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D11.10 – Final Report on Models of Produsage and Prosumption for Social Innovation

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Short Description: The deliverable provides theoretical framework for understanding the dialectical tensions in a large, participative, innovation network in participatory mode of development. In this process it explores autopoietic, associative principles in a digital ecosystem, by offering an array of theoretical and empirical discussions of the concepts from a social science perspective.

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Achievements*	We have examined a number of theories that have relevance for understanding self-organizing principles in a digital ecosystem. We have examined the relevance of autopoiesis (social), normative rule systems and cross pollination effect in knowledge sharing culture of Digital Ecosystem Community. We are able to propose a new framework, which can be considered as a preliminary framework for understanding circularity of communication and autopoiesis in an emergent Digital Ecosystems theory.
Work Packages	What exactly were the contributions to other WP and what effect they have had on the work in these other WPs (max 2 pages) What exactly are the future contributions to other work packages (max 2 pages) We assume that this deliverable can have main impacts on: 1. Task 11.9. 2. Task 12.4
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features*	and if anyone outside the OPAALS Consortium has taken notice of this work D 11.10 provides an innovative blending of theoretical and empirical insights from a social science perspective. An attempt has been made to develop a multidisciplinary theoretical framework for digital ecosystems. We believe that this report represents an incremental improvement in the state of the art towards an integrated theory of digital ecosystems. Some of the work presented here has been highlighted by IEEE DEST 2009 conference, E-Africa, National Agricultural Innovation Program of India & FAO.
Disciplinary domains of authors*	Specify the names of the authors and their disciplinary affiliation(s) **Social Science**: Jayanta Chatterjee (IITK), Debashis Pattanaik (IITK) Kasturi Sadhu Ghosh(IITK),Vinod Kumar (IITK) **Social Science, Computer Science and Biology**: Paolo Dini (LSE)

The information marked with an asterisk (*) is provided in order to address Recommendation n. 4 from the Year 2 review report

Contents

Background to the Deliverable

The Dialectics in a Digital Ecosystem for Knowledge and Role of Social Informatics in Organising Large-scale Social Innovation

Introduction

This deliverable focuses on:

- The role of social informatics and social media in organising large-scale social innovation.

This submission is the final report on Task 11.5 interlinking D11.7 i.e. Knowledge sharing behaviour of actors involved in a DEK. The context of the study is innovation and its deployment in the agricultural domain for social innovation and economic development of North Indian regions (and this deliverable is the continuation of D 11.7).

The deliverable collect different articles, some of them have been already included in D11.7 (specifically paper 1 and 2) the other are new. We prone here also article already presented because they provide foundation to other works included in this deliverable.

Before leaving space to single papers we think that some themes/issues should be introduced. The following paragraph are organized as follow:

1. Pathway of large scale social innovation
2. Producers, Prosumers and Produsage in the context of DEK
3. Antecedents of Innovation diffusion
4. The current research focus
5. Work so far
6. Link between papers here and the deliverable description
7. Appendix to research outline

Pathway of Large Scale Social Innovations

The mechanism of knowledge diffusion has interesting anthropological answers with respect to the quest about how innovations travel. Originally, diffusion was envisaged quite literally, in the sense that cultural artifacts ‘spilled over’ from communities that were full of them to others that were without them. In the version that became popular in management

theory via marketing (Rogers, 1962; Levitt and March, 1988), the emphasis was still on artifacts (consumer products or technologies), but the spreading of innovation emphasized more and more on the spreading of ideas, even ideologies. This process is no doubt a central concern in the whole issue of community learning & community informatics in a Digital Ecosystem for Knowledge (DEK).

It seems certain that ideas do travel as things, incorporated in books, documents, designs, or models (Czarniawska and Joerges ,1992&1996); it is the method of locomotion that remains in doubt. Attempts to change a physical metaphor into a biological one (e.g. 'infection', 'catching'), probably inspired by the ideas of the bacteriologist and philosopher of science Ludwig Fleck , do not solve the problem. Analogies to nature may make the process itself more acceptable (Douglas, 1986) but will not increase one's understanding of it. How does a rural citizen 'catch' an idea, or how can an innovation 'diffuse'?

Knowledge diffusion thus suggests a physical process subject to the laws of physics, so explanations of phenomena using this term provoke a further train of physical metaphors, such as 'saturation' or 'resistance'. It is true that people speak about ideas as if they were objects moving in time and space by virtue of some inherent properties. Like other field metaphors, diffusion has an economic value, rendering the less known in terms of the more familiar, and the immaterial in terms of the material. But adopting the metaphor for analytical purposes leads to an impasse. It may be plausible to say that ideas move from of 'more satiated' to 'less satiated' environments, but saying so also means suggesting that the law of inertia applies to ideas as it does to physical objects.

Rather than bringing in new physical metaphors to defend those already in use, one can look to anthropology for a different kind of metaphor. Latour, who formulated a program of symmetrical anthropology (1993), also made a suggestion concerning diffusion:

> The model of diffusion may be contrasted with another, that of the model of translation. According to the latter, the spread in time and space of anything –claims, orders, artifacts, goods-is in the hands of people; each of these people may act in many different ways, letting the token drop, or modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it (1986).
>
> The translation model answers the questions about the energy needed if ideas or objects are to move around. It is people, whether regarded as users or as producers, who energize an idea every time they translate it for their own or somebody else's use. Watching ideas travel, 'We observe a process of translation-not one of reception, rejection, resistance or acceptance' (Latour, 1992).

It is important to stress, though, that the meaning of 'translation' in such a context goes beyond its linguistic interpretation. It means 'displacement, drift, invention, mediation, creation of a

new link that did not exist before and modifies in part the agents (Latour, 1993). The process often changes the two agents through fusion.

This richness of meaning, evoking associations with both movement and transformation, embracing both linguistic and material objects, makes translation a key concept for understanding organizational change (Czarniawska and Sevon, 1996). It comprises the relation between humans and ideas, ideas and objects, and humans and objects and provides one of the key concepts on which later propositions on Knowledge and Digital Content Produsage/Prosumption have been built. We discuss this in the next section of this Introduction to D 11.10 after these References on the Anthropological understanding of Knowledge Translation (Dierkes, Nonaka et al., 2003).

Producers, Prosumers and Produsage in the context of DEK

The term prosumers is generally attributed to Alvin Toffler (1980) who devoted considerable attention to it in The Third Wave. Toffler argued that Prosumption was predominant in pre-industrial societies; what he called the "first wave". It was followed by a "second wave" of marketization that drove "a wedge into society that separated these two functions, thereby giving birth to what we now call producers and consumers" (Toffler, 1980). Thus, the primordial economic form is neither production nor consumption, but rather it is Prosumption. However, in Toffler's view, contemporary society is moving away from the aberrant separation of production and consumption and towards a "third wave" that, in part, signals their reintegration in "the rise of the prosumer" (Toffler, 1980). Similarly, Ritzer (2009) has argued that it was the Industrial Revolution that, to some extent, separated production and consumption, but he also contends that even at the height of the Industrial Revolution production and consumption were never fully distinct (producers consumed raw materials; consumers produced their meals). The later theorists in Economics had consumptionist or productionist bias. This false binary does not seem to apply to Indian agricultural domain because both farmers and agricultural scientists in Krishi Vigyan Kendras (KVKs) co-create content (new knowledge & new solutions) through their conversations, field demonstrations and collaborative problem solving. The problem based conversations and learnings that take place between the experts and farmers are good examples of produsage and presumption. We have explored in this deliverable whether DEKs enhance these phenomena.

Recently prosumption has become an important topic in research literature. Writing on business issues, Prahalad and Ramaswamy (2004) discuss this trend under the label of "value co-creation". Tapscott and Williams (2006) see the prosumer as a part of a new "wikinomic" model where business put consumers to work. These models, as well as the whole idea of relying on consumers to produce, is criticized by Andrew keen (2007) in Cult of the Amateur. Beer and Burrows (2007) see new relations between production and consumption emerging online, especially on Web 2.0. Humphreys and Grayson (2008) have discussed prosumption in relation

to Marxian theory. Zwick et al (2008) relate prosumption to neo-Marxian theory, concluding that prosumption means companies are granting new freedom to consumers. They argue that "the ideological recruitment of consumers into productive co-creation relationships hinges on accommodating consumers' needs for recognition, freedom, and agency". Xie et al (2008) discuss the general propensity to engage in prosumption. Ritzer and Jurgenson (2008) theorized the emerging importance of prosumption and the prosumer, and Jurgenson (2010) argues that prosumption online marks a reversal of the historic trend toward increasing rationalization in favor of deMcDonaldization of the Internet.

Then there is a wide range of subtler and less material examples of prosumption. Much of what transpires online, especially on what has come to be known as Web 2.0, is generated by the user. Web 2.0 is contrasted to Web 1.0 (e.g. AOL, Times of India or Yahoo) which was and still is provider-rather than user-generated. Web 2.0 is defined by the ability of users to produce content collaboratively whereas most of what exists on Web 1.0 is provider-generated. It is on Web 2.0 that there has been a dramatic explosion in prosumption. It can be argued that Web 2.0 should be seen as crucial in the development of the "means of prosumption"; Web 2.0 facilitates the implosion of production and consumption.

Wikipedia, where users generate articles and continually edit, update, and comment on them (Konieczny, 2009);

Facebook, Myspace, and other social networking websites, where users create profiles composed of videos, photos and text, interact with one another, and build communities (Boyd, 2006, 2007, 2008)

Second life, where users create the characters, communities, and the entire virtual environment (Herman et al, 2006);

The blogosphere, blogs (Web logs), kisanblog (audioblogging),microblogging (Twitter) and the comments on them produced by those who consume them;

eBay and Craigslist, where consumers (along with retailers) create the market;

YouTube and Flickr, where mostly amateurs upload and download videos and photographs;

Current TV, where viewers create much of the programming, submit it via the Internet, and decide which submissions are aired;

Linux, a free, collaboratively-built, open-source operating system, and other open-source software applications, like Mozilla Firefox, that are created and maintained by those who use them (Lessing, 2006; Stewart, 2005);

Amazon.com, where consumers do all the work involved in ordering products and write the reviews. Also, the users' buying habits and site navigation are documented to recommend products;

Yelp!, where users create an online guide by ranking, reviewing and discussing various locations and activities in their area;

Prosumption was clearly not invented on Web 2.0, but given the massive involvement in, and popularity of, many of these developments, it can be argued that it is currently both most prevalent location of prosumption and its most important facilitator as a means of prosumption based Knowledge Translation (refer previous section).

The articles is this compilation extend this background discussion to the field of agricultural extension, social innovation in North Indian countryside between 2005-2009 and ICT enabled development projects in other parts of rural India. We examine 'Produsage & Prosumption' as important instances of self catalysis in a Digital Ecosystem for Knowledge (www.georgeritzer.com).

Antecedents of Innovation Diffusion

Central to the study of innovation diffusion is the understanding of diffusion as a process of social change entailing alterations to a socio-technical system in terms of its structures and functions through communication (Rogers, 1995; Burkhardt, 1994). Key aspects of the 'diffusion of innovation' processes are thus the "dialectic" interaction among the 'innovation itself', the 'social system' in which the innovation is introduced and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes.

The Current Research Focus

In the studies submitted (D7.3 in Phase I and D11.6 in Phase III) it was observed that successful implementation of a Digital Ecosystem approach for knowledge diffusion and social innovation requires that conflicting social situations/interests are taken into consideration and that research out-put/policy agendas are based on debated and often transient consensus. A useful framework for analyzing this kind of situation where many conflicting processes are involved is offered by the Dialectic Inquiry (DI) system (Churchman 1971). This approach places special emphasis on the importance of multiplicity of view points and actors involved in an innovation and its adoption process. It argues that the new direction in research policy will only have practical results if (1) multiple view points and conflicting social situations are taken into consideration, and (2) actors with appropriate capabilities are adequately represented in the research process and are willing to take part in the process of innovation and diffusion. Thus in the second phase we have expanded the involvement

of village level agricultural scientists, extension employees and other service providers to the farmers as well as engage with the farmers themselves by creating horizontal communication networks.

From our longitudinal observations it appears that Indian Agricultural Extension Services (IAES) also depicts the challenge of social innovation and adult learning through two dialectically related modes of grasping experience – apprehension (concrete experience of farmers and agri-scientists in the village centres) and comprehension (abstract conceptualisation by agri-scientists in universities and laboratories) and two dialectically complementary modes of transforming experience – intention (reflective observation) and extension (active experimentation).

In a way we saw the problems in IAES emanating from insufficient integration of the four learning styles emerging from those dialectical relationships, namely – diverging, assimilating, converging and accomodating proposed by Kolb and others (Kolb 1984, Sternberg and Zhang 2000). The synthesis approach to the learning process provides a good framework for designing the socio-digital space within in a DEK (Digital Ecosystem for Knowledge).

- The IAES scientists desire that farmers relate new ideas and concepts explained to them to previous knowledge and experience and develop new integrated concepts. The scientists, as 'teacher experts' desire that 'farmers as learners' understand underlying principles, look for new patterns and relate new ideas to new practices .

- But the audiences of farmers have often explained that the facts and procedures presented by the scientists often differ from their ground realities (eg. The model farms attached to the agricultural science centres often enjoy near ideal conditions). Thus farmers often treat facts and new procedures handed down to them s static knowledge (Source: Conversations with farmers and scientists at Unnao, recorded in 2006).

In the papers that we have compiled in this report (D11.7) on Task 11.4, we depict a managed process of diverging and converging, enfolding and unfolding. Our continuing ethnographic studies of the actors in this process hopefully will lead us to generalisable designs and processes of DEK. These studies should validate conversational learning as a co-designing format for large scale social innovation.

The Appendix at the end of this section provides an over view of the dialectical inquiry system that has been adopted in Phase II as a research methodology that we carry forward to our research in Phase III. Clarifications have also been provided in the Appendix regarding some key concepts used for our conversations with the focus groups and for our own debates.

The papers compiled here depict how different actors and different stake holders use different format of digital interfaces and the best process designs for social innovation and adult learning are evolving.

Work so far

The compilation of papers in this folio, as deliverable against Task 11.5 sets our research direction regarding the role of social informatics and social media in organizing large scale social innovation connecting the social autopoiesis process (D11.6) with the competitive-collaborative process of socio- cultural and socio-economic change. At this point, we hypothesize that while the self catalysis and autopoiesis in a socio-technical system exhibits 'living system' characteristics through recursive, intense, conversational loops, the germination of that autopoietic process happens due to the inherent dialectical urge for change and renewal lying within the socio-cultural system itself. The designing of a creative, germinating, nurturing socio-digital space of a DEK therefore should be inspired by Maturana, Varela, Luhmann (D11.6) as well as by Hegel, Durkheim and Sorokin.

The papers in this completion focus on the Deliverable D11.10, i.e. role of social informatics on large scale social innovation and also on adult (rural citizens') learning. The field experiments are based on the hypothesis that greater the anticipated reciprocal relationships are, the more favorable will be the knowledge sharing attitude. Rather than extrinsic rewards our system deployment relied on encouraging the sense of self-worth through knowledge sharing behavior.

The experimental DEAL architecture is based on an assumption that conversation is a 'meaning making' process where understanding is achieved through interplay of opposites and contradictions. Following Parker Palmer (1990) in this ongoing experiment, one has thus assumed that socio-technical innovation and learning follows a process of being involved in 'an eternal conversation about things that matter', conducted with passion and discipline. The innovation here is not in the conclusions so much as in the process of the conversation itself,

Initially, it seems that interdisciplinary or inter- KVK boundaries inhibit or block conversation and knowledge exchange across functional/departmental boundaries is often difficult. However, soon the new space created by the physical-digital platform hosts conversations that explore new links. The following papers, as a report on Task 11.4 therefore should be read not as boundaries of exploration but rather 'shape givers'. That will shape our final exploration into the DEK as a model of 'how adult practitioners and experts learn'. Our field work will be based on our continuing engagement with the Indian Agricultural Sector but will hopefully provide insights into generic socio-economic innovation processes that can be applied across multiple sectors.

Links between the Papers here and Deliverable Description

The research outputs from task 11.5 are two investigative papers (specifically paper 1 and 2). All the papers have been presented to and accepted for publication in the proceedings of International Conferences/Journals after several reviews.

Appendix to Research Outline

The Dialectical Inquiry (DI) Approach

The DI approach to social system innovation research stems from a scheme suggested by Churchman's (1966, 1971) interpretation of Hegelian dialectics. Mason (1969) proposed the DI system as a new problem solving approach to planning and policy development. Essentially, DI involves a process utilizing a confrontation of thesis (plan) and antithesis (counter plan) in a structured debate and a synthesis (integrated plan) of the opposing views. The synthesis constitutes a new conception of the world, or *'Weltanschauung',* that is, a higher level understanding of the problems, issues, premises, and assumptions involved in the planning process. Constructive debate - explicit statement and examination of the underlying assumptions of two polarized opposites (plan vs. counter plan) - is hypothesized to improve the planning process by creating an awareness of the complexity and interdependence of the issues involved.

There are two schools of thought, philosophical (supported by the writings and research of I. Mitroff, R. Mason, and their associates) and empirical (advocated by R. Cosier, C. Schwenk, and their group), involved in a dialectical conflict over the application of DI to planning.

The proponents of the philosophical school support their claims regarding the advantages of the DI approach in decision making with a number of field studies, dealing with a variety of real world problems in diversified settings (Emshoff and Finnel, 1978, Laurenco and Glidewell, 1975, Mitroff, Barbara, and Kilmann, 1977). These field studies used no control groups or alternative planning methods; moreover, statistical results were not reported. The participants' and researchers' perceptions of the effectiveness of DI and their satisfaction with the decision making process were utilized as a measure of DI success. Supporters of the empirical school in contrast advocates for objective measurement and control over experimentation, data validity and reliability in DI (Cosier, 1978, 1980, 1981, Cosier, Ruble, and Aplin 1978, Schwenk, 1982a, 1984, Schwenk and Cosier, 1980).

The supporters of the philosophical school of thought suggested that DI is most appropriate when the problem in question is ill-structured (Mitroff 1982a, 1982b; Mitroff and Mason, 1981). Against this researchers such as Cosier (1982) and Schwenk (1982b) expressed a strong belief in the necessity of conducting rigorous research under controlled conditions for

DI. However observations from field and laboratory studies of DI do not provide any conclusive evidence supporting one or the other school of thought.

Philosophical Foundations of Dialectical Inquiry System

DI system is based on Hegelian dialectics, a philosophical system known since the nineteenth century as dialectical idealism. Built on the theoretical foundations of Hegelian philosophy, DI has inherited many of the advantages and disadvantages of dialectical idealism. Dialectical idealism represents a very insightful and comprehensive view of the universe as being interconnected and constantly changing. Hegel called the process of change 'dialectics' (Churchman 1971). According to Mulej (1978), the ideas in Hegelian dialectics: (1) are changeable and develop out themselves; (2) are interrelated and interdependent; (3) tend to be adverse to each other.

Conceptual and Operational Modes in Dialectical Inquiry System

A philosophical system, including Hegelian philosophy, consists of ontology - a theory about the fundamental nature of the world and being; epistemology - a theory of knowledge that deals with nature, application, presuppositions, basis, and the general reliability of claims to knowledge; and method - a set of principles and techniques used to obtain knowledge (Mitroff and Mason 1982). Furthermore inquiry is a purposeful human activity designed to produce systematic knowledge. Mitroff, Mason, and their colleagues view DI from a broad philosophical perspective based on the Hegelian doctrine. They suggest that: (1) more general and qualitative knowledge (e.g., improved learning) can follow - from purposeful human inquiry; (2) more specific and data-based knowledge can be derived by using specific problem-solving technology.

Dialectical Inquiry System as Methodological Tool for Field Studies

Mitroff and Mason point out that 'true dialectic entails two or more groups (possibly the same group at different points in time) actively participating in the examination and formulation from markedly different points of view' (1981, p. 649). Dialectic is a longitudinal and process-oriented phenomenon. Therefore longitudinal studies ranging from several months to several years are most appropriate timeframe to conduct DI.

DI system places special importance on the role of structured debate in inquiry. The structured debate, designed to be the forum in which proponents present and argue the pros and cons of the plan and counter plan and underlying assumptions with the forcefulness different interpretations of the same data bank (1982a, p. 208). Field based DI system follows a silent and introspective mechanism to study the pros and cons of the plan and counter plan. It is in the structured debate that the implicit and explicit assumptions are exposed and a new understanding of the problem, with corresponding new assumptions, is achieved.

Materialistic Dialectics for Socio-Cultural Change

One major, but frequently overlooked, source of change is related to the universal tendency for opposition between the individual and the social order. A basic factor endemic in social evolution is the human condition that generates a continuous potential for change. In the simplified language of analysis, human personality structure consists of two parts, one part being in the service of the unique, biological individual, the other in the service of the normative, standardized social order embedded in material culture. These two parts often oppose each other, and the dynamics of the dialectical struggle may traverse beyond the individual to the social and cultural order as well.

Although the theme of the existential struggle between the individual and material culture is not new, it is largely underdeveloped within the contemporary social sciences. Some of the best statements on this subject are still found in the works of three classical theorists: Emile Durkheim, Sigmund Freud and Georg Simmel. Durkheim's clearest assessment of this struggle is in his essay, *The Dualism of Human Nature and Its Social Conditions*, where he explicitly argues that man is essentially divided against himself.

As Durkheim sees it, the pursuit of moral (social) goals necessarily subtracts from the instinctual side of human nature, and, conversely, instinctual expression tends to be at the expense of our material and social sensibilities. Durkheim places specific importance on order and normative regulation. Freud, on the other places more emphasis on the value of biological expression. One of Freud's best general statements on this internalized struggle between the individual and society is in his *Civilization and Its Discontents.* Strongly reminiscent of Durkheim's statement, he observes that: ' . . . in every individual the two trends, one toward personal happiness and the other toward unity with the rest of humanity, must contend with each other; so must the two processes of individual and of cultural development oppose each other and dispute the ground against each other' (Freud 1958, 99). Freud believes culture grows and increases in complexity at the expense of the individual, and that the demands of contemporary civilization are becoming so excessive that the individual can only meet them at a tenable personal cost - if at all. Simmel like Freud is also concerned with the problem of increasing cultural dominance. He sees the basic antinomy as being between spirit and form. Spirit represents human creativity; form represents the products of this creativity. Although man creates his own cultural forms, he paradoxically must stand eventually in opposition to them. (A view shared by Weber and Marx as well).

Information and inputs for socio-technical innovation, once created, follow an immanent logic of their own (Simmel 1968, 39-40). They unfold and expand in directions that may have little or no relationship to the needs that first created them. At the same time they are not completely irrelevant to the individual, since they are internalized and place demands on him.

Knowledge repositories become stultifying as they move further and further from their creative base. The need eventually arises to discard the old forms and to create new ones (Simmel 1968, 44).

Thus socio-cultural change follows a dialectical mode of operation where succeeding stage represents a higher form than the previous. For example P.A. Sorokin's illustration of the decline and revitalization of cultural systems, is a best expression of such socio-cultural transformation.

According to Sorokin, if not disrupted by outside forces, cultural systems that make up part of the larger, do follow an immanent logic of their own. Every culture contains a multitude of systems. The movement of all these systems is from periods of creativity and vigor to periods of sterility and exhaustion. Unlike the decline of biological entities, many systems can and do have periods of renewed vigor in which their decline is temporarily reversed. All cultural systems, though varying in size, duration, and periods of renewal, hold two features in common: (1) they generate change from within themselves, and, (2) if allowed to run their course, they are ultimately responsible for their own demise. Sorokin has labeled this first universal characteristic the 'principle of immanent change of socio-cultural systems'; and the second is the 'principle of limits' (Sorokin 1947, 696, 699). In Sorokin's own words: This inherent deterioration explains the extinction of most of the defunct systems and of most cases of the temporary decline of various systems and super-systems. Each of them contains the seeds of its own degeneration (Sorokin 1947, 711). He argues skillfully that cultural systems do indeed move from periods of relevance and vigor to periods of inanity and decline but does not provide a satisfying explanation why such changes do in fact occur. One plausible explanation to this lies in the dialectic nature of human action and his existence as species. The early, vigorous, creative period in the development of cultural systems described by Sorokin, corresponds to that moment in the dialectic when new cultural forms have been established but are still in the service of the majority of the members of the culture. Because the system meshes significantly with the inner states of individuals, it stands a good chance of being perpetuated. Once perpetuation is under way, however, the 'principle of immanent change of socio-cultural systems' comes into play; that is, the cultural system is developed along lines that eventually become antithetical to human needs. When this internal development has gone far enough, the system becomes so far removed from relevance for most of its subscribers that it may be described as devitalized, sterile, exhausted or the like (Sorokin 1947, 705). It is at this moment in the dialectic that the 'principle of limits' becomes important. The system can no longer perpetuate itself because a significant number of the individuals who participate in it will no longer tolerate it. It must either be revitalized or replaced, so the process begins anew.

Paper 1

Socio-technical Innovation and the Role of Conversation in a Digital Ecosystem for Agricultural Extension Services in India

Debashis Pattanaik **Jayanta Chatterjee**

Introduction

There is wide agreement that we are witnessing an information technology 'revolution', or a change of 'socio-technical paradigm' based on Information and Communication Technologies (ICTs) (Castells, 1996). The study of such changes - sociology of technology - is a heterogeneous field. With the dawn of the information age (knowledge society), we have harnessed a technology that moves at the speed of light. Now, knowledge could be produced, transferred, and distributed to thousands in ways that never happened before. ICT tools are used not only to coordinate data flow, but they also provide meeting spaces for the kinds of knowledge that should be shared between different stakeholders in a community (Figallo and Rhine, 2002). Knowledge is growing faster than anything that humans now produce. Since the work of Peter Drucker in the 1990s, knowledge has come to be recognised as the primary driver of socio-technical innovation and change. Drucker, among others, argued that in the emerging society, knowledge is the primary resource for individuals and for the community overall; land, labour, and capital (Drucker, 1999). Thus managing knowledge has become an important aspect for socio-technical innovation in the present era. Over the past few years, various ICT supported knowledge management tools has become a crucial means to connect people not only to digital knowledge repositories but also to other people, in order to share knowledge and create new forms of knowledge networks and communities (Ichijo and Nonaka, 2007).

This new emergent collaboration of different knowledge nuggets helps people to improve their lives more rapidly and effectively. It empowers individuals. It is a potent means for tackling poverty, ignorance and disempowerment. It enables people to dip more freely into the well of human knowledge and select the things of most value, relevance or interest to them (Cribb and Hartomo, 2002). However for the true 'socio-technical innovation' to happen there must be a cultural change within technology itself. In addition the practitioners of socio-technical innovation should acknowledge that; 'lay knowledge' and 'scientific knowledge' are equal and necessary partners in the innovation and adoption process; and that true communication is not about sharing information, but about sharing meaning and achieving a common understanding (Cribb and Hartomo, 2002).

Technology and Society – The Interplay

It is argued that all successful technological innovation involves the construction of durable links between humans and nonhuman entities-'actors' (Latour, 2005). This implies that any socio-technical change involves two interrelated phenomena. The first is the way the 'physical' aspects of technology are influenced by the demands of its 'social' user. The second aspect relates to transformations that bring about changes in the patterns of social relationships due to introduction of a new technology (Mackenzie and Wajcman, 1985). In general much of social theory conceives social relations as simply unmediated relationships between human beings, rather than being made possible and stable by artifacts and technologies. There are possibilities that society can exist without artifacts and technologies, but such societies; for example of primates are small and rare today. Thus artifacts and technologies make larger and more complex societies possible.

Largely technological change follows persistent patterns, such as; the increasing mechanization of manual operations, the growing miniaturization of microelectronic components, and the increasing speed of computer calculations. Some of these patterns are indeed so precise as to take regular quantitative form (Mackenzie, 1996). For example, 'Moore's Law' concerning the annual doubling of the number of components on state-of the-art microchips, formulated in 1964, has held remarkably from the first planar-process transistor in 1959 to the present day (Noyce, 1977).

'Normal' technical change maintains a momentum of its own which defines the broad orientation of the innovative activities. Once a path has been selected and established, it shows a momentum of its own. In contrast persistent patterns of technological changes though possess momentum, but needs intervention (Mackenzie 1996, Latour, 1987). One form of intervention to persistent pattern of technological change is 'self-fulfilling prophecy' (Merton 1968). The other possible intervention to persistent pattern of technological change is communication loops of ongoing conversations particularly if the object of orientation is ICT.

Users' expectations of the technological future are part of what make a particular future. These expectations evolve through communicative interactions among users groups. Thus technological trajectory is like an institution. Like any institution, it is sustained not through any internal logic or through intrinsic superiority, but because of the interests that develop in its continuance and the belief that it will continue (Mackenzie, 1996). Its continuance becomes embedded in actors' frameworks of communication and routine behaviour, which are actualized by many communication loops that users of a particular technology constructs through every day practices. It continues because it is embedded. A socio-technical system in principle is a '*de novo* construct'. According to Pfaffenberger 'people are engaged in the active technological elaboration, appropriation, and modification of artifacts as the means of coming to know themselves and of coordinating labor to sustain their lives' (Pfaffenberger, 1992).

Thus socio-technical systems refer to the complex systems of social and technical components intertwined in mutually influencing relationships (Deborah and Wetmore, 2008). In general the socio- technical system refers to the interaction between society's complex infrastructures and human behavior (Wikipedia, 2009).

Socio-technical Change and Innovation: Constructivist Paradigm

All social organization of scientific or technological change assumes a community structure, as Kuhn and others (such as; Price, Merton and Knorr-Cetina) have suggested (Kuhn 1970, Price, 1963, Merton, 1973, Knorr-Cetina, 1999). For example Crane has suggested that the development of communication networks since the seventies has expanded the domain of exchange and sharing of ideas beyond local boundaries, and that become possible through ongoing interaction of people in a community like structure (Crane, 1972). This suggests that evolution of a new technology depends on relevant social groups' involvement, use and interpretation of particular technology. Importance of user involvement in successful socio-technical innovation has been suggested by Mumford in his participatory design approach. Participatory design focuses on the active engagement of the end user in all the phases of design (Mumford, 1993). Applied to information systems it suggests that successful design of information systems depends on repeated discussions with various groups of users, and integration of the multiple system perspectives into a composite information strategy that can later be implemented using a wide range of system engineering tools (Sjoberg and Timpka, 1998).

The user interpretation of particular technology as successful means for socio-technical innovation has been highlighted by Pinch and Bijker in their social constructivist approach to evolution of new technology. According to them different social groups have different interests in the development of a technical artifact. In the early stages of the evolution of an artifact, alternative designs are produced aimed to solve different problems and fulfill different needs. In later stages, because of social, technical, economic and political constraints, there is an increasing degree of stabilization through a competition for survival, as a result a few of them survive and become successful. Thus the evolution of a technical artifact denotes institutions and organizations as well as organized or unorganized groups of individuals who share a set of meanings constructed through communication loops in relation to an artifact (Pinch and Bijker, 1987). Pinch and Bijker use the evolution of the air tyre in bicycle technology to illustrate further. Pinch and Bijker note: 'when, for the first time, the tyre was used at the racing track, its entry was hailed with derisive laughter. This was however, quickly silenced by the high speed achieved, and there was only astonishment left when it outpaced all rivals' (Pinch and Bijker, 1987). From a social constructivist point of view demonstration/conversation and its ongoing self production are two guiding elements towards any understanding of technological innovation and their diffusion.

A dominant paradigm in this direction is suggested by Rogers through his socio-technical innovation approach to rural adoption of new technology, popularly known as 'diffusion of innovations'. According to Rogers key aspects of diffusion of innovations are communication and their operation in facilitating dissemination of innovation through 'word of mouth' within local communities. He suggests that communication effects, especially the ability of media messages and opinion leaders to create knowledge of new practices and ideas persuade the target to adopt the exogenously introduced innovations (Rogers ,1969). The necessary route for this change is 'word of mouth' which creates a path for acceptance of new ideas from sources external to the social system (Rogers, 1969; Fjes, 1976). In Roger's view word of mouth is the catalyst for innovation diffusion. Thus communication and conversations are central links through which new/exogenous ideas enter local communities.

Conversations, Self-production and Autopoiesis

The key point about conversation lies in its self-production. The term self-production has biological roots. It refers to systems where the components of the system participate in the processes of production that produce those same components that themselves constitute the system (Varela, 1981; Maturana, 1981). Self-producing systems have a circular organization where the outputs of the system are its own inputs (Mingers, 1995). Self-production in social context has a very specific meaning. One of the approaches to self-production in a social system comes from Luhmann's understanding of communication as a mode of circular organization proposed in his theory of autopoiesis (Luhmann, 1990). Luhmann does not claim social systems as living systems, rather he suggests that if 'we abstract from life and define autopoiesis as a general form of system building using self-referential closure, we would have to admit different modes of autopoietic reproduction and that there are general principles of autopoietic organization that materialize as life, but also in other modes of circularity and self-reproduction' (Luhmann, 1990). According to him communication exists as a unity constituted by three elements: information, utterance and understanding (Luhmann, 1995). These elements exist in a mutual interactive field as they are co-created within the process of communication (Luhmann, 1990).

Although Luhmann's conceptualization of communication refers to a higher level than 'conversation', yet conversation occupies a central position in his frame work. A significant aspect of Luhmann's conceptualization of social systems, and within that organization, is the notion of expectation and its relationship to the way the system is structured and decisions form. As such, self-referential social systems structure themselves through conversations and expectations of actions (Luhmann, 1995). This framework combined with a social constructivist perspective provides valuable theoretical support to the development of Digital Ecosystem for Knowledge (DEK) that dynamically enhances 'self production' balances 'knowledge stocks' and 'knowledge flows' in socio-technical systems.

Multiple Media and ICT mediated Architecture for Socio-technical Innovation

The networked communication of the language community depends on the nature of trust, induced by the socio-technical system. Trust is a willingness to act on the basis of reliance. It has been suggested that a thick kind of trust, in which members have high degree of confidence in others role expectations is found mostly in stable and structured communities, such as village or agricultural communities. Such communities have been known as *Gemeinschaft* since the time of Tonnies (Toennies, 1957). Opposite to it a thin trust with goal oriented behavior exists in communities which Toennies called *Gesellschaft* (Toennies, 1957, Adler and Heckscher, 2006). For socio-technical systems and knowledge networks which are like Gemeinschaft we have to enhance evolutionary growth conditions for trust based relation enhancing systems. In this context ICT helps us to propagate 'words of mouth' and enhances the trust based relationship through circularity of communication and expands the reach and thickness of network provided we focus on 'trust' and relation building and make it person oriented rather than technology oriented.

It has been observed that when knowledge structure is fluid or random, face to face (F2F), mobile nets, audio blogs, interactive radio, and TV act as successful modes for generating conversations and propagating word of mouth in a trust based relationship environment. In contrast when the nature of knowledge is explicit conversation depends on dynamic mode of knowledge sharing (Fig. 1.1). Key aspects of the 'diffusion of innovation' processes are thus the dialectic interaction among the 'innovation itself', the 'social system' in which the innovation is introduced and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes.

The communication is maintained through circularity, organization and reproduction.[5] This requires interoperability of the information (interoperability provides potential for automation and systemic self- management) and digitization of the information in various forms for easy use created by many stakeholders in the domain. The goal framework of the DEAL - Digital Ecosystem for Agriculture and Rural Livelihood, DEAL [www.dealindia.org] project focused on interoperability of the information. The goal was to facilitate communication through context sensitive query processing over heterogeneous information sources. The agenda was to build an action oriented network supportd with multiple ICT tools and technologies, whose interaction e.g. KVK (Krishi Vigyan Kendra = Farm Science Centre) scientists and farmers create new knowledge based relationships in a trust based framework (Chatterjee and Pattanaik, 2009).

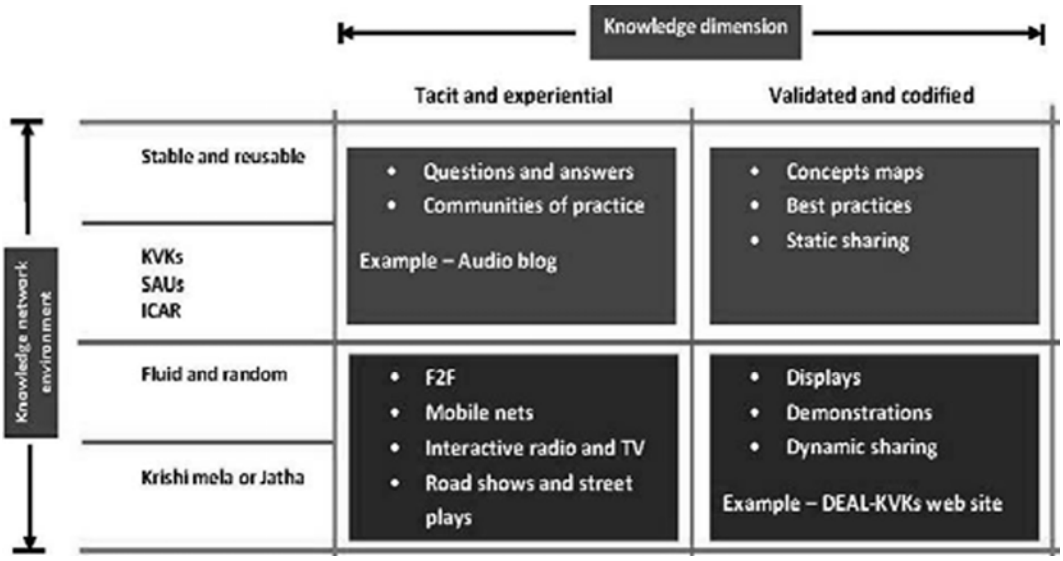

Figure 1.1 - Knowledge Network Environment and Knowledge Dimension

Socio-technical System for Agricultural Extension Services

The concept of ICT for rural development has always attracted media and corporate attention and therefore many multilaterally funded projects on this theme have been initiated over the last ten years across many developing countries. Most of these projects focused on establishing info-kiosks in villages and grappled with the initial problems of connectivity, power and other infrastructural issues. Some of them were oriented towards electronically delivered Government to Citizen Services; some were focused on trade and some on a range of consumer oriented services. Our initial study across North Indian locations during 2002-2004 of many such projects led us to believe that to ignite the agricultural and rural livelihood innovation process with knowledge flow, these rural ICT kiosks not only needed network connectivity and electrical power but also the power of appropriate content and applications.

Our research hypothesis was that the process of creating a self propagating content/knowledge network repository can be enhanced by efficient networking of many conversations to build action oriented network (digitally enabled) communities. This can then create a digital ecosystem and a dynamic grass root innovation system sustained by many feedback loops (Chatterjee et al., 2008). The DEAL perspective starts from the assumption that ICTs can play an important role in catalyzing development. In this statement we immediately recognize different possibilities of interpretation. If we focus on the technological aspects, we might expect efficiency improvements in those processes that can most easily be automated, such as information storage and retrieval or any of the other processes that support the business and economic life of the users of DEAL. Development in this case tends to be interpreted in terms of quantifiable economic measures. If, on the other hand, we focus on the communication processes enabled by the technology, we are led to inquire into the nature of

the link between the social processes supported by ICTs and the different kind of possible social interactions and exchanges. These two perspectives reflect a dichotomy at the heart of research on ICTs that corresponds to the main epistemological viewpoints in the current OPAALS-DEAL project (Rivera Leon and Dini, 2008).

Research Methodology

Field deployment of the DEAL project was between December 2006 and June 2007. Some further deployment work has been done under the OPAALS project (www.opaals.org) during 2008. We have been conducting studies among participating KVKs, October 2007 onwards. The data used in this paper are taken from the data collected during our field visits at two different time intervals during July- August 2008. The data was collected from five participating KVKs, involving a sample size of 32 in number. The data was collected through qualitative techniques and semi- structured questionnaire.

Conversation in Extension Services among Agriculture Scientists – Pre DEAL Scenario

It is observed that, in the absence of proper channels to facilitate communicative action most of the scientists of the KVKs operate in isolation and hardly have any opportunity to gain the information and knowledge about other scientists working in her/his area in another district even at the local level. In their respective KVK the scientists also have sparse networks for knowledge exchange.

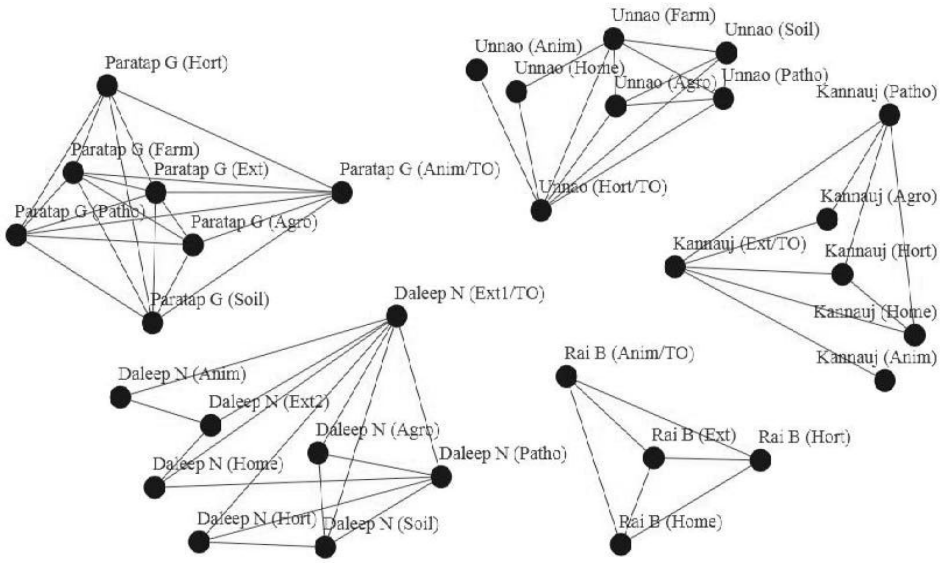

Figure 1.2 - Networked Conversation in Pre DEAL

For example in one of the studied KVK (located at Dhaura) all the scientists maintained reciprocal relationships with the SMS (subject Matter Specialist - Agriculture Scientist) of horticulture as he was the administrative head of the particular KVK, whereas in terms of actual information sharing hardly they have any reciprocal relation with another scientist (Figure 1.2). Our study shows a low network density (for communicative action) among the KVK scientists in pre DEAL scenario. The network density for communicative action in pre DEAL scenario is .11996. In pre DEAL scenario SMSs of animal husbandry and home science are most isolated actors in the network space of knowledge exchange, where as SMSs of agronomy, plant protection (plant pathology), farm management and soil science have unitary mode of networked conversation. These forms of networked conversation hardly meet the rising need of the information resources of the scientists in the present context of the rapid changes that occurs in agricultural technology.

Conversation in Extension Services among Agricultural Scientists - Post DEAL Scenario

Studies in network architectures suggest that centralized networks are ineffective modes of interaction for information sharing (Fahey and Prusak 1998, Markus 2001). In contrast a participatory bottom-up approach allows information sharing and communication more effectively. This is where the DEAL has played a crucial role.

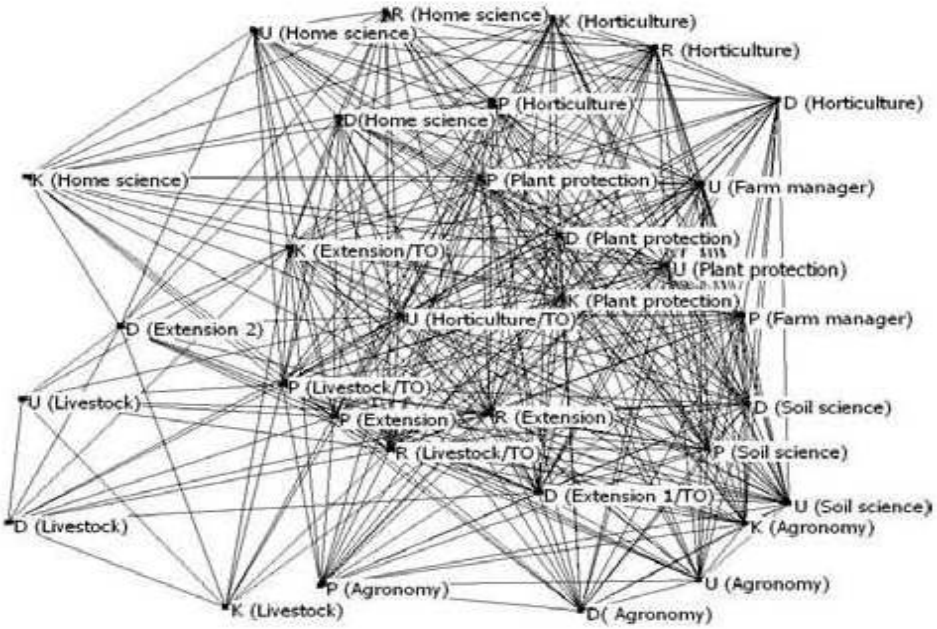

Figure 1.3 - Networked Conversation in Post DEAL

The DEAL aimed to create many conversions through an autopoietic mode of network among different SMSs of KVKs by linking each of them to other through digitally facilitated knowledge architecture. The DEK design of the system places special emphasis on voluntary

participation, and as more members access the network the number of ties increases and these ties are mutual, trust based and voluntary (Pattanaik, Chatterjee and Sarkar, 2008). Figure 1.3 shows the network developed among various scientists in a post DEAL scenario. The network density at post DEAL scenario is .6279. Literature in knowledge management and communities of practices suggest that normally people in a structured Communities of Practice (CoP) come from background having shared knowledge or shared belief system. In these kinds of structural arrangements often people learns through the facility that is available through structural resources and positions (Baalen, Bloemhof-Ruwaard and Heck, 2005). In contrast information and communication builds a different kind of network i.e., an Action Oriented Network of Practice (AONoP) by challenging the established social structure through communication interaction of different language communities (Pattanaik and Chatterjee 2008).

Language communities are structured around some form of similarities among participating agents in an AONoP. A kind of hemophiliac quest and satisfaction designs patterns interaction of language communities in an AONoP (Monge and Contractor 2005). In our case this hemophiliac quest is structured around subject expertise of agricultural experts (Figure 1.4).

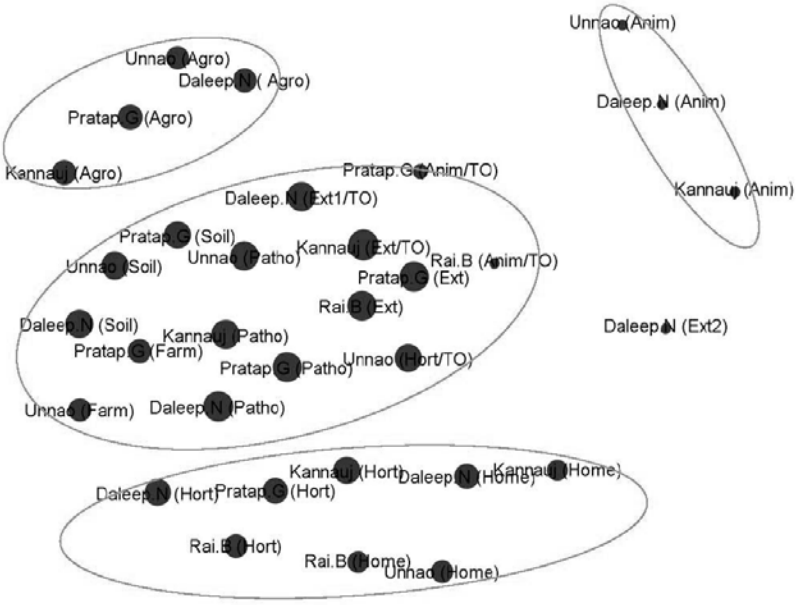

Figure 1.4 - Networked Conversation in Language Communities

This hemophile also acts as a source of trust among the actors in a language community. A knowledge portal such as DEAL under these conditions facilitates the process of socio-technical innovation through recurrent language reproduction of AONoP in a trust-

relationship based framework (Figure 1.5). A successful DEK implementation depends on only on the technology but the way people participates in it. People participate because they feel that there is a need to share their experience and ideas with other and such facilities are available to them. Once people start to participate they reorganize themselves into structured entities based on some similarity of traits (we have referred to them as language communities- in DEAL knowledge structure/domain expertise configured the structed entities in the network). Their interaction and organic growth are then designed by the amount of trust induced to the network. This eventually leads to the emergence of and participatory, collaborative, active and bottom up network (referred as AONoP). The emergence of such network rebuilds new rule systems and provides feedback to the ecosystem for context specific adaptation and change.

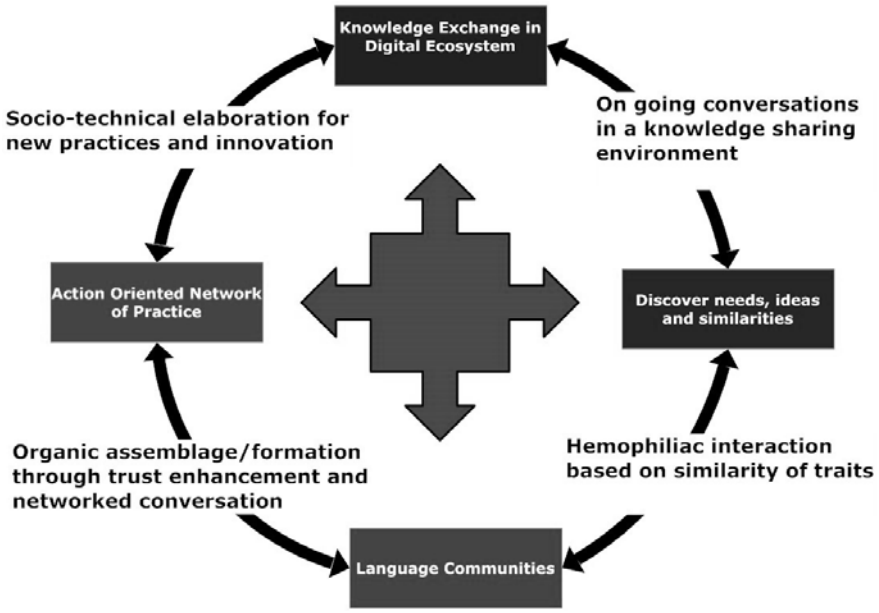

Figure 1.5 - Circularity of Networked Conversation in a Digital Ecosystem

DEAL as a socio-technical system facilitates the bottom up approach for knowledge sharing to the people from different organizations and backgrounds. A network of conversions exhibit inherent circularities and self amplifying feedback loops. The closure of the network results in – a shared system of beliefs, values and possibly praxis, a context of meaning, which is continually sustained by ongoing conversation and propagation of word of mouth.

Conclusion

The DEAL has been able to create an AONoP among various scientists for knowledge and information sharing. There is a continuous dialogue among scientists of the KVKs both at horizontal and vertical level. This has been done by creating a platform for different KVKs to share their extension experiences with each other through multiple media facilitated by ICT tools and technologies. Making new knowledge recognizable to others is

one crucial principle of socio-technical innovation. The DEAL experiment shows that successful knowledge networking depends on use of a commonly understood language and trust is the cornerstone of knowledge sharing cultures. In general as people starts conversing with each other trust grow and the transfer of relevant knowledge between them becomes easier and more efficient. Learning begets more learning; people not only learn what others know, but also learn the best ways to make others share what they know.

The DEAL experience shows that organic formation and socio-technical change happens when people are given access to tools for building conversational relationships. DEAL as a digital ecosystem for knowledge, demonstrates the emergent behaviors that makes socio-technical innovations possible and self-sustaining. Most of the content at the DEAL portal has been created outside of any structured mandate and through voluntary participation. The participating community has developed it because; there was an opportunity and need for change in the contemporary approach to extension services. One of the most fruitful out come of the DEAL experiment was the 'cross-pollination' effect of different internal cultures brought together electronically (Figallo and Rhine, 2002). People whose physical paths might have never intersected were able to interface and integrate in a new knowledge nexus. These different groups of people conversed with each other under a variety of contexts; as cohorts, subject experts, interest groups, domain stakeholders, practitioners and observers of the world. Knowledge sharers at the DEAL portal conversed both through the technology and as well as about the technology because they recognized together how improvements in application design and content delivery can help them discover, exchange and use information and conversation more effectively.

To expand the conversation further the DEAL has developed audio applications such as Kishan Blog for sharing knowledge. Kisan blog holds three possibilities for the upcoming web technology: it allows acquisition of tacit knowledge as a direct input, distortion of knowledge does not occur due to rendering in audio format, and it provides easy to use and easy to learn facilities to the user. Above all it ensures collaborative practices for knowledge generation and reuse through intrinsic rewards and trust based relationships. Contemporary web 2.0 has empowering effects if it is used as a tool for communication and cooperation in civil society. In this sense DEAL as a web 2.0 application has enlarged the sphere of voices and issues that otherw ise have remained marginal (Pattanaik and Sarkar, 2008). The DEAL experience in expanding the Indian agriculture extension services knowledge network and the self catalyzing characteristics exhibited by several applications like the Kisan blog inspire new research interests regarding the role of participative digital communication as enabler for innovation in large and complex socio-technical systems.

Paper 2

Dynamism of Organic Assemblage in Digital Ecosystem-Learning and Innovation in DEAL

Debashis Pattanaik **Jayanta Chatterjee** **Paolo Dini**

Introduction

Ensuring a thriving agricultural economy is critical for India's global competitiveness to be inclusive of as many economic sectors as possible. A global competitive Indian economy must be based on a knowledge-driven transformation of Indian agriculture because agriculture, which engages more than 60% of India's population, has already reached the physical limits of land and water. The large and complex Indian agriculture system however has started to languish and needs infusion and diffusion of knowledge-driven innovation across the entire value chain. This study focuses on the Indian Agricultural Extension System as a knowledge-learning network, and on the impact of infusion of digital and communication technologies on that complex socio-technical system to enable the next stage of adaptive innovation through new forms of learning systems.

India's first green revolution was a spectacular success. Volume of production went up by orders of magnitude for most crops, particularly for basic food grains like wheat, rice and pulses through higher acreage under cultivation, and vast areas were brought under pump irrigation. New seed varieties like dwarf wheat and dwarf rice were successfully introduced, which significantly enhanced yield per hectare. Yield also improved due to the widespread usage of chemical pesticides and fertilizers. India became a net exporter of many types of agricultural produce and the national buffer stock for basic grains ensured India's food security. Forty years later the situation has changed. The mismatch between supply and demand has again started widening. The increasing standards of living in India's bustling cities, higher demand of food grains at home and around the world can not be adequately served by declining agricultural productivity in India's country-side. This has initiated a complex downward spiral. More and more land is needed for industrial expansion. Water resources are constrained. And, to complicate the situation, over-tillage, over-irrigation, and excessive or wrong usage of chemicals, fertilizers, and many other adverse effects of earlier technological approaches have severely impaired India's productivity across the most fertile and irrigated states (Chatterjee et al., 2008).

It has been pointed out that information asymmetry and lack of rapid knowledge diffusion has created stagnation in Indian agriculture (Kaushik and Singh, 2004). Knowledge creation and sharing, together mediated through digital technologies, can play a big role in rejuvenating Indian agriculture. Innovation in Indian Agriculture at every stage of the value chain, from seed to food processing, is a national priority. But borrowed science will often not work anymore. Associative Open Innovation is needed at grass-root level (Chatterjee et al., 2008).

This goal of knowledge-driven agriculture to increase production, reduce costs, and enhance agricultural profitability, to make Indian agriculture globally competitive, also needs new programmes to reduce rural poverty and inequality and to protect the environment by reversing the degradation of natural resources (like land and water). New programmes are needed towards innovating new forms of rural enterprises that will effectively manage the shift of labour forces, stem the migration to urban slums, and broaden the base of economic growth potential of rural citizens (Chatterjee and Pattanaik, 2008).

To make good decisions, both extension workers and farmers need information from different sources and often need help to integrate the information. Due to its sole dependency on State Agricultural Universities (SAU) and to some extent on Indian Council for Agricultural Research (ICAR) institutes, the present extension agents only learn about the knowledge and technologies generated by these research stations. However the current agricultural scenarios demand an increasing role of international knowledge sources as well as better visibility of local solutions developed by innovative farmers. Thus the extension needs to expand its role from technology transfer to include roles such as (self-catalyzed) problem-solving, education, and human development (Chatterjee et al., 2008). The first step in this direction requires identification of the different elements in the Agricultural Knowledge and Information System and redesign of this system in a way that is better aligned with the improvements achievable by learning systems (Hall et al., 2002). Our work indicates that communication networks supported by multiple media tools and interaction platforms that allow reflexive learning exchanges were needed to facilitate knowledge-driven change in centuries-old agricultural practices.

Multiple Media Tools and DE for Agricultural Extension System

The first official extension system had its origin in the Potato blight in Europe in 1845. The idea was to improve potato cultivation and grow other nutrients crops in the region. Contemporary extension systems broadly aim to enhance the process of learning through linking researchers (and other innovations) with potential users of research results. The system had its origin in the US Land-Grant University system. The US system was exported to India in the second half of the twentieth century. Following it India adopted the “training and visit” (T&V) approach to the extension system supported by the United Nations. T&V had attempted to streamline the traditional extension system through three kinds of mechanisms:

(1) concentration on a few "contact farmers" in a service area, (2) concentrating on agricultural matters exclusively; and (3) concentrating on a few practices during each regular visit of village extension workers (Colle, 2008).

A dominant assumption of the extension service system is that individuals will learn about new practices and technology "if only they understand what is advocated and know how to carry it out" (Andreasen, 1995). Thus the contemporary extension service ignores farmers' perception of their needs and mismatches those presumed by the researchers, whose interpretation of reality counts. The fundamental assumption in the current extension is that no matter where they operate the method will work. The role of the extension agent and farmer is to learn "best practices" from the experts and to put their dictates into practice. Thus the knowledge that is developed through farmers' trials and errors never becomes part of the learning system.

A well-designed extension service must not only be multidimensional and sophisticated but must also be able to address diverse settings from the different vantage points. The ability to accomplish such a complicated task successfully cannot be mandated by top-down edicts. To produce best practicing agriculturists with the disposition to become agents of their own development and the social good, extension agents and farmers need a communicator and participatory bottom approach to learning system (Pattanaik and Chatterjee, 2009). We assume that planned and systematic use of multiple media tools built upon a Digital Ecosystem (DE) approach can enhance the pedagogical and communication capabilities of the agents. It can build a Glocalized Learning Environment (GLE) for the agents to converse more effectively and interactively with different audiences sustained by many feedback loops.

A Digital Ecosystem Approach to Knowledge in a Glocalized Learning Environment

Literature in knowledge management, complexity sciences (Holland, 1995; Gell-Mann, 1994; Kauffman, 1995; Juarrero, 1999; Hall, 2005), and organizational learning (Argyris and Schon, 1974; Argyris, 1993; Senge, 1990) suggests that systems that are characterized by distributed continuous learning, self-organizing, and problem-solving, produced by dynamic processes of interacting autonomous agents are non-deterministic in character. Such learning systems depend on social, geo- physical, economic, and cultural conditions, and also social network effects (Firestone and McElroy, 2003). Learning processes are part of a sequence of cognitive operations that have been described in the literature in varying terms, e.g. the organizational learning cycle (Ackoff, 1970), the experiential learning cycle (Kolb and Fry, 1975; Kolb, 1984), the adaptive loop (Haeckel, 1999) and others. In this paper we refer to them as glocalized learning environments.

The learning process is a part of actions, and actions – activities – are the stuff that social processes and social networks are made of. Existing knowledge is always the immediate precursor to action. In a conventional learning environment new knowledge is generated about specific conditions and situations by using preexisting knowledge routinely. This type of learning is widely known as single-loop learning (Argyris and Schon, 1974) and it is linear in nature. In this type of learning old information is replaced by new as soon as this appears. In contrast, glocalized learning environments play a key role in initiating and performing non-linear types of learning. Argyris and Schon call this double-loop learning (Argyris and Schon, 1974). This type of learning is media-centric and reflects the nature of continuous dialogues. It does not replace old information but keeps it for future use along with the accumulated new information (Snow, 1959).

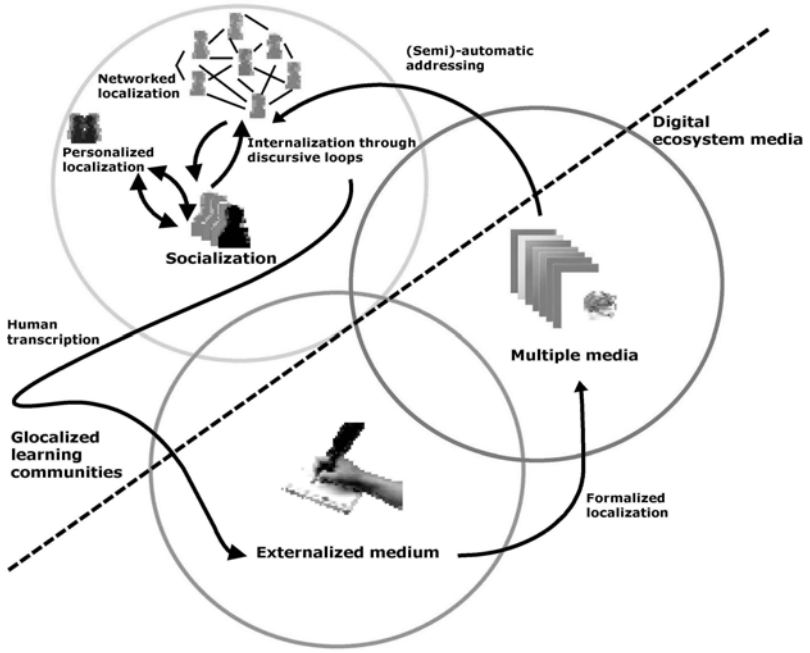

Figure 2.1 - Glocalized Learning Process in Digital Ecosystem

The DE approach to Knowledge follows the latter principle. The DE in this context aims at opening up continuous conversations among different members of Glocalized Learning Communities (GLC). This in turn helps the members of the learning communities (agents) to gain new knowledge through the realization of activities and practice. It represents the working practices of continuous dialogues in GLC by means of multiple media- and DE-specific operations. It has been suggested that media-specific operations about learning processes involve three mechanisms: (a) Transcription - a medium-dependent operation to make mediated collections more readable, (b) *Localization* - an operation to transform global media into local practices and forms and (c) *Addressing* - an operation that stabilizes and optimizes

the accessibility to channels of communication (Jager & Stanitzek, 2002; Fohrmann & Schuttpelz, 2004, cited in Spaniol, Klamma and Cao, 2009).

In the following, we synthesize the Glocalized Learning Processes (GLP) from the perspectives of media theory proposed by Spaniol, Klamma and Cao (2009). We supplement it with our own approach to a DE. Our proposed model thus elaborates the GLP in a DE.

In the upper section (Figure 2.1) we focus on actions performed by humans. Starting with some people who have internalized some specific knowledge, there are two ways to communicate with others. They can present this information to others either through human-human interaction – personalized localization – or can perform a human transcription of the knowledge. Human transcription generates new knowledge/media artifacts. This brings us to our next section where the transcribed knowledge is processed. In a DE this involves digitization of the knowledge. In occasions when knowledge is tacit or source is personalized, localization, human transcription, and digitization occurs simultaneously. For example, in the case of a rare book, it is scanned; image files are created and transferred to a personal computer. In case of oral traditions and fluid knowledge they are digital recorded and stored on a personal computer. This makes available knowledge in a localized community an externalized artifact. This then takes us to the next section where the externalized artifacts of an individual are further processed by the information system and transmitted. This is done by formalized localization of the externalized knowledge/media artifacts. Externalized artifacts are refined so that they become easily accessible, addressed by multiple media, easily transmittable and interoperable. Finally they are put in to air and passed down to different localized communities across regions.

Multiple Media and DE Architecture for Learning Systems

In our estimation multiple media and ICT intervention provide the community both wider and richer access to knowledge. Greater infusion of knowledge (more practically information) into social networks depends heavily on communication technologies. The use of ICT does shape the social structure by organizing actors in the network. The network structure in DEs depends on the knowledge dimension, the learning network environment, and associated media tools and technologies.

We have observed that when the knowledge structure is fluid or random face-to-face (F2F), mobile nets, interactive radio and TVs act as successful modes for generating conversations among different stakeholders in a network. In contrast, when the nature of knowledge is explicit dialogues depend on dynamic modes of knowledge sharing (Figure 2.2).

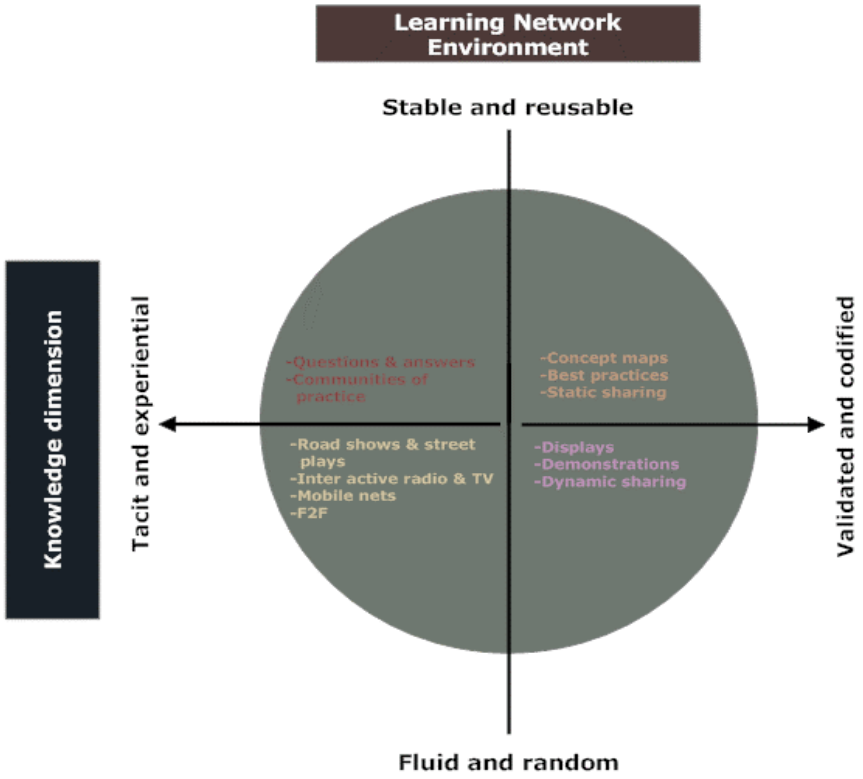

Figure 2.2 - Knowledge Sharing and Learning in Digital Ecosystem for Learning Systems

Key aspects of the 'learning systems' are thus the 'dialectic interaction among the 'learning object itself', the 'social system' in which the learning object is introduced, and the 'conversation channels' through which the social system 'members' learn about the object or idea and the 'timing' of the processes. The conversation is maintained through circularity, organization and reproduction. This necessitates a need for interoperability of the information. Interoperability provides potential for automation and systemic self-management.[18] In the following we will discuss the GLP in a DE architecture developed for knowledge sharing and learning in the Agriculture domain. The DE architecture named as the Digital Ecosystem for Agriculture and Rural Livelihood (DEAL- www.dealindia.org) project focused on semantic interoperability. The goal was to create a glocalized learning environments over heterogeneous knowledge sources. The agenda was to build an action-oriented network of practice, whose interactions, e.g. among Krishi Vigyan Kendra (KVK) scientists and farmers, create new learning environments and vice versa.

Research Methodology

Field deployment of the DEAL project was between December 2006 and June 2007. Further deployment work has been done under the OPAALS project (www.opaals.org) during 2008-09. We have been conducting studies among participating KVKs, October 2007

onwards. The data used in this paper are taken from the data collected during our field visits at different time intervals.

Learning and Innovation in Personalized Localization – The Extension System

We find that in the absence of proper conversation channels a majority of the scientists do not have conversational interactions. They operate in isolation and hardly have any opportunity to learn new things that are generated in another station or in the field. This also applies to intra-organizational learning within a KVK. For example, in one of the studied KVKs (located at Dhaura) we found that the scientists shared reciprocal conversational relationships with the horticulture scientist (as he was the administrative head of the organization). But in terms of actual learning they hardly had any conversational relations with other scientists of the same organization (Figure 2.3). It is noteworthy to point out that network density for personalized localization is 0.1199. .

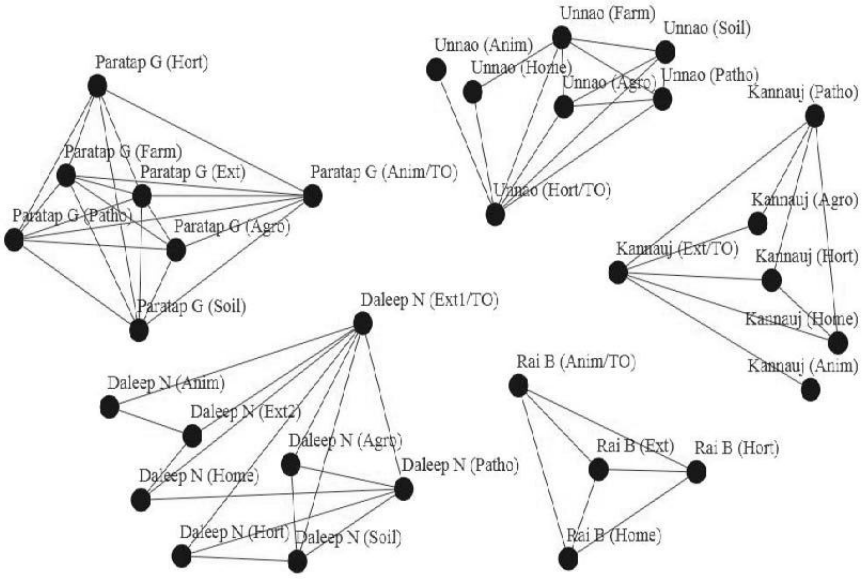

Figure 2.3 - Learning and Innovation in Personalized Localization

Further observation highlights that the animal husbandry and home science scientists are most isolated people in the personalized local network/community in the interactional space of learning, where as scientists of agronomy, plant protection (plant pathology), farm management and soil science have unitary mode of learning relations (Figure 2.3). These forms of conversational relationships and learning systems hardly meet the rising need of the knowledge resources of the scientists in the present context of the rapid changes that occurs in agricultural

technology. The lack of conversational relationships among scientists of different KVKs reflects the predominantly centralized and top-down approach to learning and innovation in the Indian agricultural extension system.

Learning and Innovation in GLE –The DEAL

Studies in network architectures suggest that centralized networks are ineffective modes for learning through knowledge sharing and conversational relationship (Fahey and Prusak, 1998; Markus, 2001). In contrast to it a participatory bottom-up approach allows better knowledge flow and thus a better learning system and a more effective conversation environment. This is where the DE plays a crucial role.

A DE for knowledge tries filling the gap by providing knowledge over multiple media addressed through (semi) automatic tools and techniques. It aims to develops a network among different people of the localized communities by linking each of them to others through a digitally facilitated knowledge architecture

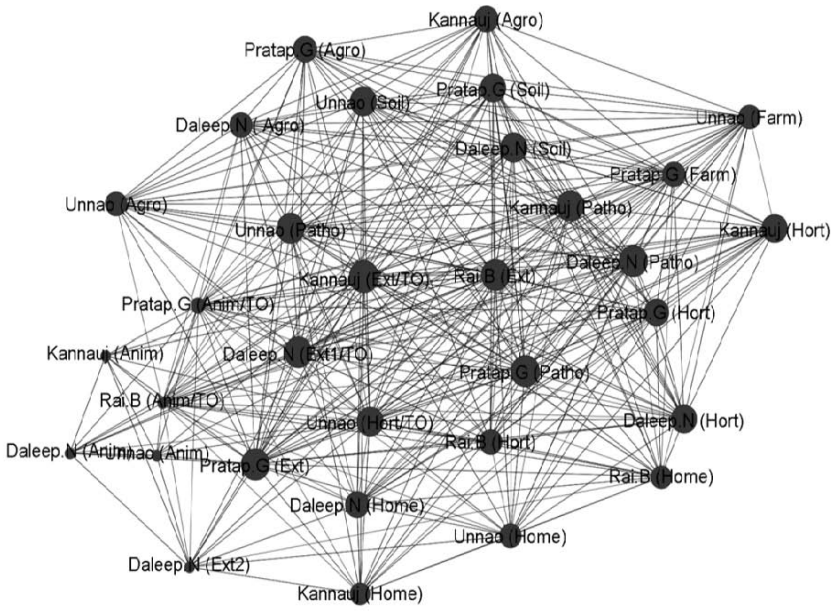

Figure 2.4 - Learning and Innovation in a Glocalized Learning Environment

The Digital Ecosystem (DE) design of the system thus places special emphasis on voluntary participation. As more members access the network the number of ties increases, and these ties are mutual and voluntary (Chatterjee, Pattanaik, and Sarkar, 2008). Figure 2.4 shows the conversational relations developed among various scientists in GLE. The GLE is an offshoot of the DEAL project. The network density for GLE/DEAL scenario is 0.6279.

Literature in knowledge management and communities of practice suggests that normally people in a structured Community of Practice (CoP) come from backgrounds having shared knowledge or a shared belief system. In these kinds of structural arrangements often people benefit from the ease with which structured resources and positions can be accessed (Baalen, Bloemhof-Ruwaard, and Heck, 2005). This facilitates quicker and easier learning systems in CoPs. In contrast, the DE builds a different kind of learning network, i.e. a network that is located at a local level physically but exists at global level virtually – Glocalized Learning Community – by reconfiguring and reorganizing the normative systems through self-amplifying conversational loops.

The self-amplifying conversational loops are outcomes of the GLE and of interactional effects that are configured by the DE architecture. A GLC community configures and reconfigures in some kind of frame of reference. In the case of the DEAL project it was subject expertise of agricultural scientists. Scientists bonded with one another in systems of homophily. This homophily also provides a sense of belonging and increases people's trust in bonding together in reciprocal relationships (Figure.2.5).

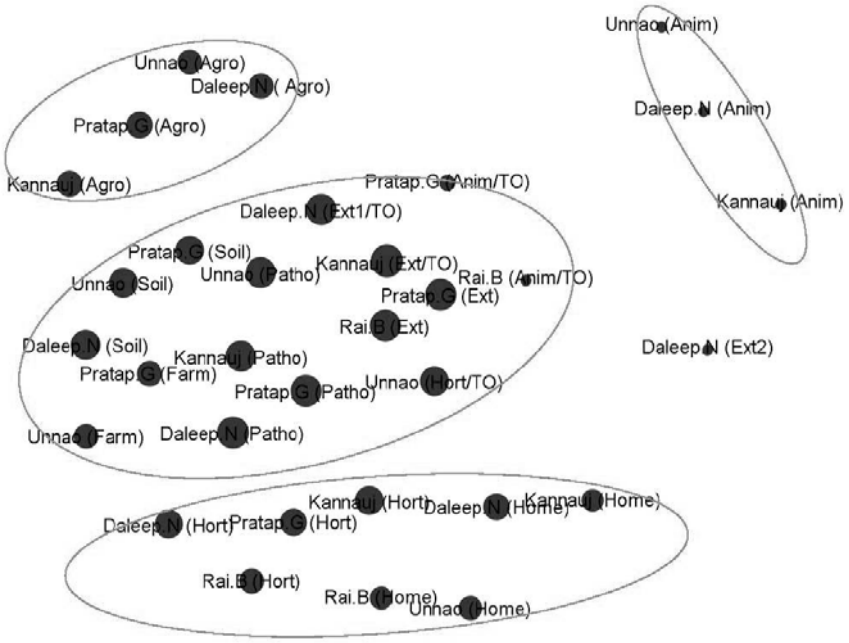

Figure 2.5 - Reconfiguration of Glocalized Learning Communities

Our research showed that a DE for knowledge portal such as DEAL nurtures conversational relationships across time and space. This promotes learning and creates new learning systems for localized communities located in different regions. In the process it

generates new knowledge and promotes innovation through GLEs. A network of conversations exhibits inherent circularities and self- amplifying feedback loops. The closure of the network results in a shared system of beliefs, values and possibly praxis.

Conclusion

The DEAL as an active DE phenomenon has created an emerging GLE of various scientists for knowledge sharing and learning. There is a continuous conversation among scientists of different KVKs. Making new knowledge recognizable to others is one crucial principle of learning supported by new media and communication technology. The DEAL experiment shows that successful learning happens when people engage in participatory and collaborative conversational activities. In general as people start conversing the transfer of relevant knowledge between them becomes easier and more efficient. Learning begets more learning; people not only learn what others know, but also learn the best ways to make others share what they know.

The DEAL experience shows that organic formation and learning happens when people are given access to tools for building conversational relationships. DEAL as a DE for knowledge demonstrates the emergent behaviors that make learning easier and self-propagating. Most of the content on the DEAL portal was created outside of any structured mandate and through voluntary participation. The participating community has developed it because there was an opportunity and call for change in the existing approach to learning in the extension services.

However DEAL as an open system of learning environment also represents the dynamism of complexity in an evolving society. There are perhaps many underlying phenomena subject to ever-changing patterns of unpredictability that have made this dynamism possible in the DE. Here in this paper we have attempted to explore a few aspects of such complexities in a DE. Further, human societies are part of the living world and therefore also the product of evolution. We know from biology that groups are made up of individuals, individuals are built from cells, cells contain chromosomes, which in turn have genes. Selection is known to occur at any or all of these levels. However the higher-level entities reproduce as a unit and function as an integrated one, even if they continue to be made up of parts that, in the evolutionary past, were once independently reproducing entities (Jablonka and Lamb, 2005).

Growth of complexities transforms a DE from a lower-level organic assemblage to a higher-level unit, it then reproduces as a unit and functions as an integrated unit. The learning process in a DE for knowledge follows principles that biologists call adaptive radiation (Guttman, 2005). One original localized population radiates out in several different directions in the virtual space. A general way of life to which a species adopted is called an adaptive zone (Guttman, 2005). In our case there are three adoptive zones: the zones of networking,

externalization of knowledge and zones of multiple media. Each of these zones as in biological systems has its own special functions (but the three zones are interrelated). Their overall aim is system maintenance and system reproduction. It is noteworthy to mention that there might be drifts in the system when new species develop within the DE for knowledge. Drift may also change some form of internal dynamics of the system. WE are living in a society where what sociologists called solidarity has undergone a fundamental transformation. We have evolved from organic solidarity (Durkheim 1984 [1933]) to a type of solidarity which is "segmented". Today separate, autonomous social segments connect with each other not only out of necessity and mutual dependency but also on the basis of individual choice (Komter, 2005). A DE as an open and collaborative platform supports the individual choice to adapt to the conditions individuals prefer.

To expand the conversation and learning systems further the DEAL has developed web 2.0 based applications such as Kisan Blog and Krishi Katha for sharing knowledge (Pattanaik and Chatterjee 2009). The DEAL experience in expanding the Indian agriculture extension services learning system and the self-catalyzing/producing characteristics exhibited by several applications like the Kisan blog and Krishi Katha inspire new research interests regarding the role of participative digital communication and multimedia tools as enablers of learning and knowledge sharing in large complex adaptive systems.

Paper 3

Digital Physical Ecosystem for Social Innovation through Social Capital

Kasturi Sadhu Ghosh **Jayanta Chatterjee**

Introduction:

For sustainable economic development in this knowledge era it is necessary to ensure that knowledge is available when and where necessary. The economy now is driven through the power and extent of knowledge flows across the society. The dynamic structure of the knowledge network is well supported by the development of appropriate information and communication technology infrastructure, processes and capabilities (ICT). ICT provides both wider (by engaging more actors) and richer (by greater infusion of knowledge) access to innovation possibilities.

Based on ICT, Digital Ecosystem approach wants to develop a self generating, self sustaining, self managing and self propagating organization of collective, collaborative and interdependent actors and aims to achieve sustainable and pro-poor economic development in developing regions (Chatterjee and Pattanaik, 2009).

This digital ecosystem framework was adopted from the observational learning of natural science, social science and computer science and was first applied to the SME's in Europe which was able to promote the collective participation of the local business units by fostering regional cooperation through knowledge sharing. There are many initiatives taken to design digital-ecosystem like development framework for the Indian rural development domains over the last five years. Agropedia and DEAL- are two such ICT mediated open knowledge and social media platforms developed for Indian agricultural development domain. The former is a pan-Indian effort and involves many institutions and in contrast the later is a localized effort of micro entities. These are promising structures for exploratory initiatives which are expected to influence the agricultural productivity and practices by connecting different Indian agricultural agents into the system of global agricultural knowledge exchange process. But in a developing country like India to introduce the digitized media into the knowledge sharing process is not an easy task as most of the agricultural users are unfamiliar and/or uncomfortable with it and more than half of the farmers are illiterate. So to develop a digital ecosystem like environment, initially a parallel process of Face to Face (F2F) knowledge exchange among the users is necessary for capacity building. The users can also be motivated by incorporating the popular traditional knowledge exchange mechanisms into the system. In this paper we discuss the knowledge exchange experience from the capacity building approach of Agropedia. And in

Krishi Katha of DEAL, we examine the context of social media application. In both we find the need of enhancing social capital for social innovation diffusion.

In this document we first explore, briefly, the concepts- social capital, social innovation and the knowledge sharing process. This is followed by the discussion on interrelations among social capital, knowledge exchange & innovation. Then we try to establish the role of digital and physical media in this social context of knowledge sharing by elaborating two real world cases of knowledge exchange system in Indian agricultural domain.

Social Capital:

Social capital is one of the important and salient concepts in social science that has attracted research interest in the context of ICT over the last few years. In the literatures it has been pointed out that "Networks, their roles in information exchange and the trust they engender are crucial to the effective functioning of organizations of all kinds…" (Temple P.,2006). This implies information and knowledge spread through network and among the members of network better when the network exhibits higher social capital. Such enriched networks can share and exchange knowledge more easily and freely than others.

The term social capital was first used by Jane Jacobs in "The Death and Life of Great American Cities" in 1961 in reference to networks in urban neighborhoods (Borgatti, 1998). Since then the research on this ground shows that social capital and network are two highly related concepts. Social Capital is the investment on social relations (or social network) to capture and use the resources embedded in the relations for generating more resources for the advantage of social actors and society as a whole (Lin, 2001). Here Bian (2008) argued that all the relations are not the resource bearer, only the personal relationships are able to bear the social capital. An actor has to nourish the process to develop personal relationship from a simple network. It is more likely to develop "in collectives characterized by a shared history, high interdependence, frequent interaction, and closed structures" (Wasko & Faraj, 2005). Hence, social capital is the power which converts the social networks or relations to personal relations for mutually accessing and simultaneously enhancing the resources within the network.

Coleman and Putnam mentioned that social capital is also related with civil engagement and social participation (Lin & Erickson, 2008). A network is likely to enhance social capital if it is able to generate trust and reciprocity among the links and capable to increase the civil engagement and social participation for mutual benefit. We summarize some other definitions of social capital given by some experts in the following table.

The definitions of social capital:

Author	Definitions
Bourdieu ([1983], 1986)	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 and recognition. Social capital as benefits derived from the Network.
Coleman (1990)	Social structural resources which facilitate the individual who are within the structure
Stewart-Weeks and Richardson (1998)	'the quality of social relationships between individuals that affect their capacity to address and resolve problems they face in common'
Collier (1998)	Set of horizontal and vertical relationships governed by networks and norms that foster the trust and capability of collaborative and cooperative work for the mutual benefit of the group
Putnam (2000)	"connections among individuals - social networks and the norms of reciprocity and trustworthiness arise from them"
Cohen & Prusak (2001)	"active connections among people: the trust, mutual understanding, shared values and behaviors that bind the members of human networks and communities and make cooperative action possible"
Paldam (2001)	i) Ability of people to co-operate with others or ii) the amount of network an individual has built or iii) the quantity of trust that an individual has in other members or iv) the amount of benefit an individual can draw on his/her goodwill and network.
Sobel (2002)	"Circumstances in which individuals can use membership in groups and networks to secure benefits"

There are many more definitions given by scholars like Flap (1991), Burt (1992), Erickson (1995) and others; all of them agreed that social capital is network based but something beyond the network structure. Resource, trust, reciprocity, shared values; understanding, co-operation, and mutual benefit are the different concepts that enhance the network to define Social Capital.

Thus from the above definitions of social capital the following points are noted:

The value of social capital depends on the number of contacts an actor has and also on the structure of his/ her relations within the network. On the other hand, the network structure and dynamics are also influenced by the social capital.

Social capital is a measure of capacity of self enforcement and willingness of voluntary participation in collaborative work practices.

If knowledge is the accessible resource among the actors then the network is the channel for knowledge flow and social capital is the power to channelize the flow.

Social Innovation

In a developing country the social innovation can be closely co-related to the socio economic development of that country. Social practices and cultural behaviors are nurtured by the economic activities. Sustainable economic development and associated social innovation depend on the collective learning process and learning based innovative outcomes resulting from the interactions of different social actors in a knowledge network.

Kuhn (1970) and others (Price 1963, Merton 1973, Knorr-Cetina 1999) have assumed social organization of scientific or technological change in a community structure. Innovation is often a process of creating new social connections between people, and the ideas and resources they have, to produce novel combinations (David Obstfeld, 2005). Mumford (1993) has suggested that successful design of a new system depends on repeated discussions with various groups of users, and integration of the multiple system perspectives into a composite information strategy. For an artifact like an interactive website, initially alternative designs are produced to solve different problems and fulfill different needs; but through a competition for survival against social, technical, economic and political constraints a few of them survive and become successful. This is an important domain of study in the context of digital ecosystems.

Thus social innovation needs the involvement, use and interpretation of the digital artifact by the relevant social groups (Pattanaik & Chatterjee, 2009). Social network activity is an important predictor of people's involvement in innovation. Allen (1977) observed that informal contacts outside the society or organization were able to import novel information and link the organization with its environment. The strategically positioned individuals facilitate information dissemination which in turn facilitates innovation. On the other hand, to make an innovation effective, the rate of innovation diffusion needs to be higher which is highly network dependent.

However, an innovation is referred to as social innovation when it is able to change the social behavior or the existing structure of the society. As explained by Hazel & Onaga (2003) social innovation is the "radical changes in accepted role behaviors or the social structure of existing social organizations".

For any type of social innovation to be adaptive, it requires creating the awareness about the innovation and needs to handle the concerned community with compassion, caring, and a deep sense of shared humanity by focusing on the "need analysis" of the community.

Thus an innovation is able to change the community culture when people adopt it and are satisfied with it. It is the social capital, emergent through formal and informal network links, which creates impetus for innovation diffusion. According to Rogers (1969), key aspects of diffusion of innovations are communication and their operation in facilitating dissemination of innovation through 'word of mouth' within local communities. In his view "word of mouth", which creates a path for acceptance of new ideas from sources external to the social system, is the catalyst for innovation diffusion. He suggested that communication effects, especially the ability of media messages and opinion leaders to create knowledge of new practices and ideas persuade the target to adopt the exogenously introduced innovations (Rogers 1969). Thus communication and conversations are inner links through which new/exogenous ideas enter local communities to change the social behavior. Thus communication and conversation are at the core of creating autopoiesis in the socio-digital ecosystem. (Pattanaik & Chatterjee, 2009)

For developing countries like India- social innovation projects take many forms- removal of poverty, securing the basic livelihood requirements like food, shelter, water, education, health , empowering the rural citizens, including them in a common pool of knowledge for better democratic decision making, providing livelihood alternatives, and socio-economic-cultural development through removing barriers of caste, creed, religion, superstition and others. But after five decades of social development initiatives, it is clear that neither top-down goal directed projects nor bottom-up spontaneous movements can solve the multiplicity of problems as a sole strategy. Successful projects combine both efficient knowledge creation and effective knowledge dissemination and then innovative communication processes for adoption and advocacy. Both processes of community building and knowledge sharing depend on growth of social capital.

Knowledge and its process of Sharing:

Knowledge as Stock and Flow: Knowledge is a broad concept. According to Huber (1991) and Nonaka (1994) Knowledge is the justified belief that increases an entity's capacity and capability for effective action. Watson (1999) supports this view by saying knowledge is more than the capability for future action; it is the dual ability to interpret information and capacity to use information. Knowledge, like resource, helps in developing intellectual capital; and

firm/individual accumulates the knowledge stock, like capital asset, for better performance. Intellectual capital which comprises of human capital (skilled people) and intellectual asset (codified knowledge) (Sullivan, 1999), also depends on the way how knowledge flows inside and across the organizational boundaries. Thus knowledge can be conceptualized as both stock and flow.

By observing and understanding surroundings in terms of concepts, theories, values, and beliefs, human minds form knowledge and also embody it. Total stock of knowledge is thus the sum of the individual ideas and concepts which remains in people's minds, books, drawings, designs or sculptures or in other written form and in digital spaces. But Without proper processing the knowledge stock in its static form is hardly productive in the economic sense.

Processing of knowledge and its conversion into useful action or application depends on the interplay between four fundamental constructs- Data, Information, Knowledge, and Wisdom (DIKW). This process is best represented by Amritesh and Chatterjee (2010) through the "Knowledge Processing Spiral". Knowledge is created by some agent from his/her accumulated knowledge which may seem as data to the other agents. Data is the symbolic representation of an observation that can be interpreted by different agents in different ways. When the data is observed and interpreted it becomes information to another agent. By internalization the information becomes knowledge to the second agent and increases his/her stock of knowledge. It adds up to the power of wisdom when the agent is able to understand and strategically apply the knowledge in the new context. Knowledge is externalized by the second agent when he elaborates it and develops a new knowledge artifact. Thus elaboration/ conversation help in externalization of knowledge and learning leads to internalization of knowledge artifacts. The processing of knowledge influences the human behavior by improving the quality of decision, actions and outcomes; and develops the internal ability to absorb new external knowledge flow. This process also on the other hand, is intended to transform, share, exchange and integrate individual knowledge through interaction among actors. The flow of knowledge helps to extend existing knowledge and fosters emergence of new innovative idea. Hence there are three different contexts of knowledge flow - acquisition of knowledge (increasing the knowledge stock), application of knowledge (exercising the original or modified version of the knowledge in another context) and innovation (creating new idea or new application). In economic aspect we can view it as the flow of intellectual insights inflows means creation of new knowledge and increasing the knowledge stock and outflow is the process related to the use of knowledge or application that creates a new knowledge spiral.

Knowledge Sharing: Sharing of knowledge, whether explicit or tacit, requires effort on the part of the individual engaged in the process and also the existence of an element of reciprocity. Hanson (1999) defines knowledge sharing as the provision or receipt of task information, know-how, and feedback regarding a product or procedure. It includes communication about the task and exchange of tangible artifact, and also the implicit coordination of expertise (Faraj and

Sproull 2000) and information about the others knowledge in the group (Rulke and Galaskiewicz 2000). Knowledge sharing is thus individuals' sharing of relevant information, ideas, suggestions, and expertise with one another. Thus, sharing of knowledge helps in processing and enhancing knowledge stock, and in learning and creating new knowledge.

The Mode of Knowledge Sharing: In the Hegelian approach, knowledge is sharing through the social but dialectical interactions among the people. Dialectic simply means the continuous dialogue between two or more who contradict each other but at the same time wants to share some knowledge among them. According to him the highest spiritual consciousness of mankind can be achieved by the continuous ideological confliction and resolution. Hegelian dialectics is comprised of three dialectical stages- thesis (the view/ action), antithesis (contradictions of that view/ action) and synthesis (the constitutional/ emerging resolution). Through endless self perpetuating struggle between ideals and eventually synthesizing of all ideas, the spiritual mankind reaches into the final perfection (http://www.crossroad.to/articles2/05/dialectic.htm last accessed 25.05.10). Thus "dialogues" and "congruence–building" are two primary tools of Hegelian dialectics for continuous knowledge sharing. This implies network with diverse members has greater chance for active interactions and knowledge sharing. Thus there is a need to remove any type of social, departmental, organizational, functional and geographical barriers and create integration among people with independent but interrelated worldviews through the effective path of communication.

Digital and Physical Media: Thus, effective communication is the essential part of knowledge exchange process. Now this continuous communications can be maintained by direct Face to Face (F2F) interactions in the form of group discussions, meetings and other assemblies; or indirect interactions through the social media applications like internet, interactive radio, TVs or mobile phones or by creating virtual communities through different networking sites such as 'Facebook', 'Orkut', 'Hi5', 'Twitter', 'Myspace', 'LinkedIn', 'Youtube' and other such communities.

The collaborative knowledge exchange and learning process through F2F interactions over physical media is possible within a localized group where there exists relatively strong bonds or communication structures among the members having almost same culture. This is the popular and comprehensive folk mode of knowledge sharing. This mode of knowledge exchange can also overcome the problem of language and technical barriers. The oral knowledge transmission in India has also shown that this can solve the problem of interpretive distortions as well when bound by rhythms and rituals.

On the other hand the dynamic structure of the network is well supported by information and communication technology (ICT) particularly in its current 'social participative' formats. ICT provides both wider (by engaging more actors) and richer (by greater infusion of knowledge) access to knowledge. In an ICT mediated networked community there is a better chance of

accommodating actors of heterogeneous type and from different areas. Here in this type of network people co-operate without knowing each other personally; so contacts may not be deep or lasting. The reputation of members can spread trust to respond to this problem. High network diversity can help to get in touch with other cultures and people with different ideas and opinions and thus help faster dissemination of knowledge. An organized trust process can help extend rapidly the community boundary. This leads to higher collaboration.

"Ba"- The SharedKknowledge Space: However, following the concept of "ba" (the shared knowledge space) introduced by Nonaka and Konno (1998), we can get an idea about the conditions and psycho- social locations of knowledge sharing. Ba is a shared space of developing new relationships through promoting individual and collective knowledge. This space may be physical, virtual or any combination of these two. As knowledge exchange mode five different types of "ba" can be recognized. In originating ba people share their tacit knowledge i.e. their feelings, experiences, emotions etc. Interacting ba is the space where people consciously think of their mental models and skills to give them common terms or convert into concepts. In Cyber ba knowledge is shared through interactions in virtual world as happens in different social media sites that mainly combines the explicit knowledge. The fourth is the exercising ba which facilities the internalization phase i.e. what happens in the training process between the mentors and collogues. And the last one is the District ba where different organizations are sharing knowledge through interaction.

The Incentive towards Knowledge Sharing: All the knowledge workers do not have the same motive and are not of same nature. Then what are the factors that lead them to share knowledge together? The intension to share knowledge depends on the favorable attitude and the subjective norm of the person toward knowledge sharing (Bock et. al.). This knowledge sharing attitude and the subjective norm are supposed to be directly related to anticipated extrinsic rewards like money or promotion which is economic motivation, anticipated reciprocal relationships in the network and the sense of self-worth through knowledge sharing behavior which are the social-psychological motivations and the extent of perceived fairness, innovativeness and affiliation in the organizational climate which is the sociological motivation.

Paul Hendriks (1999) points out some similar type of motivation factors. Following Hertzberg (1968, 1987), he argues that while salary, working conditions, status and interpersonal relations are the hygiene factors for knowledge sharing; challenge of work, promotional opportunities, sense of achievement, recognition of job done, sense of responsibility and the desire for operational autonomy (balance between regulatory needs and regulatory capacities) are the six major motivation factor for sharing knowledge. Therefore, in short we can say that people share knowledge due to reciprocity, repute, trust and altruism.

Interplay between Social Capital, Innovation and Knowledge Sharing:

According to recent research literatures, innovation is a process that depends on the degree of interaction and exchange of knowledge among the (interdependent and diverse set of) actors (Landry, Amara & Lamary, 2002). Innovation is described as the combination of tangible capital like physical capital and financial capital and intangible capital, especially social capital. This concept of innovation has been accepted over the last 60 years, when the literature started to explain innovation as a continuous process rather than a discrete event. The following table depicts that on conceptual transformation of knowledge-based theories of innovation (Landry, Amara& Lamari, 2002). This table shows the interrelations between social capital, innovation and knowledge exchange.

Different theories of knowledge- based Innovation:

Theory	**Related Researchers**	**Main Idea**
The Engineering theories of Innovation	Vannevar Bush (1945)	***Innovation derived from Science & Technology:*** Basic Research and industrial R&D are the sources of innovation in the form of improved products or manufacturing processes. The production and uptake of research are associated with solutions of engineering problems. Innovation is explained as combination of different form of tangible capital like technological, physical, manpower, financial capital.
The Market Pull theories of Innovation	Carter & Williams (1957), Schmoolker (1966), Myers & Marquis (1969)	***Innovation, the result of Market needs:*** Research is the source of knowledge to develop and improve product and process. Beside technical feasibility, organization feasibility is necessary for efficient innovation. Innovation is explained as combination of tangible forms of capital and an intangible form of capital– market information. Market information mediates the integration process.
The Chain Link theories of Innovation	Mowery & Resenberg (1978), Von Hippel (1988)	***Innovation derived from the market linkages:*** Importance given to the existing linkages developed through production, technological development, marketing and sales. Integration between research and market knowledge as well as the possibilities generated through these linkages. Innovation is explained by the combination of tangible forms of capital and an intangible factor- data about customers and suppliers.

The Technological Network theories of Innovation	Lundvall (1995), Nelson (1993), Endquist (1997)	***Innovation, a consequence of Technical Network:*** Innovative firms are linked with the highly diversified external sources of information such as clients, consultants, suppliers, govt. agencies, research centers and laboratories via collaborative network to exchange, acquire and absorb information. Technical feasibility, market feasibility and network feasibility are considered necessary for successful innovation. Innovation is explained by the combination of tangible forms of capital and an intangible form of capital-technological networks.
The Social Network theories of Innovation	Lengrand & Chatrie (1999),	***Innovation, the consequential effect of Social Network:*** Based on two old ideas- innovation is derived from research and random interactions between firm and other actors; and one new insight-knowledge is the main factor for fostering innovation. Emphasis is more on relational tools than technical tools to acquire and utilize new information. Emphasis on communication technology and on knowledge networks rather than technological networks. Knowledge based innovation needs contextual transformation of information into knowledge and convergence of different kinds of knowledge captured by different categories of actors. Beside the tangible capital, the intangible capital for innovation highlighted here is social interaction.

In evolutionary economics, innovation is the creation of new varieties through trial and error process. It deals with long term economic changes. Innovation needs diffusion and spill over of information among regions. It takes place by the interrelation and interaction of the changing economic structure and the actors through feedback mechanisms. So innovation and learning are two parallel processes in evolutionary economics (Lambooy, 2002).

Hence, by all researchers, it is accepted that knowledge interplay is one of the most important factors for generating innovation. The growing importance of diversified learning processes - learning by doing, learning by using and learning by sharing (Rosenberg, 1982) increases the importance of knowledge exchange among the actors of a network and also highlights the need of collaboration between codified knowledge and tacit knowledge. This interplay and transformation of knowledge is explained by social networks, social relations and social capital. The nature and extent of interactive learning is determined by the structural dimension of the social capital which refers to the pattern of connections between actors. It is the openness and

richness of networks which are expected to build up a "fertile environment for the creation of new knowledge, while also accelerating the innovation rate" (Seufert, Krogh & Bach, 1999). The "collection of independent actors and the community of practice who collaborate with one another in a self organizing way to share and integrate knowledge" is termed as Social Innovation Capital (SIC) by McElory (2002). This interactive learning and knowledge sharing process among the actors help in raising the absorptive capacity (Cohen & Levinthal, 1990) and developing an innovative system (Acs, 2000; Landry & Amara, 1998) in the community. The ability to exploit external knowledge is a critical factor for innovative capacity. Thus SIC is the innovation capital (capacity to produce valuable change or innovation) developed in a collective way through exchange, creation and integration of new knowledge.

Here, Limbooy (2002) describes how innovative capacity is gained by economic actors in the collaborative interaction process. The economic actors possess the competencies to learn, to innovate, to organise and to manage the ideas, information and activities, and also to adapt them at varying contexts. According to him, competencies are developed through different stages such as - Cognitive, Innovative and Organisational. People in Cognitive stage are eager to learn, to use and to develop information and knowledge. Innovative stage helps the openness of the people to change and explore new opportunities and to adopt new external forces taking part in innovation (new process, new product, and new organisational form). In Organisational stage people are able to give structure to production and exchange process and to manage both internal and external knowledge and relationships.

Thus every rational human being has his/her own capacity to think, to learn and to relate the basic ingredients for creation of knowledge and doing something new, if proper infrastructure is provided. The ICT mediated knowledge network (based on web 2.0) has provided such environment where all the users are able to create knowledge (the content), which they derive from their experiences. So, knowledge actors can serve the dual role explained by Bruns (2007) as "produsers" and develop a dynamic knowledge base. They work in a collaborative environment having fluid roles of users, producers or editors or quality evaluators of the content according to their personal skills, interest and knowledge. Not only that, through this network the consumers can also take part in the production and innovation by exchanging their knowledge and ideas in the process of production of different knowledge modules which they consume further for their need. Thus the consumers here are the 'prosumers' according to Alvin Toffler (1970). Of course, the quality and quantity of the knowledge co-created, and the efficacy and effectiveness of an innovation depend on the network and the form of bond developed through network relationships among the knowledge actors. The community social capital, thus, through exchange and sharing of knowledge, can raise the innovative capability.

Experiences from India on Digital Ecosystem for Knowledge:

No doubt, the ICT mediated platforms help to create both formal and informal knowledge networks where people can exchange explicit and tacit knowledge. These ICT initiatives are able to use the existing social relations and its associated trust, reciprocity and cooperation; and able to change the nature and structure of the existing network by creating new formal and informal links not only between the actors but also among different new groups. We however face different socio-economic problems to enhance the involvement of users, particularly in semi-urban areas and villages.

Agriculture is a critical and complex socio-technical system in a developing country like India. As more than 60% of population of India lives in villages and depend on agriculture, our community informatics explorations focused on rural livelihood innovation and agricultural innovation through a social capital based sustainable knowledge exchange network. It was assumed at the time of the first green revolution that socio-economic development can be attained through implementation of technical innovations. But today we face a complicated situation, after forty years of the first green revolution, in demand-supply mismatch and decreasing productivity due to over-tillage, over irrigation, excessive and erroneous usage of fertilizers and pesticides. It is now necessary to radically modify the earlier technological approaches. Proper knowledge diffusion has been pointed out as the missing factor. So, focus is given on building up knowledge-networks by incorporating Information communication Technologies (ICT). But due to poor educational and socio- economical conditions of the users, particularly marginal and small farmers we need to create new initiatives to reach out to the villagers at the Bottom of the Pyramid (BOP).

One of the most important features of DE is that it is self sustaining with increasing number of interdependent and independent actors. So, we concentrate to find out the conditions and the process through which the participation rate of the users in this newly developed knowledge exchange system can be enhanced to give it an ecosystem like framework. Our work shows that a combination of physical media of knowledge sharing with digital media is a powerful way to set up a collaborative knowledge network in a developing country. We can broadly divide our agricultural users into two groups for the purpose of our study.

Experts: The educated users who do not have any language problem but may not be comfortable with the digital media for knowledge sharing. They are used to exchange explicit knowledge through external artifacts like different publications and tacit knowledge through F2F interactions in classes, conferences, meetings, trainings and debates. This group includes mainly the scientists, researchers, students, and extension workers.

Farmers: The literacy challenged users who are comfortable in local languages and fear to use digital media for knowledge exchange. Here we include all the farmers and daily wage workers engaged in agricultural practices.

It is quite obvious that the experts can easily adopt the system and exchange knowledge among themselves for their own purpose. What they need is to learn about the process and system under which they have to work. The capacity building process on 'Agropedia' website- a digital knowledge ecosystem can be explained in this context.

The study on the need analysis of the farmers done in 2008 on the northern part of India (OPAALS Del-11.4 page-27, 2009) shows that the main issue behind the lack of information flow between research and farmers are the language and the complex way the content is presented before the farmers. They need a simple user centric interaction mode and content in local language that can easily be used and understood. Keeping this concept in mind the feature of Krishi Katha in DEAL (an audio based conversational platform) was created.

The Capacity Building approach in Agropedia- The Physical Media Initiative for Digital Framework

Agropedia- the Digital Knowledge Ecosystem (DKE[1]):

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". It is funded by National Agricultural Innovation Program (NAIP) and initiated by Indian Council of Agricultural Research (ICAR). Agropedia aims to alleviate the knowledge gap in Indian agriculture by developing an ICT based open knowledge platform where everyone can share knowledge. Spaces are provided separately to share both certified knowledge ('gyandhara'/experts' knowledge) or experience and practice based tacit knowledge and endogenous local knowledge of commons (janagyan'/social content). Standardized Knowledge models (KM) are introduced to index and add semantic attributes to the contents. This open knowledge platform 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 and public sector extension and with organizations promoting rural information access centers. To get an effective way out to manage and work with such a wide spread knowledge domain there are four different steps:

Identify the existing and potential knowledge actors in the Indian agricultural domain

DKE- It is a particular form of DE for managing, organizing, creating and promoting knowledge through sharing.

Identify the type of information needed to flow and the agents demand for

Establish the links between the different knowledge actors scattered all over the country

Make the agents able to use ICT mediated platform to continue with the established links in the process of learning and sharing of knowledge for mutual benefit

Identifying and Linking the Knowledge Nodes: To create a knowledge network, the Agropedia team works with selected IT experts (from 5 IT institutes, 4 top level Pvt. National Companies, and 2 international organizations) and agriculture domain experts (from more than 30 agricultural institutes and one national level fertilizer company) and practitioners from the agriculture extension system throughout the country. IITK performs a meditative role at the central node for creating social link. The agri-experts from all over India are expected to strengthen the knowledge repository by exchanging their acquired knowledge. So the mediating team helps to develop the capability of the experts (from geographically and culturally disparate agricultural research and academic institutes) to use the Agropedia platform efficiently. The central nod also collects feedback from contributing nodes about the interfaces and organization of the content. The feedback of the agricultural experts and practitioners and collaboration with other IT experts help to develop the site.

The Knowledge Exchange Process: The details about the capacity building approaches are given in Table-1(Appendix). From February, 2008 to April, 2010 the IITK team conducted 11 training sessions for experts and students; arranged 23 workshops and 17 meetings with peer groups; visited 'Kisan Mela' (Farmers' Fair) on 5 occasions; worked with international collaborators and attended national seminars, conferences and international workshops in the process of capacity building. Whatever be the process the main aim was to develop capability through knowledge exchange among experts in five major areas-

Capacity building of the IITK team on content management (11 initiatives)

Capacity building of the technical experts of the IITK team (14 initiatives)

Capacity building of the other agri-experts on Agropedia portal (24 initiatives)

Awareness building of outsiders on Agropedia portal (10 initiatives)

Capacity building of the IITK team in project management (5 initiatives)

Physical Media for assuring Knowledge Exchange in DKE: These physical real time F2F engagements create new virtual relations between experts of different knowledge communities. IITK through its capacity building process provide chances to experts from different institutes and different domains to work under a roof which help developing common understanding and sense of co-operation for mutual benefit. The process developers shared norms and values by

working on the same platform of knowledge under the same guidance. This direct interaction also create emergence of trust based relationships and increase the rate of reciprocity in knowledge exchange. Every expert has his own community within the institute and organization boundary; what Agropedia wants, is to loosen up the small boundaries to set up a "community of communities". Thus to develop an ecosystem like environment or in other words a sustainable "cyber ba" Agropedia is nurturing the missing links of the knowledge network through exchanging knowledge in "exercising ba". Hence users' ability in using Digital knowledge network is earned through use of physical media of F2F knowledge exchange.

DKE for Social Innovation: The knowledge exchange and feedback mechanism on one hand make the Agropedia site informative and user-friendly and on the other hand strengthens the knowledge base with the involvement of different experts. The Knowledge Communities are initially formed by the experts of Agriculture and IT domains. The network created by the knowledge nodes is supposed to develop new and revived linkages between research and education sectors through the use of ICT mediation and contemporary practices of knowledge exchange which can be further extended to the farmers. As the aim of the Agropedia is to develop a digital knowledge ecosystem, it is expected that such partners would voluntarily participate based on mutual benefits. It is assumed that the digital ambience in a collaborative web space will create sharing trend among the scientists, experts, students, and practitioners of agriculture promoting the process of social innovation. The current results however are not entirely supportive of this assumption. The alternative approach in Krishi Katha was thus initiated.

Krishi Katha in DEAL- A Fusion of Digital and Physical Media:

DEAL- Digital Ecosystem of agricultural and rural livelihood:

While Agropedia fosters knowledge sharing across institutions, DEAL conceived by IITK is a rural development initiative in Indian agriculture to illustrate the digital ecosystem approach that attempts to bring social innovation by developing a sustainable network infrastructure for collective knowledge sharing, learning and content co-creation among individuals in local communities, who are otherwise connected through social links. DEAL project wants to involve the farmers into the knowledge co-creation process either directly or via agents and extension workers. On one hand the farmers are seeking information; on the other hand they are the source of traditional and endogenous knowledge. Technological innovation and traditional knowledge and local experience can together change the agricultural scenario and promote sustainable agricultural development. So, to link the farmers with the agricultural knowledge network is not only important but also crucial in the present agricultural situation. The aim thus is same in the previous experiment but here the emphasis is on 'conversations' and 'localised topical knowledge exchanges' rather than on creating an authentic repository.

The Challenge: The agri-scientists, experts and students are expected to come and join the knowledge network out of their own academic and professional interest but the farmers have their own socio-economic pre-occupation, social barriers, and fear of unfamiliar media, its content and language and many other hurdles. They want innovation but cannot trust outsiders; they want to progress but do not have full faith to work with new technologies. Hence, to create the bottom up pull strategy, enhancing social capital is an effective force for the sustenance of the knowledge ecosystem linking the farmer communities. A combination of physical media with the digital ecosystem can possibly produce an effective result in this field by enhancing the participation rate in the farmer's ICT mediated knowledge exchange network.

Krishi Katha- the possible solution: The Mobile-Telephonic Application: Krishi Katha developed by considering the existing socio-cultural conditions of the farmer groups. During 2005-2010 mobile phones have created wide spread communication platforms. Krishi Katha provides a mobile phone supported application for farmers and extension agents to exchange knowledge. To use Krishi Katha the user only needs an active mobile phone.

To post query/information the users are required to call to a specified telephone number (the number of the telephone attached to Krishi Katha server). After dialling the number, the user is requested to again dial two numbers one by one (provided by the server), one for the geography (e.g. press 1 for Dilipnagar or 2 if Unnao, etc.) and other for the topic (for e.g. press 1 if query relates to wheat crop or 2 for pulses, etc.). This process helps him to choose the preferred expert for answering his query. When he chooses area and topic, the query is tagged to the particular domain expert of the selected Village Knowledge Centres. Farmers have faith on their local KVK experts due to several direct interactions (through field survey, field demo, trainings etc) and as the farmers are able to get connected with their desired experts, they feel free to call any time for any query. As soon as he puts his query/ information the selected and registered Krishi Katha domain experts get an SMS alert. The expert then provides the answer to the query through his mobile (in asynchronous time). The answer is then stored at the Krishi Katha server and aligned to the specific token number given to the user; the user instantly receives an SMS alert. Here it needs to pledge that the answer comes from the farmer's favorite expert. The user can then use his mobile and token number to listen to the answers. The questions and answers are stored in the DEAL knowledge repository and any one can access it from the DEAL website.

This mobile application has increased the frequency of knowledge exchange between the farmers and the KVK experts because it provides contact with the chosen domain experts any time, makes it possible to reach to a larger audience and functions in both real and asynchronous time. Moreover, the person-to-person messaging, both through voice calls and text-based Short Messaging Service (SMS) for knowledge exchange can expand the existing extension services beyond its basic F2F interactions.

Physical content in Digital Media: Beside the mobile service, Krishi Katha uses other ICT tools and applications for integrating different physical media of knowledge exchange to reach out to farmers and extension workers of that area in an easy and interoperable way. In the traditional mode of knowledge exchange like the farmer Jathas, participants share their experiences and gather new views and agricultural information propagated by the extension system. In group discussions and meetings farmers share their experiences and discuss about different innovations and current government policies. Experts demonstrate on experimental fields where farmers can train themselves in new methods and technologies. Extension workers have successfully used performances, puppet shows and folk theatre forms to disseminate specific information, in exhibition and kisan melas (Farmers fairs). Thus the endogenous physical mode helps emerging relationships through knowledge sharing in "originating ba". If these knowledge and information sharing modes are merged in digital media then farmers get interested to join ICT mediated platforms. On the basis of this view different field demos, group discussions, meetings, puppet shows are captured to present through video clippings; information presented in local languages in audio- visual mode; different stories, based on some informative knowledge, in local languages are developed and presented through animation. Many other similar type of endogenous mode of knowledge exchange is planned for "Krishi Katha" to make content comprehensible and interesting for farmers.

The Digital Physical Ecosystem (DPE)

The two cases demonstrate differing approaches to setting up a Digital Ecosystem for Indian villagers. In the first case Agropedia mainly deals with the educated agri-agents and pursue a community centric approach in which through the process of capacity building it creates new links between different knowledge nodes to promote social capital for developing an ecosystem. In the second case, Krishi Katha (DEAL) focuses on farmers as the major user group and follows the same community centric approach, but concentrates on increasing ties between farmers and experts (mainly extension workers) based on existing social capital. However, irrespective of the nature of the users and process of implementation, in both cases the involvement of the F2F relationship building process is crucial. In case of Agropedia, the knowledge exchange process under capacity building requires physical involvement of the central coordinating authority (IITK) with the other knowledge actors and in case of "Krishi Katha" the physical involvement is in terms of content compilation. In one case, there is a seamless integration between digital and physical media and in other, physical media is merged with digital media in the form of stored content for future access. As discussed, by definition, for the ecosystem like framework it is necessary to conceptualize a self organizing system. The digital system will evolve into a digital ecosystem if it develops, grows and sustains itself. Already it has been observed that some experts from the institute like Banaras Hindu University (BHU), India from their own initiative came to IITK to be trained in Knowledge models and the content creation process of Agropedia. This implies, on the one hand, the Agropedia network

has started to grow itself by creating new users; and on the other hand, the users are unable to use the system independently and they need training. Thus, a digital network with the physical mode of knowledge exchange can ensure increasing participation rate. This developmental stage of the digital ecosystem hence can be termed as "***Digital-Physical Ecosystem" (DPE)*** through which a physical knowledge community can be directed towards DE with the growing ability of the users and emerging society's need.

Conclusion:

Most of the developing countries, including India, even at this stage of technological development, are facing economic problems due to lack of information availability. The use of recently developed ICT (Information and Communication Technology) and social media tools in these countries are more used in the urban areas. In the rural areas new connectivity platforms (like mobile phones) need new content creation initiatives for knowledge creation and dissemination. The unequal capability to adopt and use ICT results in unequal access to information which increases the spatial and individual inequalities and individual abilities and productivity. This ultimately increases the gap between poor and rich, village and city.

The World Bank found that the poor people preferred to access knowledge and opportunity rather than charity to fight against poverty (Nath, 2000). Hence, if there is a systematic, efficient and open system with capacity building for knowledge sharing then it is possible to bring back the isolated poor people in the process of development and to transform the existing social system. So, for social innovation, the initial initiative in a developing country would be to establish "Digital Physical Ecosystem" which can gradually be evolved into a digital ecosystem.

APPENDIX

Table[2]-1: Details of Capacity Building Initiatives under NAIP – agropedia (Februaruy'08- April'10)

Date	Institute		Focus	No. of Participants		Days	Purpose
	To	From		IITK members involved	Other Members		
14-16 Feb'08	IITK	GBPUAT, ICRISAT, DHARWAD, ICAR, KVKs, HBTI, IITK, FAO, NECTEC	Workshop-Knowledge Models for agropedia-Rice	16	23	3	For content management
18-20 March '08	Bangalore ISI	IITK	Seminar on semantic web	2		3	For technical assistance
4-8 June' 08	ICRISAT	IITK	Discussion on KM	2	5	5	For content management
7-8 July '08	IITK	TATA CHEMICALS	Meeting-To learn the work-plan & objective of the project	4	3	2	Capacity building of the users
14 July - 15 Oct '08	IIT	FAO	Collaboration-Relationship building on KM by Margarita Sini		1	94	For content management
6 Aug-27 Nov '08	IITK	FAO	Collaboration-agropedia portal development by Antonella Picarella		1	114	For technical assistance
18-July 2008	Delhi	IITK	Evangelizing meeting	3		1	Other

There are some blank cells for which data are not available.

24-July'08	Delhi (Tata Chemicals)	IITK	Meeting-Importance of the Knowledge Models	3	6	1	For content management
31 July-2 Aug '08	GBPUAT	IITK & FAO	Training-To the scientists of GBPUAT & also KVK experts	5	22	3	Capacity building of the users
26-27 Sept'08	IITK	Tata Chemicals-Delhi	Training on KMs	3	2	2	Capacity building of the users
5 -6 Oct'08	GBPUAT	IITK	To Visit Kisan Mela, general discussion on the project	3		2	Awareness building
13-15 Oct'08	IITK	GBPUAT	Training on KMs	1	2	3	Capacity building of the users
23 Oct'08	GBPUAT	IITK	Meeting-Establishment of the CMS of agropedia	6	30	1	For content management
28 Nov'08	IITK	Rome (FAO)	Workshop (Farewell)-antonella presented her contributions to agropedia	20	1	1	For technical assistance
6 Dec'08	KVK Chitrakut	IITK	Meeting-Discussion about agropedia	1		1	Awareness building
8-12 Dec'08	ICRISAT	IITK	Training-To improve the expertise on computer operation & make familiar with agropedia portal	2	20	5	Awareness building
11 Dec'08	ICRISAT	IITK	Training-To improve the expertise on computer operation & make familiar with agropedia portal	3	20	1	Capacity building of the users
15-16 Dec'08	UAS-Raichur	IITK	Workshop-Guidelines of KM	5	25	2	capacity building of the users

8-10 Jan'09	IITK	GBPUAT	Training-To introduce the interactive spaces like wiki, Blog, Forum	2	2	3	capacity building of the users
*12-13 Jan'09	Delhi (NAAS)	CCS Haryana Agri univ., DOR- Hyd, GBPUAT, IITK, ICRISAT, ICAR -UP, DRR -Hyd, NCAP -New Delhi, CRIDA- Hyd, NRCPB-Delhi, IASRI-New Delhi, PAU, UAS-Bang., CSKHPAU-HP, TNAU, BHU, MPUAT-Udaipur, IARI, TATA Chemicals, SVBP-UP, IIITM-K, PUSA-new Delhi, IGNOU	Workshop-To launch the agropedia portal and KMs	15	46	2	Awareness building
29 Jan'09	SVPUA&T, Meerut	IITK	Workshop-Familiarity with agropedia portal & KM	5	30	1	Capacity building of the users
4 Feb'09	IITK	ZCU	Training-Familiarity with agropedia portal & KM	9	42	1	Capacity building of the users
12 Feb'09	CSA, Kanpur	IITK	Workshop-Familiarity with agropedia portal & KM	5	30	1	Capacity building of the users
14-16 Feb'09	IIPR, Kanpur	IITK	Kisan Mela- stall on agropedia	4		3	Awareness building

16-18 Feb'09	IIT-B, IIITM-Kerla,	IITK	Meeting-To understand how agropedia is linked to other initiatives	2	6	3	For technical assistance
19-20 Feb' 09	ICRISAT	IITK	Training workshop-Familiarity with agropedia portal & KM	3	26	2	Capacity building of the users
27 Feb' 09	IITK	California (Rahul Mehrotra)	Collaboration- Wiki as a CMS	6	1	1	For technical assistance
2-4 Mar'09	IITK	Dr. Nagaraju Pappu (Canopus Consulting)	Meeting-Technical & project management perspective	6	1	3	For technical assistance
3-6 Mar'09	GBPUAT	IITK	Kisan Mela –stall to Inform about agropedia	3		4	Awareness building
5 Mar'09	IITK	Riskraft Consulting Ltd. Group-Mumbai	Meeting with V. Balaji -To share ideas & views on user needs	3	1	1	For content management
9-10 Mar' 09	IITK	Rahul Goswami (development journalist, Goa)	Meeting-To develop strategy for socialisation	3	1	2	Other
13 April'09	IITK	Ashok Bhattarcharya (IBM)	Discussion on agropedia	1	6	1	For technical assistance
*15 April'09	IITK	Mr. Anil from IBM	Discussed Network/Security issues	6	1	1	For technical assistance
2-3 May'09	IITK	Bangalore-Nagaraju Pappu & Team	Technical workshop	8	4	2	For technical assistance
12 June'09	IASRI, Delhi	IITK	Workshop on Expert System	3		1	For content management
14-15 July'0	IITK	ICRISAT, IIT Mumbai	Engineers Workshop	14	11	2	For technical assistance

9							
18 Aug'09	SIRD (state Inst. Of rural development) Lucknow	IITK	Workshop on ICT	2		1	For technical assistance
26 Aug-7 Sept' 09	ICRISAT & UAS (Dharwad)	IITK	Training- Platform creation for content type OpenAgri (+1 appliance)	2	3	11	For content management
27 Aug'09	DRR Hyderabad	IITK	Workshop- On agropedia portal	3	20	1	Capacity building of the users
28 Aug'09	Banaras Hindu Univ. (BHU)	IITK	Workshop- Familiarity with agropedia portal & KM	6	30	1	Capacity building of the users
6 Sept'09	ICRISAT	IITK	Workshop: Enhancement in agriculture of OA	2	23	1	For content management
10 Sept'09	NDUA&T, Faizabad	IITK	Workshop- Familiarity with agropedia portal & KM	6	30	1	Capacity building of the users
24-25 Sept'09	IITK	BHU, Varanasi	Training on KMs	2	2	2	Capacity building of the users
3-6 Oct'09	CSA, Kanpur	IITK	Agropedia Stall at Kisan Mela	4		4	Awareness building
13-14 Oct'09	GBPUA&T	IITK	Workshop on agropedia	4	25	2	capacity building of the users
20-21 Oct'09	GBPUAT	IITK	Review meeting	2		2	Other
3 Nov'09	IIPR,Kanpur	IITK	Workshop- Familiarity with agropedia portal & KM	9	20	1	Capacity building of the users
8-14 Nov'09	ICRISAT	IITK	Training- Refining agrovoc-agrotags	2	3	6	For content management

2-3 Dec'09	IITK	UAS Raichur	Attend/Participate in the National Conference on agro-informatics and precision farming	1	30	2	For content management
3-4 Dec'09	FAO-Rome	IITK	Collaboration- Valeria Pesce and Imma Subirats came for collabaration and shared valuable ideas and suggestions.	6	2	2	For technical assistance
7-11 Dec'09	IITK	ICRISAT	To attend International workshop on Open Access Initiative.	1	10	5	For technical assistance
15 Jan' 10	LucknowDirectorate of Agriculture	IITK	Meeting with the Directorate of agriculture	2	1	1	Awareness building
21 Jan' 10	CSA, Kanpur	IITK	Workshop- agropedia and Open Access	6	30	1	Capacity building of the users
21 Jan' 10	LucknowDirectorate ofAgriculture	IITK	Meeting with the Directorate of agriculture	3	1	1	Awareness building
30 Jan' 10	IITK	ICRISAT, GBPUAT, NAARM, IIT Mumbai, IIITM-Kerala, UAS Raichur, IITK	Review meeting	18	16	1	Other
10-12 Feb'10	IITK	Thomas Kruz & Team came from Austria	Collaboration- To discuss the format of NAIP data sheet	18	3	3	Other
10-16 Feb'10	IITK	Directorate of Oil Seeds Research (DOR) Hyd.	Training- To make KMs on Safflower	1	1	7	Capacity building of the users
16-17 Feb'10	UAS-Raichur	IITK	Training workshop- on agropedia portal & openagri	2	30	2	Capacity building of the users

17 Feb' 10	Delhi	IITK	Workshop- Release of agropedia appliance & meeting of VC's of SAUs & Director of ICAR labs. Presentation on agropedia & openagri	1		1	Awareness building
19 Feb' 10	GBPUAT	IITK	Training workshop on agropedia & openagri	4	53	1	Capacity building of the users
6-9 Mar'10	GBPUAT	IITK	To attend the 'Kisan Mela'	3		4	Awareness building
8-11 Mar' 10	Nagaraju Pappu, Kuntal De, Rahul Goswami	IITK	To discuss the second phase of agropedia	3	18	4	For technical assistance
12 Mar'10	Allahabad agri. institute deemed univ.	IITK	Training workshop on agropedia & openagri	4	42	1	Capacity building of the users
9April' 2010	BHU-Varanasi	IITK	Training workshop on agropedia & openagri	4	35	1	Capacity building of the users

Paper 4

User Led Content Creation in DEK-Its Role in Knowledge Sharing and Social Innovation

Kasturi Sadhu Ghosh Debashis Pattanaik Jayanta Chatterjee

Understanding Knowledge Sharing

Now it is the era of knowledge driven growth when the countries are completely depended on creating, accumulating, sharing and managing knowledge to promote the growth process by incorporating the development of information and communications technology. For a sustainable economic development in this age it needs to ensure that knowledge is available when and where needed and can be acquired from external as well as internal sources.

Knowledge itself is a wide concept. We get different views from different perspective of knowledge (Alavi & Leidner, 2001) in the previous studies. Knowledge is a state or fact of knowing and understanding gained through experiences or studies, which enables individual to increase their personal knowledge and to apply it in a new context. Thus knowledge can be thought as a state of mind (Schubert et al, 1998). In second view knowledge is an object (Carlsson et al, 1996; McQueen 1998) that can be stored and manipulated; and alternatively viewed as a process of simultaneous knowing and acting. McQeen (1998) also viewed it as a condition of having access to information. According to Huber (1991) and Nonaka (1994) Knowledge is the justified belief that increase an entities capacity and capability for effective action. Watson (1999) also supports this view by saying knowledge as more than the capability of future action; it is the ability to interpret information and capacity to use information. When we think knowledge as state of mind or object or condition or capability, it is like a stock concept which can be stored and enhanced; and when we think knowledge as process it is like a flow concept which can be shared, distributed, created, and exchanged.

In the knowledge literatures we also find different types of knowledge from different aspects, (Wissensmanagement Forum, 2003 and Davies M.) such as- according to the knowledge psychology- declarative (know-what), procedural (know how), causal (know why), (know when), and relational (know with); according to the nature of articulability- tacit (unstructured, unexpressed and highly personalized individual concepts), explicit (easily comprehensible and articulate) and implicit (difficult to express but possible though not fully); according to the knowledge holder- individual knowledge (hold by individual) and collective knowledge (combined knowledge of a group); according to the source of knowledge- theoretical knowledge (gained from written documents) and practical/experiential knowledge (created through observing and carrying out actions) and other else. Whatever be the perspective any

type of knowledge can be viewed as an important Recourse as well as Asset of an organization (or individual). As resource, knowledge helps in developing intellectual capital and firm/individual accumulates the knowledge stock, as asset, for better performance. Intellectual capital which comprises of human capital (skilled people) and intellectual asset (codified knowledge) (Sullivan, 1999), depends on the way how knowledge flows inside and across the organizational boundaries. Thus knowledge can be conceptualized as both stock and flow.

Knowledge as Stock and Flow

Knowledge is described as a particular type of human capital that represents the embodiment of ideas people have in mind. By observing and understanding surroundings in terms of concepts, theories, values, and beliefs, the human minds form a part of knowledge which embodied in them. Total stock of knowledge is thus the sum of the individual ideas and concepts which remains as stock in people's mind, books or in other written form and in digital spaces. The knowledge flows includes the process of exchange, share, learning and other mode through which the knowledge is circulated from one individual to other. Without proper processing the knowledge stock in its static form is hardly of any use.

Processing of knowledge and its conversion into useful information and data for application depends on the interplay between four fundamental constructs- Data, Information, Knowledge, and Wisdom (DIKW). This process is best represented by Amritesh and Chatterjee (2010) through the "Knowledge Processing Spiral". Data is the symbolic representation of an observation that can be interpreted by different agent in different way. Information is the interpretation of data in some particular context. When information is internalized it becomes Knowledge. And finally wisdom is the ability to understand and strategically applied knowledge in the new context. The knowledge is created by some agent from his accumulated knowledge which seems as data or information to the other agents. When the data is observed, interpreted and internalized by the second agent it becomes knowledge to him and increase his stock of knowledge. The knowledge is externalized by the second agent when he elaborates it and develops a new knowledge artifact. Thus elaboration helps in externalization of knowledge and learning leads to internalization of knowledge artifacts. The processing of knowledge influences the human behavior by developing the quality of decision, actions and outcomes; and develops the internal ability to absorb new external knowledge.

The knowledge through its flow helps in expansion of knowledge stock either by collaborative learning process or creating new knowledge and does required change in the existing knowledge for further use. Knowledge flow is thus intended to transform, share, exchange and integrate individual knowledge through interaction among actors and help in extension of existing knowledge and emergence of new innovative idea. So there are three different context of knowledge flow - acquisition of knowledge (increasing the knowledge stock), application of knowledge (exercising the original or modified version of the knowledge in another contexts)

and innovation of knowledge (creating new idea). In economic aspect we can view it as the capital flow where inflows means creation of new knowledge and increasing the stock and outflows is the process related to the use of knowledge or the application part. As it is the knowledge flow which is getting more focus in generating knowledge and developing innovative ideas, in both individual and organizational level, our concern is the dynamic part of knowledge.

Dialectics of Knowledge Sharing

Sharing of knowledge, whether explicit or tacit, requires effort on the part of the individual engaged in the process and also the existence of an element of reciprocity. The social theory of learning gives idea about the processing of the knowledge and the importance of collective learning (or knowledge sharing). As the thought, language of a learner are framed by the socio-cultural context of a learner (Vygotsky, 1986), the construction of meaning of an information which turn into social knowledge in reality and influence the personal behavior and attitude, is related to the cultural experiences (Bruner, 1990). Orr (1996) describes how knowledge is shared among the experts through their social network. Hanson (1999) defines knowledge sharing as the provision or receipt of task information, know-how, and feedback regarding a product or procedure. It includes oral communication about the task and exchange of tangible artifact, and also the implicit coordination of expertise (Faraj and Sproull 2000) and information about the others knowledge in the group (Rulke and Galaskiewicz 2000). Knowledge sharing is thus individuals sharing of relevant information, ideas, suggestions, and expertise with one another. Dixon (2000) states that after identifying the relationships between actions and outcomes, and by sharing their own understanding the members of a community gain a state of common knowledge. He also argued that both explicit and tacit knowledge require different processes for sharing. The studies by Donald, Mason, Robson, Lefrere & Collier (2003), Novak & Wurst (2004), Kazi, Wohlpart & Wolf (2007), Tolsby & Kirkebak (2007) also point out 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 members.

When we cross the boundary of organization or individual community of practice and enter into a KEN or better to say “community of communities” having independent but interrelated worldviews, the process of knowledge exchange can be best explained with the help of Hegelian dialectic process. It gives emphasis on the social but dialectical interactions among the people. Dialectic simply means the continuous dialogue between two or more who contradict each other but at the same time wants to share some knowledge among them. According to Hegel the highest spiritual consciousness of mankind can be achieved by the continuous ideological confliction and resolution. Hegelian dialectics is comprised of three dialectical stages- thesis (the view/ action), antithesis (contradictions of that view/ action) and synthesis (the constitutional/ emerging resolution). Through endless self perpetuating struggle

between ideals and eventually synthesizing of all ideas, the spiritual mankind reaches into the final perfection (http://www.crossroad.to/).

Thus "dialogues" and "consensus–building" are two primary tools of Hegelian dialectics for continuous knowledge sharing. With the rapid inclusion of Information and communication technology (ICT) into each and every network the dialectic interactions among knowledge nodes increase as it smoothen and enhance the rate of information flow.

This implies network with diverse members has greater chance for active interactions and knowledge sharing. It is also supported by many others experts like Jonathon N. Cummings (2004), Franke (2005). Cummings (2004) argues that the value of external knowledge sharing increases with the structural diversity of the work groups rather than the demographic diversity (age, sex, tenure etc.). The members in a structurally diverse work group, by virtue of their different organizational affiliations, roles, positions, training and professional experiences, and also because of their diverse geographic locations typify the group as unique sources of knowledge where diverse opinions create dialectic interactions and helps in active knowledge exchange besides gathering different ideas. This active exchange of knowledge through unique external sources also improves the organizational performance and behavior. According to Franke (2005) the "more the members have varied profiles, the greater the chance that their resources will be diverse" which foster the process of knowledge transaction. So there is a need to break any type of social, departmental, organizational, functional and geographical barriers and create integration among people through the effective path of communication. The effective communication is the essential part of knowledge exchange process (PPT by T. Hanson).

Now this communication can be maintained by direct Face to Face (F2F) interactions or indirect dialectic interactions through the social media applications like interactive radio, TVs or mobile phones or by creating virtual communities through different networking sites such as 'Facebook', 'Orkut', 'Hi5', 'Twitter', 'Myspace', 'LinkedIn', 'Youtube' and other else. Here people are free to share and contribute knowledge. The recently developed social media and networking sites help in increasing one's network and also make it easy to find people whom he thinks relevant for his required knowledge/information by searching the lists of friends of friends, or friends of friends of friends or …. The dynamic structure of the network is best supported by this information and communication technology (ICT) for the better accessing of the knowledge resources. ICT provides both wider (by engaging more actors) and richer (by greater infusion of knowledge) access to knowledge. Actually the collaborative knowledge exchange and learning process through F2F interactions is possible within a localized group where there exists relatively strong bonding among the members. On the other hand in an ICT mediated network community there is a high chance that actors are of heterogeneous type and from different areas. Here in this type of network people co-operate without knowing each other personally; so contacts are not strong. The reputation of members spreads and trust on members generates on transitivity basis. High network diversity helps to get in touch with other cultures

and people with different ideas and opinions and thus in higher expansion of knowledge. The trust extends rapidly from one people to another. This leads to higher collaboration of knowledge and creativity. Besides the enablers in information technology infrastructure the effective sharing of knowledge thus demands knowledge values held by community members i.e. commitment to leaning, open-mindness, shared norms, shared vision, match the members' objective with community goal and also absorptive capacity of the members to recognize the value of new external information, to assimilate it and apply it in required context (Kharabsheh). Thus, the main two factors that can facilitate knowledge flows and exchange process are i) the development and adoptability of Information and Communication Technology (ICT) and ii) the structure of the society or community.

The knowledge sharing is therefore giving focus to controversy as the central process for continual sharing is debate, dialectic and collective enquiry. Knowledge is always the outcome of interactive and controversial social processes (Lanzara and Patriotta, 2001). Now the question may arise when people share knowledge which we discuss in this sub section.

For learning: People can learn in the process of knowledge sharing. When individual or organization want to acquire knowledge or increase intellectual capital knowledge sharing among different groups of people or organization is the best way as it gives people scope to capture different ideas, opinions, and suggestions. This is supported by almost all the experts of organizational learning and individual learning. Argyris & Schon (1974) describes the process of single loop (the conventional one way learning process) and *double loop learning (having problem solving, feedback mechanism)* as the organizational learning process. Senge (1990) gives focus on the capability of creating personal vision, mental models, *shared vision, team learning and understanding of interactivity and relations between different segments* of system through continual learning and observing different situations of the organization process. Biost (1998) explains the social learning cycle in six phases- 'Scanning' of raw data, 'Problem solving' to give structure and coherence of the insights by applying imagination and independent thought, 'Abstraction' of general insight to diverse range of situation, *'Diffusion' of insights among members,* 'Absorption' of new codified tacit knowledge by applying this knowledge in different context, and 'Impacting' of the tacit abstract knowledge in the concrete practices and behavioral practices. Jensen, Jhonson, Lorenz and Lundvall (2007) propose two different modes of knowledge learning- STI (Science, Technology, Innovation) and *DUI (Doing, Using, Interaction).*The learning process is a part of actions; interactions depends on social network; and social processes and social networks are made of relations develop through social actions and activities. Again action is always based on the existing knowledge. So these two modes are complementary to each other. Thus all the theories point out the existence of knowledge sharing in the learning process.

For knowledge creation: Through the process of knowledge sharing people not only learn but also become able to create new knowledge. Knowledge Creation includes both creation of tacit

and explicit knowledge as a result of cognition, social interaction, understanding and elaboration. All the experts of 'learning', said above, agree that the effective learning process make people able to create knowledge either in tacit/implicit form as internal capability or in the explicit form as codified artifacts. The knowledge processing cycle of Nonaka (1994) gives a popular theory in the process of conversion of knowledge from implicit to explicit and vice versa. In this theory he points out how knowledge is continuously created in the transformation mechanism from tacit to explicit and explicit to tacit through the circular path of four stages-socialization (sharing tacit knowledge or experience with other), externalization (understanding and articulating the tacit knowledge to represent it into words, language or other explicit forms), combination (capturing and integrating the pieces of externalized knowledge to give a new form, disseminating the explicit knowledge through communication and editing and processing the explicit knowledge to make it more useful) and internalization (conversion of explicit knowledge into tacit form that reflects in the learning and application of the newly gained knowledge) (SECI). The four stages are highly interrelated and depend on the ability of value creation by the respective actors. Thus also, according to Nonaka knowledge sharing is crucial for knowledge creation process.

For innovation: Tacit knowledge is difficult to transfer, and to extract from the owner. The only gateway to reach into the tacit knowledge and reuse and reconstruct that knowledge is the interactive knowledge sharing process. In evolutionary economics learning and innovation are two parallel processes. Only the proper mix of the tacit knowledge possesses in the mind of people and with the explicit knowledge lead to the new idea and insights for innovation. Nahapiet and Ghosal (1998) argue that knowledge creation is a result of combination and exchange of pieces of knowledge and also the basis of innovation. The sharing of knowledge helps in combined the unconnected pieces of knowledge resides in different individual for knowledge creation and a proper mix of novel conceptual distinctions and novel ways of combining the previously connected knowledge for radical innovation. For example in an organizational setting the task-related knowledge from a customer and an organizational expert are likely to be different which helps to extract new ideas and insights if there is a scope for proper knowledge exchange among them. The effective knowledge sharing process can lead to effective knowledge creation and learning which are the basis for innovation and innovation-led -development through successful implementation.

For Knowledge management: Knowledge management (KM) is a concept related to organization; it may be private business organization, public sector or co-operative farming. Knowledge management means manage all kinds of knowledge and knowledge processes. Now everyone is aware that there is more useful information in human minds than the external artifacts which can hold only a fraction of total knowledge available. Thus to manage knowledge there is a need to make interconnections among different human minds. According to Alavi & Leidner (2001) the objective of KM is to build, manage and enhance knowledge as

both asset and resource through creating, sharing, learning and distributing knowledge for developing core competencies. Thus knowledge management can be thought as the process to support and coordinates the creation, transfer and application of human knowledge for value creation and innovation.

For Economic development: Through the exchange of knowledge an individual and organization perform better and gain the capability of competency which enhances economic growth. Not only that, the proper diffusion of knowledge also helps in pro-poor economic development. For diffusion of both knowledge and innovation, the social process of information sharing is the paramount way. Sunden & Wicender (2003) on their paper "Bridging the Digital Devide- ICT Solutions Supporting the Economic and Social Development for the Unseen Majority" and an article on "ICT in developing countries" (www.parliament.uk/parliamentary_offices/post/pubs2006.cfm) conclude that by improving the information sharing and enabling communication ICT helps the countries to tackle down many health, social, and economical problems. By Kaushik & Singh (2004) lack of proper knowledge diffusion has been pointed out as the missing factor for agricultural development in India even after technological revolution. The effective knowledge sharing across different communities can reduce risk and uncertainty associated with the natural and human behavioral changes; provide proper knowledge and best practices for the production process, information about new innovation, market, and on all other daily life necessities. People working in service, manufacturing or farming sector and residing in village or city, can trim down the erroneous events by getting right information at right time. A nation with having access to knowledge to all and networking facility is, therefore, always in the path of growth and development.

In brief, a collaborative and effective knowledge exchange network fosters both the knowledge creation and learning process. The learning process is effective only when knowledge is absorbed by the learners. The effective learning process is able to develop reasoning ability which helps them to justify the information and makes them liable for required modification, and continuous sharing and exchanging of knowledge with others. In this context knowledge can be thought as the output created through the mental process such as cognition, comprehension and learning as the process of internalize the external knowledge which helps to build up innovative ability. Thus when individual and organization eager for better performance and behavior they need to engage in the process of continuous knowledge sharing. As said by Finger and Burgin (1999) in pursuit of service improvement, public sector organizations as well as private sector organizations transform themselves into 'learning organizations', where individuals, groups and organizations sharing knowledge across institutionalized boundaries. It makes the employees able to understand different corporate cultures, solve practical business problems, match the style of organization, share education, training, become socialized, develop career structures for different occupational and professional groups and over all to fight against the knowledge famine. This is also true for the farming sector. Specifically, the sharing of tacit

knowledge is needed to acquire by social interaction, dialectical debate for those harnessing its utility in return for competitive advantage. Only through this social process they can capture knowledge from different contexts, as knowledge is highly personal and associated with the various contexts within which it is shaped and enacted (Fernie et al., 2003).

However, knowledge sharing is effective if each and every member contributes knowledge besides using it (Produsage). But most often there is a lack of this organizational development. So, in most organizations there are two different types of knowledge users- knowledge contributors who want to externalize their knowledge and the knowledge receivers who want to internalize the knowledge. Contributors always act as receivers but not the reverse. Why does it so happen and why people don't want to contribute their knowledge? To overcome the problems McDermott & O'Dell (2001) give the following solutions for an organization which can be applied for any community or real world networking groups.

Create a knowledge sharing culture by connecting sharing knowledge and practical group goals, problems or results.

Match the overall style of the organization with new behavior and approach to make sharing knowledge a natural step.

Link sharing knowledge to widely held core values of the organization so as to make knowledge sharing consistent with peers' expectations Enhance the Human networks that already exist and enable them with tools, resources and legitimization to build the sharing culture.

Recruit the support of people in the organization who already share ideas and insights; ask influential people to encourage and even pressure others for sharing their knowledge; and build measuring knowledge-sharing aptitude into routine performance appraisal.

Develop horizontal and reduce hierarchical nature of knowledge sharing processes.

In the next sections we try to elaborate how social network enriched with social capital play a crucial role in knowledge sharing. In this context we want to focus on the knowledge sharing processes in Indian agricultural extension network. We explore three different agricultural knowledge sharing platforms for this purpose.

Social Capital – Concept, Definition and Approaches

Social capital is one of the important and salient concepts in social science since last few decades. Many research projects have already been done on different forms and context of social capital. In the literature on social capital and knowledge management it has been pointed out that "Networks, their roles in information exchange and the trust they engender are crucial to the effective functioning of organizations of all kinds" (Temple, 2006). Information and

knowledge spread through network and members of a network having higher social capital can share and exchange knowledge more easily than others.

The term social capital was first used by Jane Jacobs in "The Death and Life of Great American Cities" in 1961 in reference to networks in urban neighborhoods (Borgatti, 1998). Since then the research on this ground shows that social capital and knowledge network are two highly related concepts. For our work purpose it is necessary to draw attention on the network based definition of social capital.

According to Lin (2001a) Social Capital is the investment in social relations (or social network) to capture and use the resources embedded in the relations for generating more resources. It is the resource that helps actors to access and use diverse resources, facilitate knowledge flow, influence flow, and capacity building (Lin 1982, 1999b, 2001b). Here Bian (2008) argued that all the relations are not resource bearer, only the personal relationships are able to bear social capital. An actor has to nourish the process to develop personal relationships from simple network. In digital ecosystem without the foundation of this personal relation based physical ecosystem self-organizing and self-catalyzing characteristics may not emerge. (Chatterjee and Ghose, 2009).

Coleman and Putnam mentioned that social capital is also related with civil engagement and social participation (Lin & Erickson, 2008). A network is likely to enhance the social capital if it is able to generate trust and reciprocity among the links and capable to increase the civil engagement and social participation for mutual benefit. We summarized some definitions of social capital given by some experts in the preceding paper.

There are many parameters of social capital with which we can establish the significance of social capital in the process of building up effective communication systems for collaborative knowledge exchange. Here we are following the social capital theory developed by Nahapiet and Ghoshal (1998).

The Process of Collective Learning and Knowledge Based Innovation

According to the recent literature, innovation is a process that depends on the degree of interactions and exchanges of knowledge among interdependent actors (Landry, Amara & Lamari, 2002). It is described as the combination of tangible capital like physical capital and financial capital and intangible capital, especially social capital.

Knowledge is one of the most important factors that germinate innovation. Now the growing importance of diversified learning processes- learning by doing, learning by using and learning by sharing (Rosenberg, 1982) increase the importance of knowledge exchange among the actors of a network. This diffusion and transformation of knowledge is explained by the incorporation of social ingredients like social networks, social relations and social capital. The nature and

extent of interactive learning is determined by the structural dimension of the social capital which refers to the overall pattern of the connections between actors.

Limbooy (2002) describes how the innovative capacity is gained by economic actors in the collaborative interaction process. The economic actors possess the competencies to learn, to innovate, to organise and to manage the ideas, information and activities, and also to adapt them at varying contexts. Competencies are developed through different stages such as - Cognitive, Innovative and Organisational. People in Cognitive stage are eager to learn, to use and to develop information and knowledge. Innovative stage helps the openness of the people to change and explore new opportunities and to adapt to new external forces by taking part in innovation (new process, new product, new organisational form). In Organisational stage people are able to give structure to new production and exchange processes and to manage both internal and external knowledge and relationships.

Thus every economic actor has his/her own capacity to think, to learn and to relate to the basic ingredients for creation of knowledge and doing something new, if proper infrastructure is provided. All the users of knowledge network are able to create knowledge too , the content they gain from their education or work experience or from their observation and inference. So, knowledge actors can serve the dual role explained by Bruns (2007) as "produsers". They work in a collaborative environment having fluid roles of users, producers or editors or quality evaluators of the content according to their personal skills, interest and knowledge. Not only that, through this network the consumers can also take part in the production and innovation by exchanging their knowledge and ideas in the process of production of different articles which they consume further for their need. Thus the consumers here are the 'prosumers' according to Alvin Toffler (1970). Of course, the quality and quantity of the knowledge co-created, and the efficacy and effectiveness of an innovation depend on accessibility of the network and the form of bond developed through network relationships among the knowledge actors. The community members, thus, through taking part in exchange and sharing of knowledge, can raise the innovative capability of the community.

Empirical Analysis

Now we present some empirical evidences which reflect the importance of social capital in knowledge exchange processes and in motivating simple users to become 'produsers'. We take into consideration three different mode of collaborative agricultural knowledge sharing processes in Indian agricultural communities of 'Orkut', 'Agrowiki' of 'agropedia' and 'KisanBlog' of 'DEAL'.

Research Methodology

In 'Orkut', there are total 729 agricultural communities among which we consider only the active communities. Assuming community with at least 100 members, our data sets are

collected between 15th Feb and 17th March, 2010). Out of these based on intensity of activities, as active communities, we finally chose 29 communities. For assessing participation level we count the no. of voting polls and no. of total posts under a particular forum topic. On Orkut, some members are common in many communities, so in case of number of total members there is a possibility that one member is counted more than once.

In Agrowiki we categorized the users into 10 groups from their affiliation to the various agricultural universities. The criteria for selection were that the group should have created at least 5 topics with 15 members and at least 10 participants showed interest. Our selected groups are UAS-Dharwad, GBPUAT, NAARM, CAS-Raichur, IITK, T.N. Agricultural University, BHU, CSA-Kanpur and 'Others'. The group 'others' comprise of many management institutes, agriculture institutes, technology institutes, banking organizations, Business organizations, Krishi Vigyan Kendras (KVKs) and Agriculture Research Stations (ARS) . As Agrowiki has some properties of Wikipedia the participation on this platform is possible through creating wiki-content, edits/revisions of the existing wiki content or through add-on comments.

In case of 'KisanBlog' also we chose 6 groups depending on the villages of active users. These are Kannouj, Raibarielly, Unnao, Dilipnagar and 'others'. 'Others' includes several farmers from other villages and experts from other KVKs and agriculture universities. All the selected groups have created more than 20 topics and around 40 participations in total with at-least 20 users. Here IITK does not create any topic and raise no questions; but it acts as a major supportive partner by providing answers to some questions arising in the other 5 groups. Other than experts and farmers we have also recognised a class of users as 'guest'.

Data Analysis

'Orkut'- the most significant networking site in India: Orkut is a social networking site mostly used in Brazil and India. And in India it is one of the most popular sites through which people maintain increasing social connections. As on 15th March, 2010 there were 708 agricultural communities among which 571 were created by Indian users. These numbers increased up to 729 and 590 respectively on March 30, 2010.

Most of the communities are related to agriculture colleges or universities or related to some agricultural NGO or business. Among the 571 communities, the no. of members for more than 80% (466) of communities was less than 20. Most of the communities are developed after 2005 and largely in 2006. Among the 29 active communities, assessed by us, 11 are developed independent of any institute. The details of the communities are given in the following table. There are many other communities having common Interest in some particular technology/ equipment/ machinery for agriculture and for agricultural development like "Agriculture Equipments", "Computer tech n Agriculture" , "MS-IT in Agriculture - DA-IICT", "SCRIET AGRICULTURE ENGINEERS", "agriculture engg." or community related to agricultural

professionals as "PNB agriculture officers", "DENA BANK AGRICULTURE OFFICERS", "Agriculture officers", "Agriculture extension" and others.

The most active community in terms of no. of members (2526) is "Indian Agriculture" which was created in February, 2007. This is followed by the community named "All India Agricultural students" with 1762 members. From the total no. of participations in forum (380) and voting poll (275) the community of "College of Agriculture, Nagpur" (2006) is leading followed by "Indian Agriculture" with 399 participation in forum and 106 in poll. And if we consider the total no. of created topics in forum (164) and created polls (17) the "College of Agriculture, Pune" community is in the first position with 1469 community members, 334 participations in forum and 131 participations against polls within 4 and ½ years of its creation (November, 2005). In the community "College of Agriculture, Pune" people are sharing information beyond agriculture. But the reciprocity in this community is not much. It has been observed that people like to interact with voting polls than for forum discussion. The positive thing about the participation here is that participation per topic on an average is more than 1, means each topic has at least a dialog. That implies people sharing their knowledge within the community though may be at a slower pace. The College of Agriculture, Shimoga (2006) has the highest participation per topic (more than 9) and other 5 Agri-college communities have participation rate more than 6.

But the participation rate per member in the communities gives us an interesting result. Communities having the larger number of members, has shown relatively lower participation rate per person (0.2) and having the lowest member (103) has shown the highest participation rate (1.03). It means though there are many members in some communities most of the members are passive. In those communities only few of the members are active in the sense that they contribute their knowledge and others are users of that knowledge only. Thus we can divide the communities into two groups-

The learning community- When participation per member is less than 0.5 and The knowledge creating community- When participation per member is more than 0.5 i.e. if not all members then at least each second person is contributing something to the community knowledge pool.

In this respect we have 19 learning communities and 8 knowledge creation communities among the 29 active communities.

AgroWiki - This is a social networking platform on the "Agropedia" website. It was developed in January, 2009. It is a popular and growing website in Indian agricultural field where the total no. of users was 2264 as on 15th March, 2010. Agrowiki is one of the significant features added to the "Interaction" space of the Agropedia site. 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.

Table 3 shows brief data on Agrowiki. The most active group is IITK. Besides creating large number of topics, it generates large participation not only within its group, but also initiates interactions with other groups. The participation is high for UAS Dharwad, GBPUAT and IITK users relative to others. Compared to the number of users, the number of topics created are few, except for IITK, GBPUAT, and UAS Dharwad.. Moreover the no. of topics is almost equal to the no. of participations. These imply the average participation per topic and also per person are not high. But the lower rate of participation per topic shows that members are contributing content but are not able to create much interaction through these topics. So the developed community can be viewed as a learning community where few of the users contribute possibly because of self-esteem and reward factors like remuneration, promotion, self identity. However, overall from the table it is observed that whatever participation it has, is confined to the NAIP project institutes; whereas the participations from other institutes are scant. For most of the groups (excluding NAARM & T.N. Agri University) it is seen that participation rate is higher within own institutional boundary than from outside.

KisanBlog - This is the audio-blog associated with the DEAL website (www.dealindia.org): The DEAL project attempts to create a digital knowledge network for fostering the process of sharing and dissemination of information and knowledge among farmers, KVK experts (the knowledge mediators) and scientists of the state agriculture universities and other institutions (the explicit knowledge sources). Kisan blog is a web 2.0 application which is user-friendly, allows acquisition of tacit knowledge as a direct input without any distortion and ensures collaborative practices for knowledge generation and reuse through intrinsic rewards and trust based relationships (Pattanaik & Chatterjee, 2009). Here the users put their questions and get answers to it which can be provided by anyone. The DEAL experience in expanding the Indian agriculture extension services knowledge network and the self catalyzing characteristics exhibited by Kisan blog inspired new research interests regarding the role of participative digital communication as enabler for innovation in large and complex socio-technical systems.

Thus ‘KisanBlog’ is like a question- answer forum which can be synonymously used as blog for ‘kisans’ (farmers) to put questions and answers in audio as well as text format individually or with the help of KVK experts. Like the other two knowledge exchange networks, here also we observe that the participation is high within the groups. Table 4 shows that Raibarelly has the highest rate of participation per topic whereas Kannauj has the highest rate of participation per member, but in absolute term Kannauj and Unnao seem to be more active from. For all the 5 groups, we can see that the participation and participation rate per topic are much higher within the group. We can also note another interesting point in this respect. The group ‘other’ involves all the users from all other villages, from this point we can view this group as an open group. If this is so, then our argument that ‘the chance for knowledge sharing is more in a confined group

than in an open group' is again supported as the rate of participation per topic as well as per member are lower in the open group 'others'.

General Discussions

From the previous literature survey and our above analysis we can state that a clearly defined and specific criteria based or project/problem based community has higher probability of higher quality 'usable' knowledge sharing among the members than an open community of general interest. This may be because-

People having same origin or basis like education from same college, located in some specific area or associated with some specific institute have a strong base of social capital. People of confined groups may have relatively higher trust on other members as most of them are known to each other, their attitude and personal behavior generate reciprocity of actions. The work of one can influence the other. They may have same culture, norms and rules which promote knowledge sharing within the group.

Overall, they all have same interest and objective which create a sense of commonality. This acts as an incentive factor for knowledge sharing.

It is also reasonable to argue that it is the social capital in the form of 'trust' and 'influence by peers' that motivates other user to participate in the content creation process. Therefore, here in this collaborative knowledge exchange process the users become the producers of content. From our analysis we can't claim that all the uses are 'produsers'. Moreover, the participation rate also depends on the mode of knowledge exchange, type of content and nature of users. For example, we get relatively more young users and higher participation in voting polls in Orkut; more farmers as users and maximum questions by farmers and maximum answers by KVK experts in KisanBlog; and more users and higher participation from the agricultural universities in case of Agrowiki.

Conclusions and Further Scope

In this paper, we started with the dynamic aspect of knowledge and turned our focus on the effective knowledge exchange processes. Assuming that collaboration is the most effective way of co-creation and dissemination of knowledge, we tried to find out the role of social capital in this area. From our analysis we conclude that social capital manifests in social network and add value to the network in the form of trust, reciprocity, norms, understanding which helps in mobilizing more knowledge among the members of the knowledge exchange network through developing effective and mutual collaboration. Our analysis also support that the social context is equally important for the "contextually dependent" ICT mediated knowledge network structure.

This study can be expanded and may explore some new dimensions if we assess the profiles of the active users, and the nature of the content they are creating. Further we can extend our work by incorporating other communities on the web through Facebook, Twitter, Hi5, Myspace and other networking sites in the context of topical and economic livelihood oriented knowledge sharing.

Appendix: Tables for required data and calculations

Table 1: The active agricultural communities of 'Orkut'

Name (Year of development)	Structure of the community	No. of members (M) as of 15/3/10	No. of topics (T) in forum & poll	No. of total Participations (I) in forum & poll	Participation rate in average		Last date of posting
					Per topic (I/T)	Per member (I/M)	
Indian agriculture (2007)	Open for all the interested people	2526 (2593)	127+4= 131	399+106= 505	3.85	0.2	15/3/10
All India agricultural students (2007)	Open for all the interested people	1762 (1848)	74+2= 76	87+204= 291	3.83	0.17	13/3/10
College of agriculture, Pune (2005)	Confined for the people associated with the institute	1469 (1474)	164+17= 181	334+131= 465	2.57	0.32	13/3/10
Agriculture jobs (2007)	Open for all the interested people	817 (860)	57+1= 58	90+8= 98	1.69	0.12	2/3/10
College of agriculture, TVPM (2006)	Confined for the people associated with the institute	603 (605)	60+2= 62	146+26= 172	2.77	0.29	13/3/10
College of agriculture, Nagpur (2006)	Confined for the people associated with the institute	841(864)	95+9= 104	380+275= 655	6.3	0.78	13/3/10
Agriculture solution exchange (2007)	Open for all the interested people	508(506)	44+3= 47	100+83= 183	3.89	0.36	6/3/10
Indian agriculture integrated (2006)	Open for all the interested people	394(396)	58+1= 59	107+72= 179	3.03	0.45	14/3/10
Agriculture Banking (2006)	Open for all the interested people	660 (672)	69+2= 71	268+60= 328	4.62	0.5	22/2/10
Agricultural College, Kolhapur (2006)	Confined for the people associated with the institute	541(545)	25+0= 25	78+0= 78	3.12	0.14	13/3/10

Agriculture Institute, Naini (2006)	Confined for the people associated with the institute	455(476)	21+1= 22	44+4= 48	2.18	0.11	13/3/10
College of agriculture, BBSR (2006)	Confined for the people associated with the institute	409 (412)	20+3= 23	68+46= 114	4.96	0.28	13/3/10
Agriculture Entrepreneur (2007)	Open for all the interested people	373 (371)	37+0= 37	75+0= 75	2.03	0.20	6/3/10
College of agriculture, Raipur (2006)	Confined for the people associated with the institute	306 (313)	32+7= 39	54+87= 141	3.62	0.46	13/3/10
College of agriculture, Mandya (2006)	Confined for the people associated with the institute	288	39+3= 42	61+34= 95	2.26	0.42	13/3/10
College of agriculture, Dhule (2006)	Confined for the people associated with the institute	306	18+8= 26	24+116= 140	5.38	0.48	13/3/10
Agriculture Revolution (2006)	Open for all the interested people	364	20+1= 21	27+27=54	2.57	0.15	18/2/10
College of agriculture, nashik (2006)	Confined for the people associated with the institute	185	7+6=13	23+69=92	7.07	0.5	13/2/10
College of agriculture, Palvan (2006)	Confined for the people associated with the institute	235	12+4= 16	38+92= 130	8.12	0.55	13/3/10
Krishna College of agriculture (2008)	Confined for the people associated with the institute	126	4+2=6	3+45=48	8	0.38	19/11/ 09
Shivaji agriculture, (2006)	Confined for the people associated with the institute	198	18+2= 20	26+103=129	6.45	0.65	13/3/10
Coll. of agriculture, Junagadh (2006)	Confined for the people associated with the institute	181	13+6= 19	23+67=90	4.74	0.5	13/3/10
Agriculture Info Group (2006)	Open for all the interested people	215	22+2= 24	28+17=45	1.86	0.21	13/3/10

Agriculture import export (2006)	Open for all the interested people	265	32 +1= 33	51+13=64	1.94	0.24	18/2/10
Agriculture Students (2007)	Open for all the interested students	189	6+2=8	8+39=47	5.88	0.25	13/3/10
College of agriculture, Durg (2007)	Confined for the people associated with the institute	103	33+7= 40	43+63=106	2.65	1.03	13/3/10
College of agriculture, Shimoga (2006)	Confined for the people associated with the institute	199	7+6=13	8+113=121	9.31	0.61	6/2/10

Table 2: Comparison between 16 confined (agri-college) communities and 11 open communities

	Confined community (16)	**Open community (11)**	**Total (27)**
Total Members (M_t)	6845	8073	14918
Total created topics (T_t)	657	565	1222
Total participations (I_t)	2624	1869	4493
Average participation per member (I_t/M_t)	0.38	0.23	0.30
Ave. participation per topic (I_t/ T_t)	3.99	3.31	3.68

Table-3: The information on active groups of 'agrowiki'

Content Source	**No. of Users**	**No. of Topics created**	**Total Participations (with source)**	**Rate of participation per topic**		**Rate of participation per member**	**Last date of posting**
				Within own area	**From other area**		
UAS-Dharwad	17	73	Dharwad-74, iitk-10, UAS	1.01	0.16	4.35	13/2/10

			R- 1, other-1				
GBPUAT	90	242	GBPUAT-291, iitk-128, other-14	1.20	0.59	3.23	15/3/10
NAARM	17	15	NAARM-18, IITK-21	1.2	1.4	1.06	2/4/09
UAS Raichur	63	8	UAS R-11, iitk-5	1.38	0.63	0.17	17/2/10
ICRISAT	23	6	Icrisat-9, iitk-2, other-2	1.5	0.67	0.39	8/3/10
IITK	47	370	Iitk-724, other-7	1.96	0.02	15.40	12/3/10
T.N. Agri University	44	7	TNAU- 7, iitk-8	1	1.14	0.16	14/8/09
BHU	72	7	BHU-7	1	0	0.1	8/9/09
CSA, Kanpur	42	8	CSA- 8, Iitk-4, other-2	1	0.75	0.19	8/8/09
Others (academic institutes, KVKs, and other organizations)	1878	17	other-19, iitk-13	1.12	0.76	0.01	17/2/10

Table-4: The information on active groups of 'KisanBlog'

Content source	No. of users with nature*	No. of created topics (Ques-tions)	No. of answers received (with source)	Total Participation		Participation rate per topic		Participation rate per member
				within own group	From other group	within own group	From other group	
Kannaij (K)	35 (F-28, G-2, E-5)	56	45 (K- 32, T-11,O-1, D-1)	88	13	1.57	0.23	2.51
Raibareilly (R)	33 (F-25, G-4, E-4)	37	35 (R-32, O-3)	69	3	1.86	0.08	2.09
Unnao (U)	44 (F-40, E-4)	54	36 (U-33, O-3)	88	3	1.63	0.06	2
Dilipnagar (D)	20 (F-2, G-16, E-2)	24	24 (D-11, T- 5, O-8)	35	13	1.46	0.54	1.75
IITK (T)	4 (F-0, G-2, E-4)	-----	-------	----	----	-----	----	------
Others(O)	84 (F-17, G-56, E-11)	63	55 (O-23, T- 14, U-4, K-8, D-4, R-2)	86	32	1.37	0.51	1.02

*F- farmer, G-guest, E-expert

Paper 5

Can Digital Ecosystem build Social Capital that Foster Local Innovation? Experience from DEAL

Jayanta Chatterjee Debashis Pattanaik

Agricultural Innovation

Promotion of agricultural innovation for modernization, higher yields, poverty eradication, and economic growth has occupied policy makers and academics in developing countries since the 1950s. Since the 1960s, numerous agricultural technologies have been developed by the National Agricultural Research Systems (NARS) of developing countries, often in collaboration with international research centres (Byerlee 1998; Mruthyunjaya and Ranjitha, 1998; Sechrest et al. 1998). Technologies developed by scientists in research laboratories and testing plots of NARS are transferred to farmers working in their fields by the agricultural extension service. In the last two decades, this "top-down" technology transfer approach to agricultural innovation has been severely criticized by development researchers and practitioners alike, who call for a participatory approach to technology development (Farrington and Martin 1988; Chambers et al. 1989; Biggs 1990; Thompson and Scoones 1994; Douthwaite et al. 2001). This involves three main components:

Developing agricultural research systems in such a way that farmers can act as stakeholders in the innovation process, at least for adapting a laboratory-developed innovation to local farming conditions (Pal and Byerlee 2003).

Using farmers as primary and active agent in the innovation process, by focusing on the grassroots level where farmers' experiential and traditional knowledge is the main route to producing successful agricultural innovations (Chambers et al. 1989; Thrupp 1989; Sherwood and Larrea 2001). In these farmer-centred approaches, some farmers act as experts who may train other farmers on a new technology (in farmer field schools, FFS, for example), and thus create a community based innovation capacity on the basis of knowledge sharing among farmers (Fakih et al. 2003;Wu and Pretty 2004).

Highlighting and integrating diverse types of knowledge at all stages of the innovation process by placing equal emphasis on farmers' and scientists' knowledge (Merrill-Sands et al. 1991; Thompson and Scoones 1994; Waters- Bayer and Bayer 2005). This approach to agricultural innovation systems framework pays attention to a wide range of individuals, organizations and institutions that play a role in developing agricultural

innovations (Hall et al. 2003; Spielman 2005; IBRD/WB 2006). Interactions between different individuals and organizations are deemed critical for continuous learning and innovation success in an innovation system. The components of such a system include the NARS, private firms, civil society organizations, farmers and different informal institutions such as habits and routines of the actors. Here farmers, scientists and other actors either establish channels, or use existing ones, to access knowledge from different actors in the system. The accessed knowledge may then be integrated with one's own knowledge and/or practices.

In an innovation system, innovation capacity [or learning capability] is built at the level of individuals, their organizations, and the system as a whole. In village based society like India innovation capacity of individual farmers are embedded in the knowledge network of the village, which includes other actors deemed important in a local innovation system such as extension workers, KVK scientists, NGOs and the government agricultural department.

Social Capital as Innovation Capacity: Social Networks, Trust, Closure and Embeddedness

Social capital has become a core concept in business, political science, and sociology. The term social capital refers to "advantage created by a person's location in a structure of relationships." The advantage is visible when certain people, or certain groups of people, do better than equally able peers. In general it is argued that some people who do better because they are more able individuals; more attractive, more articulate, or skilled. In contrast social capital explains how people do better because they are somehow better connected with other people, trusting certain others or obliged to support certain others. To Bourdieu social capital is the resources that result from social structure - ''social capital is the sum of the resources, actual or virtual, that accrue to an individual or group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition'' (Bourdieu and Wacquant, 1992: 119).

James Coleman has defined social capital as a function of social structure producing advantage (Coleman, 1988: S98, 1990: 302): ''Social capital is defined by its function. It is not a single entity but a variety of different entities having two characteristics in common: They all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure. Like other forms of capital, social capital is productive, making possible the achievement of certain ends that would not be attainable in its absence.'' Putnam (1993: 167) has further expanded Coleman's metaphor, and defines social capital as: ''Social capital here refers to features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated action" (Putnam 1993: 167). These perspectives are diverse in origin, and diverse in their style of accompanying evidence, but they agree on a social capital metaphor in which social structure defines a kind of capital that can

create for individuals or groups an advantage in pursuing their ends. People and groups who do well are somehow better connected.

The baseline assumption about innovation is that it spreads by word of mouth. It is widely agreed that social relations emerge from physical proximity, and shared opinion develop with social relations (Festinger, Schachter, and Back's, 1950). People come to know about unknown by asking friends and colleagues who knows about it. This implies that people connected by a strong relationship will have similar opinions about an innovation and follow one another quickly in adopting the innovation. However word of mouth does not operate in vacuum. The lack of social and personal model means that there is a risk in adopting an innovation. Further adopting an innovation and following what other say are about building trust. Trust is a relationship with someone (or something if the object of trust is a group, organization, or social category) in which contractual terms are incompletely specified. The more unspecified, taken-for-granted the terms, the more that trust is involved in it. People anticipate cooperation from the other person, but they commit to the relationship before they know how the other person will behave. When people enter a group effort, they trust the other people to contribute their share.

To simplify it further let us say ego refer to the person being asked to trust. Alter is the person to be trusted. There is some strength of relationship between the two people, and surrounding them are friends, colleagues, acquaintances and enemies. These other people are third parties to the relationship. Where ego and alter are connected to the same third party, there is an indirect connection through a third party, or more simply, there is a third-party tie between ego and alter. The stronger the third-party ties connecting two people, the more closed the network around them. Begin with the relationship between two people under study, ego and alter trust between them is twice created by repeated interaction, from the past and from the future. From the past, repeated cooperation from alter makes ego more confident in alter's tendency to cooperate. The repetition of cooperative exchange promotes trust. From tentative initial exchanges, people move to familiarity and from there to more significant exchanges (Cross and Parker, 2004: 98–104). The gradual expansion of exchanges promotes the trust necessary for them.

Blau summarizes the process as follows: ''social exchange relations evolve in a slow process, starting with minor transactions in which little trust is required because little risk is involved and in which both partners can prove their trustworthiness, enabling them to expand their relation and engage in major transactions" (Blau 1968: 454). Trust required for a system to survive is generated by the process of social exchange in a self-regulating fashion. Granovetter summarizes the information benefits of this ''relational'' embeddedness as: ''that trustworthy behavior may be a regularized part of a personal relationship reflects one of the typically direct effects of relational embeddedness and explains the widespread preference of all economic actors to deal with those they have dealt with before. Our information about such partners is cheap, richly detailed and probably accurate" (Granovetter, 1985: 490). Over the course of

repeated exchanges, two people build a sense of who they are in the relationship, a sense of what to expect from the other person as well as themselves. Krackhardt (1992) describes this phenomena [strong friendship in a small organization] as ‘‘philos’’-relations that connect people who interact, have a history with one another, and have come to feel emotional affection for one another. In sum, past cooperation is a basis for future cooperation such that trust is correlated with the strength of a relationship. A history of repeated cooperation between two people strengthens their relationship, increasing the probability that they trust one another.

In explaining social capital network closure is an important issue (Coleman, 1988: S103). Without a high degree of trustworthiness among the members of the group, the institution could not exist. No self-sustaining network is possible by a lack of social capital and no social capital is possible without network closure. There is need to exist a set of behavior, norms and effective sanctions that will support production of social capital. This constitutes closure. The consequence of this closure results in a set of effective sanctions that can monitor and guide behavior. Coleman’s suggest that closure enhances social capital and more importantly facilitates trust.

The cross-cutting relationship in a network with closure fulfills three functions: first it passes information about how particular members acted in the past in particular social interactions. Second, help members share information about previous consensual social exchanges [this helps in assessing the welfare-enhancing tendencies of various norms]. Third, facilitate the identification and rewarding of champions of the public. Network closure being social capital is an advantage to live among the known people engaged in a society of trust. Network closure increases the probability of such a life. Thus closure is social capital. This is not to delimit the importance of brokerage in social network. What is crucial is that by lowering the risk associated with trust, closure leads to advantages that would otherwise be unlikely or impossible.[3]

The first use of the term embeddedness in the social sciences is generally attributed to Karl Polanyi (1944; 1957). In his classic work, *The Great Transformation*, Polanyi (1944 [2001]) argues that economic transactions are embedded in socio- political and cultural exchanges. More generally, an economy is “embedded and enmeshed in institutions, economic and non-economic” (Polanyi 1957 [1995:34]). An “economy is not autonomous, as it must be in economic theory, but subordinated to politics, religion, and social relations” (Block 2001: xxiv). Disembedding the market from social relations has never succeeded in history for an extended

[3] The broader integrate approach considers both brokerage and closure as two important dimensions of social capital. Brokerage is about coordinating people between whom it would be valuable, but risky, to trust. Closure is about making it safe to trust. The key to creating social capital [value] is to put the two together. Bridging a structural hole can create value, but delivering the value requires the closed network of a cohesive team around the bridge.

period of time. Complete disembedding cannot take place without the destruction of society and the natural environment (Polanyi 1944 [2001]; Block 2001).

In recent past there has been a renewed interest in embeddedness, largely due to Granovetter (1985). Granovetter builds his arguments about embeddedness on a critique of the under socialised conception of behaviour in mainstream economic theory and the over socialized conception of some sociologists. Both views neglect the impact of ongoing social relations on economic transactions by focusing on atomized actors, "in the under socialized account, atomization results from narrow utilitarian pursuit of self- interest; in the over socialized one, from the fact that behavioural patterns have been internalized and ongoing social relations thus have only peripheral effects on behaviour" (Granovetter 1985: 485). Granovetter (1985) argues that analyses of economic action must reject the idea of atomized actors: actors undertake economic transactions and other activities while embedded in "concrete, ongoing systems of social relations" (Granovetter 1985: 487).

Granovetter briefly outlines two forms of embeddedness: historical (now often called relational) and structural. Historical embeddedness focuses on a dyad and is related to repeated transactions between two actors. The history of transactions along the dyad provides low-cost reliable information to the two connected actors about each other. Eventually the tie gets buttressed with non-economic factors such as trust and reciprocal obligations (Granovetter 1985). Structural embeddedness, on the other hand, focuses on the position of an individual dyad in a broader network of relations. Transactions in the dyad are then constrained and/or supported by the social structure (network) in which it is embedded. Following Granovetter (1985), a large number of studies in economic sociology have attempted to further develop the concept of embeddedness. For example in the last two decades, the concept of embeddedness has been used to explain the effect of social relations on the performance of organizations (Uzzi 1996; 1997; Rowley et al. 2000); the logic of negotiations (McGinn and Keros 2002); economic activities of immigrants (Portes and Sensenbrenner 1993); consumer transactions (DiMaggio and Louch 1998); community cohesion and solidarity (Moody and White 2003); and the role of the state in the economic development of nations (Evans 1995; 1996). Related work has focused on theoretical development of the concept of embeddedness (Zukin and DiMaggio 1990; DiMaggio and Louch 1998; Gulati 1998). Despite this large body of work, the theoretical underpinnings, and conceptual clarity, of embeddedness in economic sociology however has remained weak (Portes and Sensenbrenner 1993; Fine 2001; Krippner 2001) and needs further explanation on/of structure.

Zukin and DiMaggio (1990) have used a broad theoretical foundation to discuss embeddedness: in addition to being embedded in social relations, economic action is viewed as being contingent on human cognition, culture and political institutions. Cognitive embeddedness refers to the "ways in which structured regularities of mental processes limit the exercise of economic reasoning" (Zukin and DiMaggio 1990: 15-16). This type of embeddedness is related to the

concept of bounded rationality which forms one of the cornerstones of evolutionary economics (Nelson and Winter 1982). The second, cultural embeddedness implies that economic behaviour (rationality) and market exchange is shaped by cultural factors such as norms, beliefs, rituals, ideologies, and shared understandings of the real world (Zukin and DiMaggio 1990; Polanyi 1977; Block 2001). The third, political embeddedness, refers to "the sources and means of economic action that reflect inequalities of power" (Zukin and DiMaggio 1990: 20). Here, economic institutions and behaviour are considered to be shaped by a power struggle involving economic and non-economic actors and institutions such as the state and social classes (Zukin and DiMaggio 1990). This type of embeddedness has been extensively studied by political economists and the old institutionalists (Commons 1924; and Davis 1949; for recent syntheses, see Scott 2001 and Parto 2005). The final type of embeddedness outlined by Zukin and DiMaggio (1990) ties in with Granovetter's (1985) focus on structural embeddedness of economic action in networks of social relations. Our focus in this paper is largely on this type of embededdness.

Structural embeddedness distinguishes between non-anonymous, non-market (embedded) exchanges that take place between social contacts or acquaintances and market (arms-length) transactions that are rational and impersonal (Uzzi 1996; 1997; Uzzi and Lancaster 2003; Krippner 2001). Since few transactions happen in isolation from others, the focus is a network of transactions. In theory, this network of transactions is embedded in a corresponding network of social relations. And in the case of embedded transactions, as opposed to arms-length ones, all traceable economic transactions simply double as social ties are characterized by non-economic factors such as trust, respect, and long-term reciprocity. There is a possibility that some economic transactions may be governed by other forms of non-economic factors such as unequal (bargaining) power, conflict, and lifelong dependence rather than trust or mutual respect. Thus in a general formulation, that recognizes a range of often-contradictory non-economic factors, one can only talk about the degree of embeddedness of economic transactions in certain types of social relations, such as those characterized by trust and respect, or unwanted obligations and dependence, or simple indifference.

Social Capital in Indian Agricultural System - Conventional Framework of People-Private and People –People Network System

By nature social capital and intellectual capital are intertwined [particularly in the context of social and knowledge networks]. Social capital promotes growth of intellectual capital and in turn available intellectual capital in a network advance social capital by attracting more actors to the network structure. In general the network among rural farmers is of three different types. The first network, problem-solving knowledge flows, {usually shows the nature of knowledge creation and diffusion in the community}. The second network involves farmers' business transactions with others, the farmers' present structure of dependence (or counter-dependence) on middlemen and farm-inputs suppliers. The final one is network of social

relations that focuses on close kinship and friendship ties. It usually involves socio-political activities of the farmers and the power structure in the community.

Generally of all the circular processes in a network, the dominant core is the one with the highest density of internal links. Often powerful actors who drive socio-economic and technological activities of the community are members of the dominant core, coupled with sources of power. Our field investigations at many villages in Northern India highlights that, in the absence of channels that bridge structural holes rural farmers largely depends on voluntary organizations for intellectual capital. Voluntary organizations in this context recommend use of a few available methods (or practices) to promote innovation among the practioners. Promoting innovation capacity the voluntary associations work closely together with the farmers and enable farmer-led innovation. Usually in such occasions the voluntary organizations identify progressive farmers and train them. To extend further support occasionally they station a voluntary organizations representative in the village for mobilizing farmers and providing ready assistance to farmers. Whenever possible voluntary organizations publish new practices or other things on vernacular language and circulate them among the local farmers. In people-private network locally available farmers' existing intellectual capital [knowledge base] is used as resource to create social capital.

Under the conditions of absence of a voluntary organization in the locality farmers commonly depend on local pesticide dealers largely for knowledge access. When the knowledge gained from the pesticide dealer does resolve farmers' issue of concern they often aggravate the condition. For example: afraid of losing their crops, farmers go for spraying greater quantities of pesticides to no avail. This form of people-people network results pesticide treadmill and debt trap for farmers due to high cost of cultivation (Ramanjaneylu et al. 2004). The debt trap is exacerbated by farmers' dependence on the local pesticide, fertilizer and seed dealers (very often the same person -all in one dealers) for credit and marketing of their crop. The problem degenerates when marginal and small farmers are refused loans by banks and have to borrow money at high interest rates from local moneylenders. Hardly this form of network helps enhancing farmers' social capital.

The alternative people-people network that farmers constitute in the absence of a mediating agency is of farmer-farmer linkage. In this kind of arrangement farmers uses locally available community knowledge as resource for developing social capital. The farmers living in such structures either follow the traditional practices that are common and stable, in this way they reuse the existing intellectual capital of the community. Sometimes they also do need based experimentation and share their knowledge following rules of "words of mouth" in physical space. They share their knowledge with other local farmers including those visiting farmers from nearby localities. The social capital generated in this way is limited and restricted to a particular region. Advantage is available to the farmers who are in physical proximity of the region. The benefits of this kind of people-people network are twofold – first it reduces

dependency of the farmer on "all in one dealer," there by reduces the risk of being exploited and advances development of village economy. Secondly it promotes generation of intellectual capital that is local and indigenous. The disadvantage with this model lies largely in its structural arrangement. Most of the innovations taking place under such arrangements are personal initiatives. There by pace of knowledge generation is slow. As stated earlier the advantage generated in the network is available largely to those actors who are members of the community or in physical proximity or visit them because they have social links.

Social Capital in Indian Agricultural System - Conventional Framework of People-Public Network [Extension System]

People-Public Network in Indian agricultural system follows a top down approach to intellectual capital building among farmers. People-Public Network is commonly known as extension education [service] system or "training and visit" (T&V) approach. It aims at the process of linking researchers (and other innovations) with potential users of research results. The focus is on "transfer of technology" from the expert to the user. Usually the extension staffs persuade the farmers and other practitioners to adopt a new way developed by domain experts.

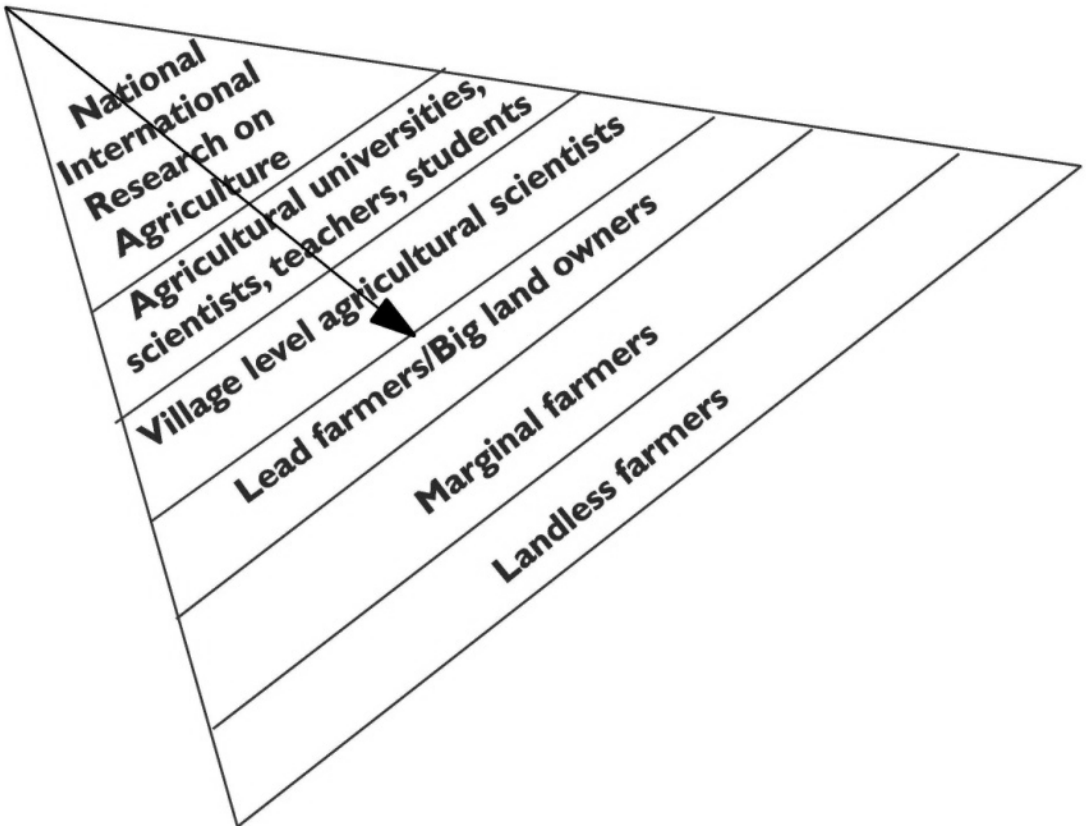

Fig.5.1. Vertical Extension Service of Agricultural System

People-Public Network attempts to streamline the traditional extension system through three kind of extension: (1) concentration on a few "contact farmers" [big and lead farmers]in a service area, (2) concentrating on agricultural matters exclusively and (3) concentrating on a few practices during each regular visit of village extension worker (Colle 2008). A dominant assumption of the system is that individuals will adopt new practices and technology "if only they understand what is advocated and know how to carry it out" (Andreasen 1995). In this way it carries its own pitfalls – it ignores farmers' perception of their needs. Thus fails to detect mismatch between farmers' needs and those presumed by the researchers. In addition the reach of the extension is severely limited because of its concentration on a few big and lead farmers (Fig.1). The concentration on a few big and lead farmers of the extension system is to increase success rate of the new practice or knowledge. In this way marginal, small and landless farmers are permanently isolated from the innovation capacity building process of the agriculture extension system.

Studies from India highlights the following features of contemporary agriculture extension system (Colle 2008):

Direction of information flow: Information is supplied from top to bottom and centre to field.

Relevance of information: Information often is not relevant because of the mismatch between scientists' perception and farmers' expectations about reality.

Character of agricultural information: The message tend to be narrowly suited to production of few particular commodities rather than farmers concern

Overall character of extension information: Extension service packages largely concentrate on technical and production aspect of agriculture ignoring the whole farmer.

Clientele: Extension services focus only on particular agricultural populations (big farmers).

Control of the system services: The agenda of extension services are controlled by managers and scientists to the exclusion of being farmer centered.

Method used to reach farmers: A greater emphasis is on face to face contact, with little attempt to integrate communication media.

Cost of the system services: A labour intensive face to face extension service delivery system is very costly to sustain.

Lack of results: There is no significant evidence to support the claim that T&V extension service system is increasing agricultural productivity.

Inadequately trained extension agents: Extension personnel tend to be trained in technical areas but have not been effectively trained in communication.

Incentives for extension personnel: There are few incentives beyond monetary rewards to perform at the level expected by the system.

Evaluation and Monitoring of extension: Better training, planning and computerizations are necessary to effect better monitoring.

Extension funding: Extension is underfunded and that results in unfilled extension lines which results in inadequate coverage for farm population

Linkage to research: The link itself is weak, and where it exists at all, the relationship tends to be dominated by scientists.

Such practices in the IAES reflect ongoing practice of inadequate information flow reflecting self-interested data distributed by those with the most power and resources. In contrast there is a need to develop service delivery system in a way that can promote intellectual capital of the practioners, thereby growth of social capital. This then can facilitate the advantage that constitutes contemporary knowledge and the concurrent ideological consciousness. We assume that contemporary People-Public Network in agriculture in India represent modes of oppression emerging from dominant power in built in the structure. It is a form of intellectual capital that carries experts' dominant view and ignores those that is generated locally and indigenous. Much to owe of farmers it is cost- intensive [often involves high technology and new science and both are cost intensive] and are often out of reach. This structural arrangement supports farmers in building social capital only in little way.

Innovation Capacity of Farmers and the Knowledge Network Structure in Indian Agriculture System

Innovation capacity is key to intellectual capital and in that sense to social capital. Farmers innovation capacity broadly refers to: (1) the "degree" to which a farmer used the set of new practices, (2) experimentation by a farmer to devise new, or modify existing, practices and his attempts to share results of the experiments with others, (3). sustainability of a new practice adoption by a farmer. Frequent use of one or more of these implies increased innovation capacity. Innovation capacity of individual are embedded in their knowledge networks. Thus knowledge sharing among farmers is essential for building sustainable innovation capacity among them.[4] Our field visits, interaction with KVK experts and farmers in Northern India points out that innovation capacity of Indian framers is limited and constrained.

[4] The diffusion of transferred knowledge and its integration with the recipients' knowledge through experimentation are commonly used to define innovation capacity in a range of literatures (Cohen and Levinthal 1990 and Almeida et al. 2002; and Hall et al. 2004).

A central feature of the agricultural innovation studies of the last two decades is on innovation through interaction. As discussed above the knowledge interaction of Indian farmers include farmer-to-farmer knowledge flows, exchange between farmers and other agricultural actors, and interactions between a diverse set of off- farm actors. Therefore, understanding the innovation capacity of a farmer requires paying attention to their connections with actors such as other farmers, suppliers of agricultural inputs, civil society organizations, extension workers and experts and state departments/organizations.

A common feature of Indian farmers' knowledge network is that, it includes at least one voluntary organization representative (if available) or pesticide dealer. The direction of the knowledge flow is from voluntary organization representative and pesticide dealer to farmers. Thus farmers themselves do not form any cores in knowledge network. The lack of a (strong) core among the farmers demonstrates the absence of sustainable knowledge flows among farmers themselves, and is primary reason for limited innovation capacity among Indian farmers. If there are KVKs within their physical proximity, the KVK experts constitute the core of the knowledge network. Thus usually farmers adapt a technology that is developed/suggested by an expert.

However knowledge network to be effective the core must be connected to the rest of the network (here farmers). In the farmers knowledge network either pesticide dealer or expert caries a wider influence due to their position as core (often as dominant core) in the network. Their structural position in the network supports them to lower the costs of farmers' switching back to them even after new practices are introduced. Core position is determined by number of circular flow between a set of nodes. Thus core position of the pesticide dealer or expert in the knowledge network implies higher interaction of them with farmers. This helps them to establish stable knowledge exchange with farmers and build trust and influence. They then use these as capitals to lower the switching back costs. This restricts adoption of a new practice unless otherwise it is suggested as good by the pesticide dealer or the expert. This leads to deficit in the innovation capacity of the farmers [i.e., sustainability of an innovation adoption].

Co-development of technology and joint problem solving requires bidirectional knowledge flows between farmers and non-farmer(s). Indian agricultural system lack two way knowledge flows between farmers and experts. This severely impairs innovation capacity concerning farmer experimentation and sharing of experiment-results with experts. Farmers for the most part played the role of passive knowledge recipients rather than active innovators and knowledge sharers in the network. As a result farmers direct involvement in building innovation capacity and building social capital becomes marginal. They remain as recipients of problem-solving advice in the knowledge network structure.

Social Capital, Social network and Embededdness in Indian Agriculture Innovation System-Current Practices and Pitfalls

An innovation system is treated as a network of actors with diverse capabilities. Interactive learning through knowledge sharing and joint problem solving among diverse actors forms the basis of sustainable knowledge creation and knowledge diffusion in an innovation system. Traditionally this interactive learning, underpinned by knowledge sharing and joint problem solving, is geographically and socially embedded (Lundvall 1992; Lundvall et al. 2002; Asheim and Coenen 2005). According to Lundvall et al., "learning and innovation are interactive processes, which depend on trust and other elements of social cohesion" (Lundvall et al. 2002: 225). They reiterate, "production of intellectual capital is strongly dependent on social capital" (Lundvall et al. 2002: 225). However, the way in which this dependence or relationship between social capital and learning operates is rarely specified in the innovation systems literature. Since learning is an interactive activity in an innovation system, it depends on knowledge flows among the actors who constitute the system.

Often in local innovation system of Indian agriculture, only a small percentage of knowledge flows are embedded in social relations characterized by trust and other facets of social cohesion.[5] Usually in rural social networks greater value of embeddedness lies in indirect social ties, compared to direct social ties, because of the greater density of the social network of indirect links (friends of friends). This implies that the structure of the social network is very different from the knowledge network in local innovation system. As a consequence effective socio-political coordination in a local innovation supported by a dense social network does not act as impetus to effective knowledge transfer among the rural farmers. Rarely people in the local innovation system access knowledge from their kin and friends. Therefore, although in village economy there exists a dense social network of kin and friends it does not provide a fertile social substratum for knowledge exchange in the system.

In terms of knowledge delivery of embeddedness it is widely recognized that the local pesticide dealer, village headman and progressive farmers are the key nodes in a village agricultural knowledge network. Thus though in principle it is possible to say that an individual with high social capital for knowledge access may also have high social capital for knowledge delivery, in practice they differ. Social capital for knowledge access just shows how well an individual is situated in his/her social network to access knowledge for agricultural practices. The delivery side of social capital in contrast is akin to power: it refers

[5] Embeddedness of knowledge flows is of types of social ties-direct and indirect (two-step) ties. The first refers to access of knowledge directly from one's friends and kin, and the second from friends of friends (or kin of friends, etc.).

to an individual's potential control over others' livelihoods through provision of a useful resource for productive activities.

By practice in Indian agricultural knowledge network large amount of knowledge flows take place among farmers and whom farmers known as "experts" [a pesticide dealer, progressive farmers, KVK experts, voluntary organization representative and village headmen] who are generally not socially tied with each other (either directly or indirectly). Conversely, the farmers' extensive networks of social ties do not act as a foundation for knowledge sharing and learning. In other words, social capitals characterized by trust and solidarity [strong ties] do not play a significant role in the provision of knowledge in the local innovation system. This significantly constrains both the production and availability of intellectual social capital in agrarian social structure. Irrespective of their high embeddedness in the village structure, Indian farmers fails to transform the available knowledge bits to intellectual capital because of four reasons [this malfunction obstructs growth of social capital]:

First, successful learning communities possess routines that root useful knowledge in daily practices and habits (Brown and Duguid 1991; Amin and Cohendet 2004). Knowledge related to new practices [developed by experts and others] are not ingrained in the daily practices of the farmers. Within the agriculture knowledge network largely farmers depend on 'experts' such as the NGO representatives and pesticide dealers, progressive farmers, KVK experts for accessing useful knowledge. This dependence does not allow a culture of local learning to flourish in the agrarian community. Further learning was not a purposive activity in the agrarian community [people prefer to follow tradition]. The caste-based hierarchy of Indian village violates the horizontal structure of social relations considered essential for a successful knowledge-sharing community. Variety in skills and knowledge fosters knowledge sharing and innovation by allowing learning to take place along different paths suitable to individual needs and problems. Indian villages are by nature small in size. Thus the diversity of skills available in the village is also small. This hinders knowledge sharing and innovation in village community irrespective of their high emebeded social networks.

The expertise-based hierarchical relations between knowledge sources (NGO representatives, pesticide dealers, KVK experts and others including government officers) and farmers does not foster social ties among them. Very often experts consider themselves as possessors of superior knowledge than the farmers. There exists a wide gap linking the 'expert' knowledge with the 'practitioner' knowledge of the farmers. It is not only profound in the technological arena but also reflected in the social relations among experts and farmers the farmers. Social ties bridging the vertical divide between experts the farmers are largely absent in village social structure, creating little 'social space' for linking social capital for knowledge to flourish.

In this context Information and Communication Technology (ICT)[6] provides an opportunity to enhance the service dominant co-creation, bidirectional knowledge production and more relevant delivery in the extension system by providing a set of tools and techniques that are interoperable and easy to use. The current extension services demands the participatory model that incorporates the concept of integrating multiplicity of approaches. It stresses the importance of everyday practices of local communities and of democratization and participation at all levels. It points to strategy, not merely inclusive of, but largely emanating from, the traditional "receivers." It refers to what Paulo Freire has suggested as the right of all people to individually and collectively speak their word (Freire 1970).

Social Capital in Indian Agricultural System – The Emerging Framework of Multidimensional Coordination [ICT Model]

ICT mediated development projects, largely depend on 'social contexts of design, implementation and use' (Synder and Rosenbaum 1999). The 'contextually dependent nature of ICT's suggests that similar ICT's can have different outcomes in different situations' (Kling et al., 1998). Thus, the 'social context' is the fundamental premise in understanding the relationships between people, ICT and digital information, and the setting in which these relationships evolve.

A person's role and normatively expected behavior cannot be understood in isolation, but only in terms of his relation to wider community. It is this societal sanction that induces trust-members transacting with a particular individual, will process information about her/his role (normatively expected behavior) with reference to the social network he is part and then decision to trust. Portes (1998), observes that, for individuals 'whereas economic capital is in bank accounts and human capital is inside their heads, social capital inheres in the structure of their relationships' The importance of social networks is best exemplified in interesting paradox remarked by Granovetter (1985), according to him social capital, manifest in social networks, can make transactions that can't happen in a free make possible, by lowering the transaction costs – costs of information collection, monitoring, negotiating and enforcing. The role of information communication technology can then primarily be to enhance this social capital. An ICT intervention provides the community both wider and richer access to information. Greater infusion of information into social networks depends heavily on computer technologies. The use of ICT does shape the social structure by engaging the actors in a continuous process of dialogues and discussions. The internal propensity of the community engaged continually organizes and reorganizes the structure through an autopoietic mode of discursive formation

[6] ICT – Information and Communication Technology

while maintaining its boundary. The process of organization and its internal dynamics are structured by the social capital that it generates in a network through trust based relationships.

As discussed earlier a thick kind of trust, in which members have high degree of confidence in others role expectations is found mostly in stable and structured communities, such as agri-communities. Such communities have been known as Gemeinschaft. In contrast a thin trust with a goal oriented behavior exists in communities which Toennies called Gesellschaft (Adler and Heckscher 2006). For knowledge networks and communities which are like Gemeinschaft we have to enhance evolutionary growth conditions for social capital through trust based relation enhancing system [of ICT based tools and technologies].

It has been observed that when knowledge structure is fluid or random face to face (F2F), mobile nets, interactive radio and TVs act as successful; modes for generating social capital in a trust based relationship environment. In contrast when the nature of knowledge is explicit social capital depends on dynamic mode of knowledge sharing (Fig.2).

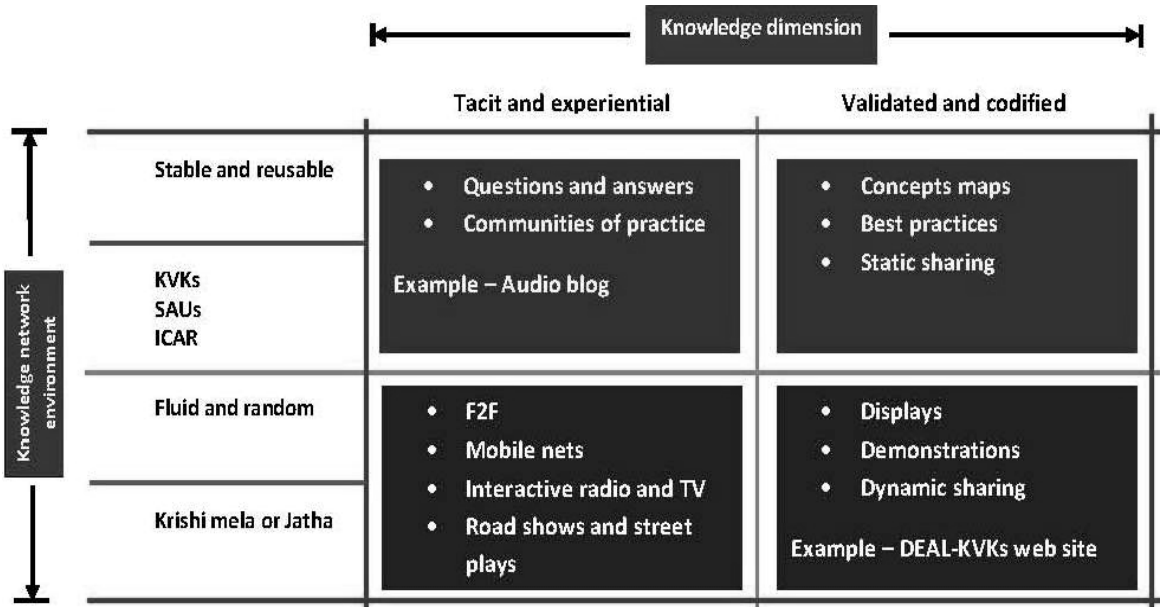

Fig. 5.2 Dialectics of Knowledge Network and Knowledge Dimension.

Key aspects of the 'diffusion of innovation' processes are thus the 'dialectic interaction among the 'innovation itself', the 'social system' in which the innovation is introduced and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes. The communication is maintained through circularity, organization and reproduction. Thus the goal framework in the Digital Ecosystem for Agriculture and Rural Livelihood (DEAL) project focused on interoperability and real time

interaction/communication. The agenda was to build an practice based knowledge network whose interaction e.g. Krishi Vigyan Kendra (KVK) scientists and farmers create new social capital i.e., social and knowledge based relationships.

Social Network – Theoretical Debates and Insights

Roughly there are two models in social network - Ising models, and random graphs.

Isging Models- In Ising model agents are located at fixed points in a regular integer space, for example at the integers on a line or at integer coordinates in Euclidian two-dimensions. Agents are directly connected to their n nearest neighbours in the physical space. These structures are often called nearest-neighbour networks or graphs. The networks are clearly very regular, and have high levels of local coordination, and typically, are locally very dense. They do, however, have relatively long average paths between pairs of agents. The general model was developed in 1925 (Ising, 1925) to study ferro-magnets, and therefore its analytic properties are relatively well-understood. In economics it has been used to study a wide variety of situations: macro dynamics (Durlauf, 1993); technology diffusion (Allen, 1982, or An and Kiefer, 1993); criminal behaviour (Glaeser et al. 1996); the effectiveness of prices (Föllmer, 1974). This work all takes advantage of the fact that in the Ising model local interactions are very neatly defined and only distance, between locations, rather than absolute location matters. Nonetheless, complex patterns of aggregate behaviour can emerge from local interactions.

Random Graphs - At the other extreme of network structures, economists have used random graph models to study, for example, coalition formation (Kirman 1983, or Ionnides, 1990); technology diffusion (Steyer and Zimmermann, 1998), learning (Ellison, 1993); strategy revision (Blume, 1995). In these graphs, any agent is connected with some probability to any other agent in the population, regardless of location. Consequently, the networks that emerge have no spatial patterns in the space in which agents are physically located. An alternative interpretation is that agents are not located in physical space, but rather only in network space, so any notion of distance is only distance in the network. In addition, there is essentially no local coherence, and generally graphs are not locally dense, even in network space. On the other hand, random graphs are known to have low average path lengths: the path in network space between two agents is, on average, low.

From the point of view of knowledge creation and diffusion, the focus on these ex- treme forms of network structure, draws attention to the contrast in the properties of local density and path length. It is often asserted that innovation is facilitated by agglomeration of human capital. A location in which many agents are working on related issues creates a critical mass of knowledge workers so that they become an epistemic community, in which a common language emerges, problem definitions become standardized, and prob- lem solving heuristics emerge and are developed. In this type of situation, Marshal's idea that knowledge is in the air applies

strongly. Agglomerations having these features foster innovation. (See the empirical studies referred to above.) Applying the network model, this situation is present if the network of agents exhibits high local density, or equivalently high "cliquishness". That is, if there are (relatively small) groups of agents who are closely and heavily interconnected. As we have seen, this is true in a nearest-neighbour graph, but not in a random graph.

By contrast, knowledge diffusion is most rapid when path lengths are short. Diffu- sion is about spreading a piece of knowledge to all agents in the economy, and this will happen fastest (and with least degradation) when it takes few steps between the originator of the knowledge and its recipients. Short path lengths, associated with the random graph structure make this happen most quickly.

Thus there appears to be a tension between knowledge creation and knowledge dif- fusion. The tension is resolved by the network structure known as the small world. This is a network structure which is at the same time highly cliquish and with short paths between agents. It lies between the nearest-neighbour network and the random network.

Small Worlds **-** Economists focused on Ising and random graph models partly because they had been extensively explored in other disciplines, but more because there was no obvious way to characterize systematically structures that lay between these two extremes. Watts and Strogatz (1998) develop a one-parameter class of random graph models in which the parameter could be used to scale between the regular graph of the Ising model and the random graph. This is illustrated in Fig 5.3.

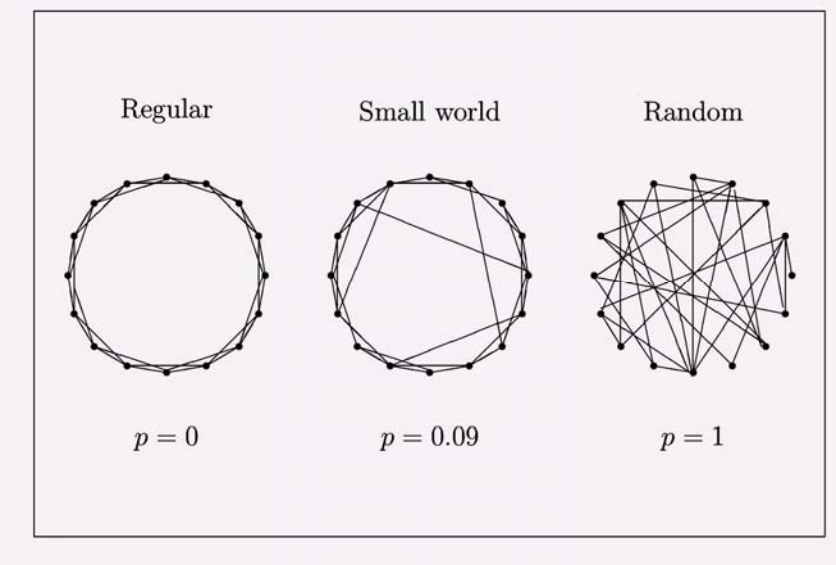

Fig. 5.3 Transition from a Locally Ordered Structure to Random Graph

Source: Robin Cowan. 2004. Network models of innovation and knowledge diffusion

Research Methodology

Field deployment of the DEAL project was between December 2006 and June 2007. Some further deployment work has been done under the OPAALS project (www.opaals.org) during 2008. We have been conducting studies among participating KVKs, October 2007 onwards. The data used in this paper are taken from the data collected during our field visits at different time intervals. For understanding vertical networks we have collected information from four participating KVKs while horizontal network data were collected from all the five participating KVKs. One KVK was excluded in the vertical network analysis as during the period of data collection it was only participating in the horizontal information sharing.

Knowledge Network and Social Capital

Social Capital – Agents, Closure and Embededdness in People-Public and Private Network [Pre DEAL]

The positions of actors in the network are based on their roles. The network shows the information flows within a community and across communities. Here, the community is understood in terms of the village unit. So, within community linkages are those between actors in the same village for e.g.; between the farmer of a village and the respective village KVK while across groups' links include links between actors from different villages – e.g. the link between farmers of different villages. By the strata of operations classification, information flows between members of the same functional role also qualify– CSA Agricultural University is a member of the educational institutions group, KVKs are part of the villages' level functionaries, and the Zonal Coordination Unit (ZCU), ICAR are all implementation and monitoring agencies. The network diagram shows different sources of agricultural information and the interrelations, both formal and informal, between them.

Formal links are characteristic of the reporting relationship between actors – for instance, in the case of a KVK and the ZCU, and informal links are characteristic of the social relations between actors – like relations between farmers of adjoining villages In a network the reporting relationships between members consists of different layers – administrative, academic and functional. It is found that while there are well established and clearly defined relationships between members from the different layers, there are very few formal ties between the 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 four KVKs. Communication is routed through the ZCU, and is conducted F2F at periodic zonal meetings (Rajagopalan and Sarkar 2008).

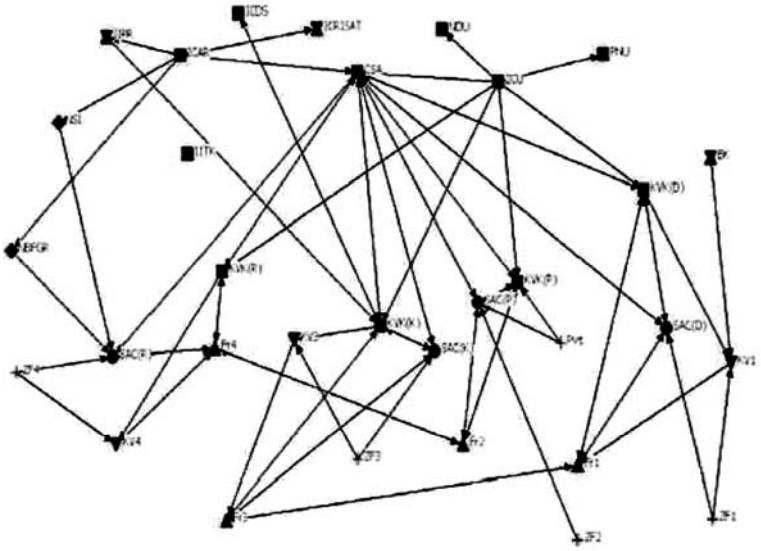

Fig.5.4.Network Ties before DEAL

In the pre-DEAL scenario, except for the informal links between farmers of neighboring villages, the other links represented in the network are structurally determined. There are very few reciprocal ties between members of the same layer – for instance, the links between Pant Nagar Agriculture University (PNU) and Indian Institute of Pulses Research (IIPR) are both indirect and non-reciprocal (Rajagopalan and Sarkar 2008). As we have discussed earlier this restricts the growth of social capital in the agricultural knowledge network. A greater amount of knowledge generated is of individual effort. People follow approved ways of doing thing there by making closure to function in a limited way [as applicable to different sub-network that exists in the knowledge network structure]. Furthermore embeddednes as discussed earlier remains social and does not transform to social capital due low physical interaction among different sets of actors. For example social embededness of the farmers' results in social interaction of farmers in a given community, it rarely expands further to include KVK expert, government official and other specialized groups working in agriculture. As a result it neither adds value to the existing capital nor provides much advantage to the actors in the network.

Social Capital – Agents, Closure and Embededdness in People-Public and Private Coordination [Post DEAL]

Fig. 5.5 represents the ties after implementation of the DEAL project. IITK (through DEAL project) is the actor introduced to the existing network. Its integration to the network is represented by the arrows between it and other nodes, signifying an increase in information accessed.

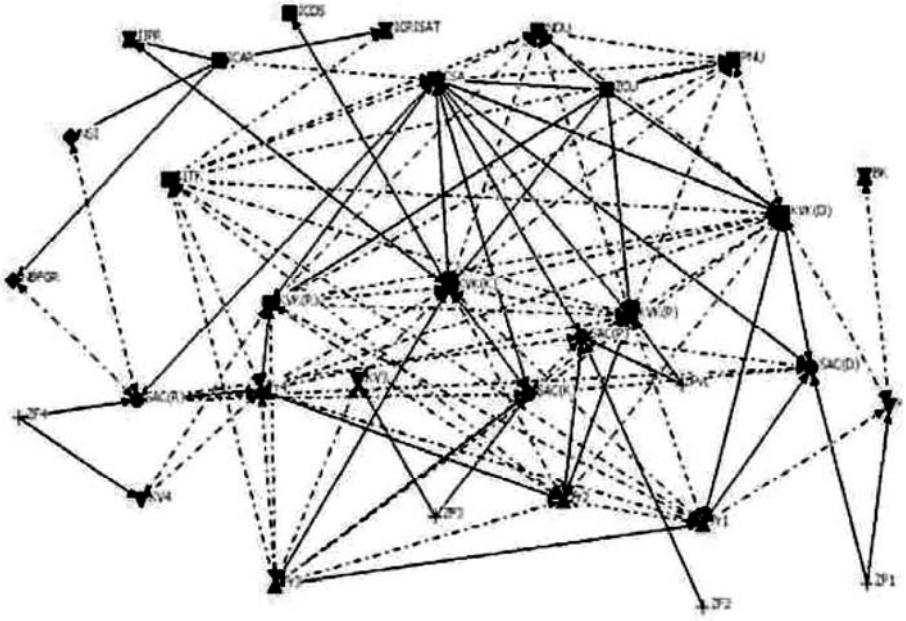

Fig.5.5 Network Ties after DEAL

The dotted lines represent ties that have been formed due to co-creation and sharing by various agents [facilitated by DEAL], while the solid lines represent the pre existing network ties. By implication, ties formed through DEAL are mostly weak links. These are voluntary clusters of members who are from different groups. Groups in the network can be understood at two levels – one, at the geographic level, which consists of members of different types (farmer, KVK, research institute) at a specific location, and the other is related to functional relationships. These could include academic ties, administrative reporting relationships (financial flows) or operational ties, for example, between KVKs. Linking together all the actors in dynamic relationships helps retain both strong and weak ties. The total number of ties increased from 77 to 183, and no old ties were displaced.

What was observed was that several weak links were introduced between existing nodes, signifying greater interaction (and hence innovation), and a deepening of community relations. This implies that there is an increase in intellectual capital in the network structure- which also suggests that there is an improvement in the social capital. From this it may be appropriate to say that ICT intervention led to the enhancement of social capital.

Social Capital – Agents, Closure and Embededdness within Public Network [Pre DEAL]

Here we have removed people [farmers] from a public network [KVK system] and made an attempt to understand the process of intellectual capital generation in it. We hypothesize that under current scenario of the agricultural extension system, KVK experts represent the farmers. Therefore understanding of their social network will not only shed light on how experts benefit from the advantage of social capital but will give some ideas about the agriculture community in general. Furthermore digital technology is yet out of reach of majority of the farmers. In practice the KVK experts are the real users of the technology so far. They generate collective knowledge by participating in digital architecture and then disseminate them to the farmers at physical space. Involving people [farmers] will then likely to mislead the interpretation of ICT use in present context.

When there are no digital enabled communication channels available, the KVK experts' network is bounded to their subgroups, i.e. there interaction is limited to physical space and proximity. In these situations hardly they have opportunities to know about other experts' contribution to existing knowledge base beyond the subgroup to which they belong.

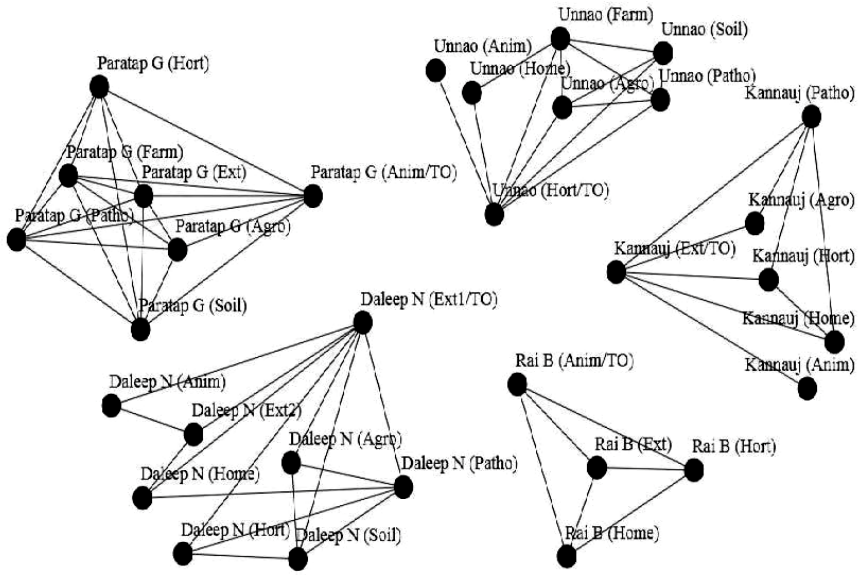

Fig.5.6. Network in Pre DEAL

Within their respective KVKs the experts also have information sharing with other experts in a narrow sense of sharing [largely depend on their domain expertise and their practical need]. For example at KVK at Dhaura all the experts have reciprocal relationships with the SMS of

horticulture as he was the administrative head of the KVK, where as in terms of actual intellectual content generation hardly they have any reciprocal relation between one another (Fig 5.6). Similarly in pre DEAL scenario experts of animal husbandry and home science are isolated actors within their subgroup. Experts of agronomy, plant protection (plant pathology), farm management and soil science have unitary mode of network relations. These forms of relationships hardly meet the rising need of the knowledge requirement of the experts in the present context of the rapid changes that occurs in agricultural technology. The lack of links and reciprocity among experts of different KVKs also reflects the current top-down approach of knowledge dissemination in Indian agricultural extension system. The network clouser are the mandatory rules of the organization and mutual trust. As actual intellectual capital formation do not occur it also do not foster growth of social capital. The network density for the five KVKs we studied is .119 in pre DEAL scenario.

Social Capital – Agents, Closure and Embededdness within Public Network [Post DEAL]

Studies in network architectures suggest that centralized networks are ineffective modes of interaction for information sharing (Fahey and Prusak, 1998; Markus, 2001). In contrast to it a participatory bottom-up approach allows information sharing and communication more effectively. Thus facilitates generation of intellectual capital. This is where the DEAL has played a crucial role.

The DEAL aimed to create social networks among different experts of KVKs by linking one to other through digitally facilitated knowledge architecture. The idea was that an ICT facilitated social network aimed at intellectual capital carries greater potential of social capital than conventional mode of interactions. The Digital Ecosystem (DE) design of the system places special emphasis on voluntary participation, and as more members access the network the number of ties increases, which eventually lead to generation of intellectual capital and in that process enhance social capital of the community.

Fig. 5.7 shows the network relations developed among various experts in post DEAL scenario. The network density for post DEAL scenario is .6279; and total number of links in the interactional space is 628. Literature in knowledge management and communities of practices suggest that normally people in a structured Communities of Practice (CoP) come from background having shared knowledge or shared belief system. In these kinds of structural arrangements often people gets benefit of the facility that is available through structural resources and positions (Baalen, Bloemhof-Ruwaard, and Heck 2005). In contrast to it on the other hand information and communication builds a different kind of network i.e., a network of practice (NoP) by challenging the established normative structure through discursive interaction of different communities (Pattanaik and Chatterjee 2008).

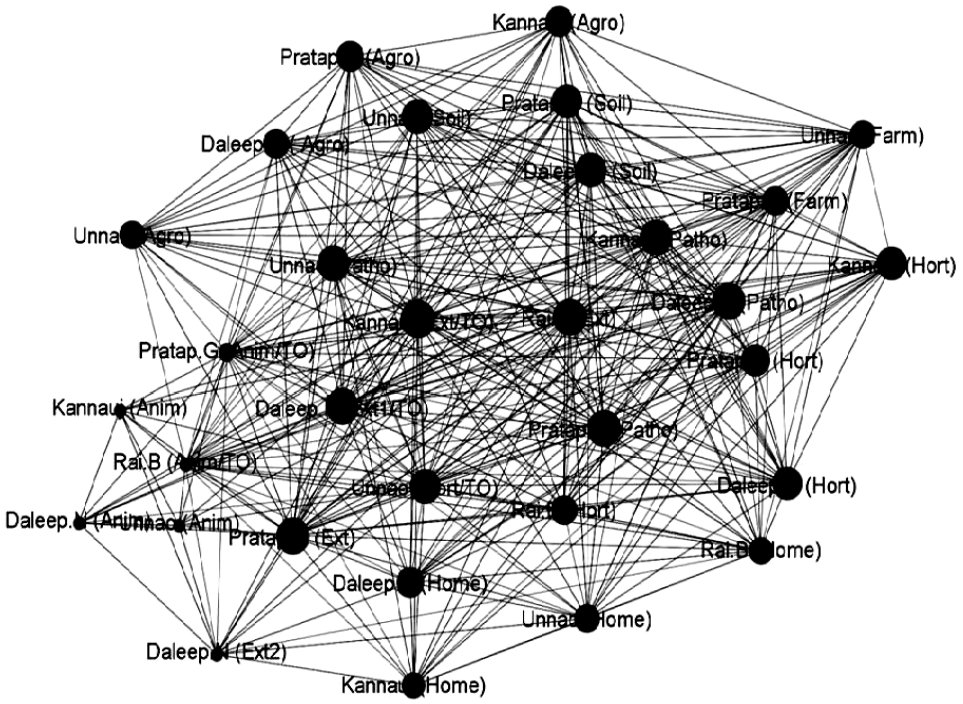

Fig.5.7 Network in Post DEAL

The network closure is the voluntary participation, mutual trust, respect and obligation to share. As interaction between different actors expands, they network closure binds them to the mode of generating intellectual capital. One of the reasons that successfully binds them to generate intellectual capital is what Krackhardt (1992) describes as ‘‘philos’’-relations, the history of interaction with others binds them in emotional affection for one another. Being member of a knowledge network members express their concern and affection to one another by adding value to one another’s knowledge base. And in this way they generate intellectual capital unconscious of their awareness. In return in a cyclical operation it enhances their social capital. Unknowingly and voluntarily they fill the structural holes in trust-relationship based framework. DEAL as a socio-technical mediator facilitates the unconscious and amazing modalities of intellectual capital generation and social capital building through a continuous process of dialogues and conversations. A network of ongoing conversation exhibit inherent circularities and self amplifying feedback loops. The closure of the network results in a shared system of beliefs, values and possibly praxis, a context of meaning that makes the system self-regulating and self sustaining, in a word autopoietic. Network closure then is social capital for autopoiesis in digital ecosystem.

Conclusion

Usually the network around each person is like a broadcast system transmitting narratives of personal accounts stories to a set of audiences. Signal about personal behavior multiplies as it spreads in narratives. This then builds trust and respect for the person in question in a given network.

The DEAL has been able to create a network of relationship among various experts that fosters intellectual capital generation. There is a constant knowledge exchange among both within the groups and between groups both at horizontal and vertical level. This has been done by creating a platform for different KVKs to share their extension experiences with each other through digital mediated social interaction.

It is argued that random networks as it was observed among KVK experts in post DEAL scenario are good for knowledge generation. A space in which many agents are working in cross cutting relationships and on related issues creates a critical mass of knowledge workers. This does not depend on path lengths of the network. For knowledge diffusion to occur paths lengths should be short. Diffusion is about spreading a piece of knowledge to all agents in the economy or social structure. This happens fastest when it takes few steps between originator of the knowledge and its recipients. Thus regular networks are best suited for knowledge diffusion. This phenomenon has renewed our interest in understanding of regular and small world networks that promote knowledge creation and knowledge diffusion, which requires a new set of observation and research.

As discussed earlier when knowledge structure are fluid and random, F2F or P2P encounters like street plays, interactive radio, TV and road shows are success modes for knowledge diffusion. These mostly refer to social interaction within the physical space. Thus successful knowledge generation and diffusion depends on the intermixture of digital with physical. This will then help in transforming the spectators [people who are at the bottom] to become active participants. For grass root innovation we need to develop new tools and methods that will enhance human skill (techno-readiness) of those who are at the bottom of social structure (Prhalad, 04; Amartya Sen, 99). DEK at the present stage of grassroot capability in rural India then should complement physical and F2F/P2P knowledge diffusion systems to establish long term viability and self-organising characteristics.

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