailor the web portal and services to real user needs. Thus for the creation of a knowledge community, which is complete in all respects the three group of people need to work together as a team.

IITK has arranged and will continue to arrange workshops and trainer training session for the two participating SAU's and other agriculture institutes and organisations. The purpose is to make these institutions aware about the agropedia portal management, empower them to use it and convert other extension workers into users, while collecting feedback and suggestions from them at the same time. It enables the partners to create and edit knowledge models as well as contribute content within the domain of agreed crops. The IITK team develops and shares the guide lines for Knowledge Models with sample Knowledge models on some general and specific agricultural concepts. It helps to develop the Knowledge Models mainly with the help of Concept Map tools.

Thus, IITK has the responsibility to develop the technical platform to support agropedia from back end.

Indian Institute of Technology, Bombay (IITB): IITB is the ICT developer and the host of the aAQUA, a question answer forum on agriculture, which will be added content under forums of the agropedia site. aAQUA would be available in English, Hindi and Telugu. IITB (would help other consortium partners for capacity development in aAQUA management and gives) provides 24x7 hours support to SAU partners in this respect. It has already successfully provided the aAQUA platforms to two SAU's for their KVK's and in NAARM and ICRISAT for training purposes.

Indian Institute of Information Technology and Management (IIITM) Kerala: IIITM-Kerala provides the ICT and hosts for the multi-modal engagement and delivery services. It has the responsibility to develop the proper user interface, give advice to web studio design and support

for content management in SAU's. It also develops design of decision support systems (DSS) for farmers and provides capacity development and advisory support to NARES partners. It has already trained a number of faculty and ICAR experts in the management of portal-based multi-modal services in support of farmers and extension services. Recently they have ensured to provide some content in 'agropedia' site, if required. The semantic search capability of agropedia will support IITM-K's efforts at designing and deploying a DSS.

Govind Ballabh Pant University of Agriculture and Technology (GBPUAT), Pantnagar: The state agricultural university is one of the main agents for development of knowledge models, content providers and an implementing partner. It provides content mainly on sugarcane, wheat, Litchi and Peas for agropedia. The scientists can gather knowledge from their experience and other sources and digitize them after analyzing the validity of the data. It works as the intermediary for knowledge transfer to the agropedia repository and engages two KVKs for impact assessment. The university implements the tools, observe the impacts, find the difficulties and give the feedback and suggestions to the ICT developers for the required modifications. It also works for capacity building and strengthening selected KVK's/ARS.

University of Agricultural Science (UAS), Raichur[38]*:* This agricultural university, like GBPUAT, is a content provider and implementing partner. It provides content mainly on Rice. It also works for capacity building and attached with two KVKs for impact assessment. Thus the responsibilities of these two agricultural universities are similar, except that they are working on different crops. Due to time and distance issues, the IITK team was not able to interface effectively with the Raichur team up to November, 2008 and this arose some problems for them in uploading content and creating KMo in the portal before December'08.

National Academy of Agricultural Research Management, Hyderabad (NAARM): NAARM works as a facilitator to the other partners in their works. It facilitates content sourcing by giving the spatial data sets of land use, soil and other features. It advances in agricultural research and education through the incorporation of GIS tools. It provides capacity strengthening support to SAU's and capacity development of NARS in Knowledge Management.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru: ICRISAT is the Consortium Leader. It works as a channel for communication among the partners and with CGIAR & FAO. Thus it manages the whole project. Beside this ICRISAT works as content provider mainly on drought related issues and provide a full fledged training and test-bed for use by NARS partners and research students in IC tools in extension and education. It also works for impact assessment and identifies and develops new actors and opportunities for system integration.

In brief, for agropedia, IITK develops the software architecture and deploys it complete with user interface, which hosts the portlets of IITB and IIITM-Kerala, who benefit from the semantic search facilities of agropedia for their servers as well. Content, which is the backbone of agropedia for it to be successfully deployed and used, will be provided by the implementing partners, GBPUAT, UAS-Raichur and ICRISAT. The resources of NAARM could be used to

introduce and popularize the agropedia. ICRISAT is also the Consortium coordinator which works as a channel for communication and over all facilitation.

6.5 SOCIAL PERSPECTIVE:

6.5.1 OBJECTIVE

The purpose of the NAIP-agropedia project is not only to develop an efficient well designed platform for agricultural knowledge management, but to ensure that it is effectively deployes by socializing the whole process. The top-down push system, with a path like, Research→ Technology →Implementation is not effective as it bypasses user needs completely. A 'Need Analysis' helps to understand the existing problems from the user perspective, the gap between "what is and what should be" and contextualize it in the right socio-economic circumstances. So before developing the agropedia portal, the first task of the IITK team was to know the urgency for and the awareness of people of the need of ICT based infrastructure. This is followed by empowering the implementing partners to use the agropedia platform so that they can influence more and more people to use it. Moreover, it is critical to involve these partners in the implementation of the platform itself. IITK's efforts toward these objectives are described next.

6.5.2 TASKS AND DELIVERABLES

The social science team supports the technical team by interfacing with the other project partners to develop use cases, providing feedback on the services designed, keeping the team together and devising mechanisms for evangelizing the use of agropedia. Thus, they represent the user (in addition the agricultural scientists) and give their views, suggestions and comments on the tools being developed, to make the systems as user friendly as possible. In addition, training and capacity building to evangelise the use of agropedia is an integral role of the social science group. In more abstract terms, the task of the social science team could be interpreted as one to develop mechanisms to populate 'agropedia' and make its use sustainable by enabling a network to continue using it and dynamically improving it, though no specific deliverable is associated with this activity.

6.5.3 PROCESS

Any system is accepted by people of a society when they find it useable and helpful for them. The evangelization process indicates 'how to learn one's culture and how to belong in it'. The IITK team is thus building agropedia in consonance with the culture and the need of the users (extension workers) and wants to involve as many people as possible in the building process, which itself would propagate better use. Even after development of agropedia, it may be necessary to modify it according to changes in the tastes or needs of the users, developments in technology, or on a broader level, with changes in the situation such as infrastructure availability. Thus the purpose of the project is to develop the system by keeping in mind the culture, value of the society and the ability of the people. For this, agropedia works within the existing social system and uses the strength of the prevalent social capital through building up proper networks.

6.5.3.1 NEED ANALYSIS STUDIES

Need analysis of the farmers (completed)

A detailed study was undertaken, using questionnaires and interview techniques. The following is a summary of the findings, which did not throw up too many new issues.

Each and every farmer faces the problem of lack of information or more specifically the reliable source of information. Not getting any reliable and conveniently available source nearby, the farmer depends on seed sellers for information; even knowing that the sellers cannot be relied upon because they push products that give them higher margins. Though different initiatives have been taken by the government to provide information, small and marginal farmers are not able to get it, mainly due to the barriers of language of communication, cost and time involved in accessing information and social barriers of caste and community. Moreover, many times the information is not in line with the queries of the farmers and while answering, the experts use many technical terms. These make farmers less interested to search for information from the experts. Sometimes they are hesitant to ask questions just thinking that they would be made fun of.

Farmers need information in simple form that they can easily understand and obtain. Their queries are related to seed variety, pesticide and weedicide selection, weather and cultivation technology, government schemes and policies. Most queries are local related to cultivation. The information is best absorbed if it is in local language, with pictures, voice and movies; demonstrated or given in an interactive session in a friendly environment. To reduce farmer hesitation, experts need to respect farmers as sources of indigenous knowledge and encourage sharing of knowledge rather than dissemination.

Beside this, most farmers are not well versed with KVKs and their activities. Many of the KVK scientists are frustrated as they do not have adequate administrative support, are not involved in the extension planning process (as all technologies are introduced in a centrally planned top down manner without taking into account local intricacies), and sometimes do not get access to information and support of experts immediately to answer farmer queries. To make the process effective, feedback from using any technology should be taken from the farmers and incorporated; this is absent in the present government structure.

Need Analysis of the KVK scientists (in progress)

The information is being collected in different ways, through questionnaires form and direct interaction with partner KVKs as well as implementing partners as GBPUAT and UAS Raichur.

6.5.3.2 WORKSHOPS, EVANGELIZING-MEETINGS AND TRAINING SESSIONS

IITK has already successfully organized some interactive sessions to drive awareness of the agropedia initiative and develop knowledge models in an inclusive and democratic manner. A

summary of these are presented below, in chronological order, with actual minutes of meetings attached as Annexures, where available.

1ST RICE WORKSHOP AT IIT KANPUR

The first workshop was on rice was held at the Visitor's Hostel, IITK from 14th -16th February, 2008. The objective was to understand the knowledge modeling aspects of rice. A number of delegates came to attend this workshop from different parts of the world particularly from FAO, NECTEC (Thailand), London School of Economics, ICRISAT, Dharwad AU, GBPANT AU, ICAR, and HBTI of Kanpur. The experts of the five KVKs, working with IITK and the members of a NGO named WIZMIN, working for the rural people, also joined in this workshop. We discussed about the vision for Agropedia, its necessity, the work process, action plan, prospects and objective of the KM consortium, responsibilities of different actors, the need and importance of extension services, Agrovoc in flavor of technology 2.0, use of Semantic Tool to build a Repository of Reusable Information Objects in Agricultural Education and Extension, and synergies in collaboration. The focus of the workshop, however was on obtaining inputs for a rice knowledge model for AI including aspects of rice production technology, extension needs etc., and to set the tone for a collaborative effort to build AI. The outcome of the workshop was clarity among the different partners on their roles, some action points and a reiteration of commitment to create an agri-knowledge e-community and build the best and most useable agricultural portal in India, which could have international usability as well. Refer annexure-I.

2ND WORKSHOP /1ST TRAINING SESSION ON KNOWLEDGE MODELS AT PANTNAGAR

The second workshop on Knowledge Models was held in Pantnagar from 31st July to 2nd August, 2008, to train the scientists of GBPUAT and their KVK experts. The IITK group comprised three technical experts, a knowledge model expert of FAO and an agriculture expert. They discussed in detail about how to develop Knowledge Models with the help of C-Map tools and how it linked with content uploading onto the AI web site. In addition hands on training were provided on how to use different portals added in this web site for better understanding. The IITK group needed objective feedback on whether the scientists are comfortable with the AI web site and the techniques that were being used and the difficulties and problems faced, based on which the AI portal could be modified. A questionnaire developed by the social science team was used for this purpose. Refer annexure-II.

WORKSHOP ON UNDERSTANDING USER NEEDS AND FOLLOW UP ON KMS

Prof. T.V. Prabhakar, Mr. Jitendra Singh and Ms. Sugatha Chaturvediof the AI team visited the Kisan Mela on 5th October 2008 organized by GBPUAT in the university campus. On the second day they participated in discussions with NAIP team members of GBPUAT. The IITK team has also arranged for some training on how to upload knowledge models onto the IITK server, how to access knowledge models from agropedia.net, how to upload content in agropedia portal and how to write in Agrowiki. From their discussion several points emerged on the finer details of knowledge models, and a future action plan was developed. Refer annexure-III.

TRAIN THE TRAINERS SESSION AT IITK FOR CONSORTIUM MEMBERS FROM GBPUAT

Kiran Yadav and Kamini Bisht of GBPUAT came to IITK for complete training on knowledge models (the CMAP tool and the relationship building) in a three days programme from 13th October to 15th October, 2008. This training programme helped reduce confusion and solved the problems that were being faced by the KM developers in GBPUAT on the five crops- organic basmati rice, wheat, vegetable pea, litchi and sugarcane.

WORKSHOP ON UNDERSTANDING USER NEEDS AND DETERMINING CONTENT TYPE

A team of five agricultural scientists and two computer experts from IITK were at GBPUAT on on 23rd October, 2008 for deciding the type and form of the agricultural content for the content management system of AI. The meeting was very useful, resulting in the revision of some of the terminology that were being used in the agropedia KMs. It also paved the way forward for work to commence on building the content management system. Refer annexure-IV.

EVANGELISING MEETS AT DELHI

Dr Runa Sarkar of the AI team addressed the consortium on Agroweb – Digital Dissemination System for Indian Agricultural Research (ADDSIAR) at Delhi on 18th July, 2008. The objective was to kindle the curiosity of the ADDSIAR consortium partners on AI and make them aware of this initiative. The presentation on Agropedia stressed the need for different ICAR organizations to participate in the agropedia web 2.0 processes for it to be successful. It was well received with commitments from different partners to contribute to the platform when running and suggestions on methods to evangelise, including targeting KVK scientists who come for training at NAARM to enable and equip them to become part of the e-community.

Prof. T V Prabhakar of the AI team, along with Dr V Balaji of ICRISAT were part of deliberations at Delhi under the aegis of DR N T Yaduraju of NAIP for project formulation to develop a rice knowledge portal. This effort would complement the AI efforts significantly.

WORKSHOP ON AGROPEDIA WORK PROCESS BY ANTONELLA PICARELLA AT IITK

Ms. Antonella Picarella from FAO, Rome (volunteer) came to work with the Agropedia Indica team as a technical expert, in a 6 month contract. Her contract was terminated on 28th Nov. 2008. So a workshop was arranged on that day at IITK. Here in this workshop she gave a demonstration on her work on AI and her experience. She also gave some feedback for the improvement of the AI.

TRAINING- WORKSHOP IN ICRISAT, HYDERABAD

Two agricultural experts, Dr. Sharwan Shukla and Dr. Vivek Singh from IIT Kanpur went to Hyderabad to attend the training-workshop arranged by ICRISAT for agricultural scientists from 8th December, 2008 to 12th December, 2008. In this workshop ICRISAT trained all the agricultural scientists of the consortium partners on “Digital Content Creation and Management for Crop Specific Information”.

On the last day IITK had to give a demonstration on agropedia portal. For this purpose Dr. Vimlesh Yadav, Mr. Jiteendra Singh and Mr. Govind Murari of IITK went to Hyderabad and joined

in the training session on 12th December, 2008. They also collected the feedback of ICRISAT members on agropedia site. Refer annexure-V.

WORKSHOP-TRAINING ON KNOWLEDGE MODEL IN DHARWAD (RAICHUR)

There was a training-workshop on knowledge model from 15th-16th December, 2008 at Raichur, one of the research stations of Dharwad SAU. From IIT Kanpur one agricultural expert Dr. Vimlesh Yadav, and two technical experts, Mr. Jiteendra Singh and Mr. Govind Murari went there to give the Dharwad members a complete training on the guidelines of knowledge model. They also gave the demonstration on Agropedia portal and discussed how to create Knowledge Models, in details. Refer annexure-VI.

MEETING OF THE IITK AGRI-SCIENTIST WITH THE GBPUAT SCIENTISTS AT IITK

A pre-workshop meeting was arranged with the GBPUAT scientists (Kamini Bisht and Gyanprakash Singh) at IITK from 8th-10th January, 2009. This was to further familiarise the agri-scientists with the knowledge models (KMs) and functionalities of agropedia, so that they could demonstrate the Knowledge Models and instruct how to use the interactive spaces like wiki, blog and forum to other participants in the follow-up workshop. In this meeting they were briefed about the processes to be followed at the Delhi workshop and were asked to assert ownership on specific Knowledge Models for which he/she had to lead the discussion. Other tasks of the agri-scientists in the next Delhi workshop were also decided in this meeting. With the help of the others participant's feedback they were supposed to validate the knowledge models and make a proper sequence of the contents so that it becomes easy to find the appropriate content. They were also supposed to look for the expert specialist among the participants and motivate the specialists to provide contents for the agropedia.

WORKSHOP ON CROP KNOWLEDGE MODELS AND AGROPEDIA AT DELHI

This workshop was to launch the Knowledge Models and the agropedia portal. This was arranged at NAAS building, Delhi for two days, 12th -13th January, 2009. The scientists and experts from different agricultural universities and KVKs of India were invited to attain the workshop. Here after the inaugural session on 12th January, 2009 the Project Investigators of IITK with ICRISAT released and demonstrated the agropedia portal. As decided previously, the selected agri-scientists of IITK and GBPUAT divided into nine groups to demonstrate and discuss on the different Knowledge Models and to get feedback from their own group. Then a general discussion was arranged by the Project Investigators on the Knowledge Models to modify the Knowledge Models according to the group discussion but with the general agreement of all the scientists. This workshop was a successful one in validating the Knowledge Models. As the technical part of the portal was almost ready to launch before the whole world, the GBPUAT was given a deadline of 15th March, 2009 for providing the complete content on Rice, Wheat, Vegetable pea, Litchi, and Sugarcane mainly under the 'Extension materials' category. However, the work process of the IITK agropedia team was appreciated by all the participants. Refer annexure-VII.

CAPACITY BUILDING WORKSHOP OF IITK AGROPEDIA TEAM MEMBERS AT IITK

IITK agropedia team arranged for a Capacity building workshop for its team member on 17th January, 2009. The objective of the workshop was (a) to develop training modules for future workshops, (b) to streamline future workshop conduction and (c) to train individuals to conduct the workshops. All the team members were asked to give a talk on his/her experience in the project work process mainly in the previous Delhi Workshop**,** organised jointly by IITK, ICRISAT and GBPUAT on Crop Knowledge Models and agropedia, 12-13 Jan, 2009. Everyone agreed that the Delhi workshop was a successful one from the point of view of launching the Knowledge Models; it got a lot of feedbacks which helped our agri- scientists to validate the Knowledge Models. It was also be a successful one towards the building up of the agricultural e-community among the agri-scientists as the response outside the consortium partners was high, in spite of the fact that there was a communication lag in the process of sending the invitation letter and very short time between the invitation and workshop itself.

In this capacity building workshop each one of our team learnt how to present a topic with the required PPTs. The Project Investigators discussed with us in details about our strengths and weaknesses, and also suggested how to make our presentation better.

ONLINE MEETING WITH ICRISAT

There was an online meeting for discussing on computer security/ fire-wall issues between the IITK agropedia team and Gerard Slyvester of ICRISAT on 3rd February, 09.

THE AGROPEDIA STALL IN THE INTERNATIONAL CONFERENCE ON "GRAIN LEGUMES: QUALITY IMPROVEMENT VALUE ADDITION AND TRADE"

Indian Institute of pulses research (IIPR), Kanpur organised an international conference on "Grain Legumes: Quality Improvement Value Addition and Trade" at its campus from 14th to 16th of Feb, 09. Here, our agropedia team wanted to have a stall on agropedia to make the site familiar to others. For this, our two agri-scientists Dr. Vivek Singh and Dr. Sharwan Shukla met with the Sr. Scientists Dr. S.K. Dubey of IIPR on 3rd Feb, 09. According to the discussion three agri-scientists (Dr. Vivek Singh, DR. Sharwan Shukla and Dr. Yogesh Kumar) and two technical experts (Amit Tripathi and Rahul Samaddar) organised and conducted the agropedia stall there. The participants of the conference (most of them are scientists and research scholars) showed a great interest in the agropedia portal and Knowledge Models. All the three days, in the evening (as the participants were busy and the projector is not working properly in the daytime) people used to come to attend the presentation on agropedia portal provided by the IITK team members. The team members were able to involve 15 individuals as registered users and to add two blog contents in our site. There was a huge demand for the browsers and the personal cards of our team members which reflected the success of the agropedia stall.

MEETING WITH DIFFERENT PARTNERS OF REFEARI-ICTKM

A team of two technical experts, Mr. Govind Murari and Mr. Vikash Awasthi, from IITK agropedia team visited IITB on 16-17 Feb, 09 and IIITM-Kerala on 17-18 Feb, 09. The main purpose of visit IITB and IIITM-Kerala was to assemble the contents which these two consortium partners

have been acquiring for their 'aAQUA' and 'Kisan Kerala' site, respectively. With IITB they talked in details about their agricultural question answer forum 'aAQUA' and the possible way to make their contents useable for agropedia users. They have told that they are able to provide their content in Q-A form only through RSS feeder for agropedia forum as IITB has the copy-right over the content of 'aAQUA'.

In the meeting with IIITM-Kerala they discussed for how much the concept and content of 'Kissan Kerala', developed and run by IIITM-K, could be used by the agropedia users. They ensured to enrich our agropedia forum through the RSS feed and the agropedia Library with content. The IIITM-K suggested to use their content for agropedia whenever necessary but with the reference of 'Kisan Kerala'. They don't have any copy-right issue for their content.

TRAINING WORKSHOP ON AGROPEDIA AT ICRISAT

After visiting IITB and IITM-K the same IITK team (Mr. Govind Murari and Mr. Vikash Awasthi) went to ICRISAT-Hyderabad to organise a training workshop on agropedia on 19-20 Feb, 09. On the first day Prof. T.V. Pravakhar from IITK was present there to give a support to our technical team. Some members of our Dharwad partner, few KVK experts and some scientists from other different institutes came to join this workshop. Twenty registered users and three blog contents are added in our agropedia site during this training period.

DR. NAGARAJU PAPPU OF CANOPUS VISITING AGROPEDIA LAB

Dr. Nagaraju Pappu of **Canopus** Consultant Ltd., Bangalore joined the IITK agropedia team as its technical consultant. For this purpose he came and visited IITK agropedia lab from 2nd-4th March, 09. Our team demonstrated the agropedia portal. Many valuable suggestions both from technical and project management perspective came from his side in the discussion. On the one hand, he gave focus on the authenticity of the site and on its content and on the other side, he suggested to be more disciplined and to follow a much more managed approach of having proper plan and keeping reports. Dynamic approach to rate user experience is mandatory according to him.

THE AGROPEDIA STALL IN KISAN MELA AT GBPUAT

GBPUAT, Pantnagar was organising a Kisan mela there from 3rd to 6th March, 09. Our IITK agropedia team set up an agropedia stall in this mela. A team of three members including Dr. Vivek Singh, Dr. Yogesh Kumar, and Mr. Deepak went to Pantnagar for this purpose. The main objective of this stall was to make aware the agri-scientists, students, extension workers and other agriculture related people (who came to visit the mela) about our agropedia site. Our team was able to create 41 registered users and three blog contents for our site during this mela.

INTERACTIONS WITH STAKEHOLDERS OUTSIDE THE CONSORTIUM

TATA CHEMICALS

A scoping meeting of the IITK NAIP project team with the members of Tata Chemicals was on 7th and 8th of July, 2008 in IITK. Mr. Praveen Chandra, Mr. Shiromani Kant and Mr. Ramandeep

Singh from Tata Chemicals came to IITK to give a clear picture of their work process and the purpose, and to know the work plan and the objective of the project. In this meeting both the team tried to understand how much they could help each other to fulfill their objectives.

This was followed by a visit of Prof. Jayanta Chetterjee, Prof. T.V. Prabhakar and Dr. Vimlesh Yadav of the AI team to the Tata Chemicals office at Noida on 24th July, 2008. A large number of Tata Chemicals employees actively participated in this meeting. After realizing the importance of the knowledge models, Tata Chemicals agreed to collaborate with IITK to develop knowledge models on crop-nutrition.

The third meeting between the two teams was essentially a training session on knowledge Models and COE (CMAP Tools Ontology Editors) tools, held at IITK on 26th and 27th of September, 2008. Mr. Prem Chand Jha and Dr. Vineeta Misra, attended to build an understanding of the techniques of Knowledge Models for developing crop-nutrition knowledge maps. As the visitors from Tata Chemicals were experts on plant nutrition, they also gave feedback on the knowledge models developed by the IITK team. Once again, questionnaires were administered to assess the usefulness of the training session.

HARCOURT BUTLER TECHNOLOGICAL INSTITUTE (HBTI), KANPUR:

Three MCA students, Anupam, Rakesh and Awnish of HBTI, Kanpur with one of their faculty members Mr. M.D. Singh came to IIT Kanpur on 2nd December, 08 to give a presentation on organisation of the huge information base collected by them on different agricultural crops. They wanted to share their idea with the Agropedia team. They did a lot of works-- collected images and descriptions on different varieties of rice (both paddy and processed paddy), wheat, chickpea, Rajma, pea, sesamum (til), urad daal, fruits, vegetables, seeds of vegetables and fruits, Medicinal plants, mushrooms and insects. For e.g. there were 73 varieties of rice paddy, 22 varieties of processed paddy, 40 varieties of wheat, 7 varieties of til, and two different types of rajma (white and brown) had 34 and 40 varieties respectively, in their collection. They have collected most of the data from IIPR, Kanpur and BHU, Varanasi. Then they synthesized the data base and tried to organize the whole set of data (as technical experts) for computer application mainly for a better user interface.

KVK CHITRAKUT

Mr. Jeetendra Singh from IITK visited to Chitrakut on 6th December, 2008 to attend a meeting with the KVK scientists of Chitrakut, U.P. The KVK Chitrakut is one of the most important KVK in India. They agreed to work with the agropedia team and to share their information with the Indian agricultural community through agropedia.

STATE AGRICULTURAL UNIVERSITIES (SAUS) OF UP

It was decided to organise training workshops on Knowledge Models and agropedia by IITK in different SAUs premises of Uttar Pradesh. Accordingly, in these training sessions, 70% of the participants should be the scientists from different disciplines of the agricultural university, 10% the PhD students and remaining 20% be the local KVK experts; and in the programme schedule 20% time should be allotted for KMs and rest for the agropedia portal. For this purpose the

agro-scientists of IITK agropedia team contacted with the Sardar Vallbh Bhai Patel University of Agriculture and Technology (SVBPUA&T), Meerut and Chandra Sekher Azad University of Agriculture and Technology (CSAUA&T), Kanpur.

SARDAR VALLABH BHAI PATEL UNIVERSITY OF AGRICULTURE AND TECHNOLOGY (SVBPUA&T), MEERUT

A training programme on agropedia was jointly organised by IIT-Kanpur and Sardar Vallabh Bhai Patel University of Agriculture and Technology (SVBPUA&T) – Meerut on 29th January, 09 at Meerut campus. From the IITK agropedia team three agricultural scientists (Dr. Vimlesh, Dr. Yogesh Kumar, and Dr. Vivek Singh), two computer experts (Vikash Awasthi and Amit Tripathi) and a social science researcher (Amritesh) went there to provide them training on using the agropedia portal and the knowledge models. There were twenty two agricultural scientists attended the training session. Most of them were the faculties of this university. We got a good response from this university in our training programme. But most of the participants were not comfortable with the computer system. So our members faced some problems during the hands on practice session on both agropedia portal and knowledge models. Also the time was short to make them understand about the agropedia portal and the KMs because both the things were new to them. So our members suggested to arrange such training session for one and a half day and to include some PhD students as participants. Here, 18 registered users were added and among them two created their blog contents. For details refer annexure-VIII.

ZONAL CO-ORDINATION UNIT (ICAR), KANPUR

The Zonal Co-ordination Unit (ICAR), Kanpur organised a training session on 'Market-Led Extension' with the collaboration of MANAGE-Hyderabad from 2nd to 6th February, 2009 at Kanpur. In this programme the IITK agropedia team wanted to introduce the agropedia portal before the ZCU participants. As most of the participants were the KVK scientists, the IITK team found it as a good opportunity to come in contact with the end-users of our project. So the zonal co-ordinator, Dr. A. K. Singh was invited at IITK with the participants on 4th Feb, 09 in the training workshop of 'ICT Intervention in Agriculture with Special Reference to Marketing'. Here the agropedia team explained the need of ICT in the agricultural domain and in this context demonstrated the recently developed agricultural site- agropedia, its features and functionalities. IITK also arranged for a hands-on practice session for the participants. There were twenty two participants present in the training session. They had lots of quarries on the portal and had huge interest on the Knowledge Models. But the main problem was that when they were invited for the hands-on session most of them did not want to sit in front of the system just because they were not comfortable with the computers; even some of them didn't have their e-mail ids. However, among them 18 agri-experts created their own account in the agropedia site and also added a wiki-content. Annexure-IX provides the participants list of this training workshop.

CHANDRA SHEKHAR AZAD UNIVERSITY OF AGRICULTURE AND TECHNOLOGY (CSAUA&T), KANPUR

A Training programme on agropedia was organised by the IITK agropedia team in Chandra Shekhar Azad University of Agriculture and Technology, Kanpur on 12th February, 2009. From IITK team three agricultural scientists (Dr. Vimlesh, Dr. Yogesh Kumar, and Dr. Sharwan Shukla)

and two computer experts (Vikash Awasthi and Meeta Bagga) went to train the CSAUA&T scientists and students on agropedia and Knowledge Models. Though only three of the participants created their login password and added a single wiki-content but they expressed their huge interest on this portal. The detail of this workshop is given in annexure-X.

V. BALAJI OF RISKRAFT CONSULTING LTD. GROUP

A meeting was arranged on 5th March, 09 in IITK with Mr. V. Balaji of Riskraft Consulting Ltd. who was working on the project named Agriculture Decision Support System (AGDSS). The objective of this meeting was to know and share the basic ideas and concepts of these two projects running by two different groups in the agricultural domain. He has given focus on the needs of the farmers, while we have focused on the needs of the extension workers. Within the 6 months of his project he developed a site named, agdss.com, and gathered all types of data on Wardha district of Maharashtra which would be very helpful for the Wardha farmers. He told that he tried to collect the data which meet the farmers' needs. From his survey it came out that farmers were apparently interested for the agricultural information on crop production process and the different government schemes. However, his purpose to visit IITK was to manage his whole dataset in a more systematic and organised way so that farmers could get their specific content easily. For that, he was very much interested in knowledge models and in the techniques and technology used in agropedia site for the option 'Search by Tag'. However, it was hoped that this collaboration would give a fruitful result in future to our initiative.

RAHUL GOSWAMI, THE DEVELOPMENTAL JOURNALIST OF GOA

A meeting was arranged with Rahul Goswami, the Developmental Journalist of Goa for two days from 9-10th March, 09. The objective of this meeting was to get a road map on how to socialize agropedia and to develop some strategy for socialisation. After a long discussion with our agropedia team and being satisfied with his quarries, he agreed to work with us by sharing his valuable experiences. Already he gave some feedback and important suggestions in this aspect of agropedia to start with, as can be seen in annexure-XIV.

6.5.3.3 OTHER 'EVANGELISING' PRACTICES

In addition to the above initiatives, the social science team has been working towards

a) Preparing agropedia flyers and others dissemination materials to be distributed at Krishi Melas and at agricultural university campuses

b) Publishing Articles in popular domain literature

c) Developing Research Papers for conference and journals

d) Developing methodologies for content analysis

e) Continuous evaluation of workshops and meetings through analysis of the questionnaire results

The social science team received a lot of feedback from the workshop participants. It also tried to assess and understand the farmers' and KVK experts' needs and expectations from such a

knowledge management portal. The agropedia team continuously modifies the user interface and services provided by the agropedia platform to make it user-friendly and informative, based on inputs from the social science team. Through the process of expanding the distribution and dissemination of information about agropedia, the ultimate objective is to create a digital knowledge ecosystem in the Indian agriculture domain where the whole process of Knowledge creation, sharing, and transfer grows automatically and able to sustain with changing environment.

6.6 CONCLUSION

As knowledge creation and exchange is an open- ended process both with respect to time and area, there is a need to build a digital ecosystem based ICT platform for the agricultural domain in India. agropedia is an attempt in this direction. Through the agropedia, knowledge actors from divergent view points, disparate cultures and different geographies with a common interest in agriculture can come together to create novel and useful knowledge nuggets. The ICT based platform developed by agropedia connects localized knowledge clusters and overcomes the shortcomings in the networks of the existing extension system through channelising knowledge flows and knowledge dissemination. The structure of the network is neither too organic nor informal, nor too rigid or hierarchical so as to promote the process of knowledge co-creation. Moreover, local interaction coupled with interaction with other knowledge nodes in the e-community would create a dynamic process of knowledge creation. In building up and strengthening a structure of communication and collaboration among the actors in Indian agriculture, agropedia aims to exploit the existing social capital based network structure.

The strategy for agropedia development appears to have parallels with other OPAALS partners, involved in the creation of digital community ecosystems. Abstractions from experiences with creating these ecosystems then feed into the development of a formal process of digital ecosystem adoption, reported in D12.10. Some of the commonalities between the approaches followed, one in the Trento region and the other in India are as listed below

- ✓ Start from concrete local needs
- ✓ Work with the actors at many levels – The Trento experience suggests a top down, bottom up and intermediate level approach, the Indian experience suggests a network approach incorporating both top down and bottom up approaches
- ✓ Create ownership by using the language most familiar to the actors (don't use the "ecosystem" terminology, for example)
- ✓ Clearly articulate (or determine a mechanism for evolving) some objectives for the digital ecosystem, which are of value and immediate interest to the actors involved
- ✓ Action research and participatory research can act as a spiraling feedback mechanism for continuously fine-tuning the mechanisms of participation within the ecosystem
- ✓ It takes time and energy to concretely involve and motivate local partners, without whom the entire process is unsustainable

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