Knowledge Management

An MSc Course Module (Revised)

For

Agricultural Information and Communication Management Program

Open Education Resource

Prepared

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Contents

Chapter 1: Introduction

Objectives

By the end of this chapter, students are able to:

- Make distinction among data, information and knowledge
- Indicate how tacit and explicit knowledge are interrelated and differ

1.1 The concept of knowledge management

Investment in agricultural education, research and extension in Africa are crucial in generating knowledge to achieve the critical objectives of ensuring food safety and conserving the environment thereby reducing poverty and enhancing social and economic development. To realize these objectives, there is a need to learn how to learn and act which makes investing in knowledge management a crucial move. Therefore, one can simply raise the question "what are the steps involved in the generation of knowledge?" We can start from making a distinction among data, information and knowledge. Knowledge necessarily implies a process of assimilation and transformation by the human mind. A data base can contain information - that is, organized data - but for this data to become knowledge, it must be appropriated and confronted by reality. Availability of data does not necessarily mean there is information. Data can be converted into information if we are able to observe relationships. What makes a collection of data information is the understanding of the relationships between the pieces of data. While data are contextually interpreted, they do not tell how current information is going to change or be applicable in the future.

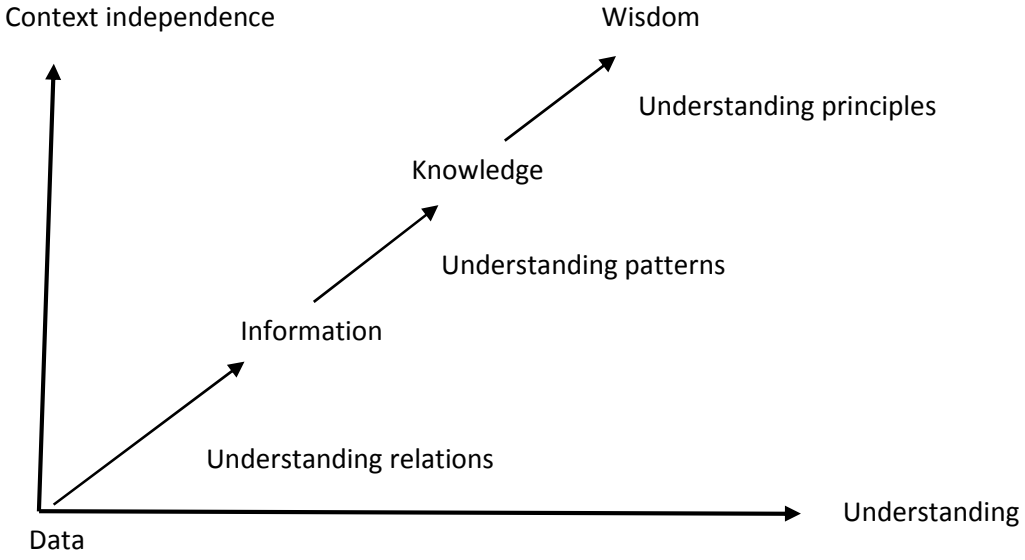

Figure 1: Conceptualizing progress from data to knowledge (based on Uriarte, 2008:2)

For instance, some authors make distinction among the three in the following way: while information is usually defined as: “organized data” or “data endowed with relevance and purpose” or “interpreted data”, knowledge is true and justified belief where it can only reside in one’s mind and is the result of human experience and reflection based on a set of beliefs that are at the same time individual and collective (Drucker, 2001).A further processing of information together with other information will help generate knowledge where this involves understanding patterns. And when one is able to realize and understand the patterns and their implications, then this collection of data and information becomes knowledge. But when such patterns are fully understood, we will realize a high level of predictability and reliability how these patterns will change or evolve over time. Then we will understand principles and develop our wisdom, which now becomes context independent (Uriarte, 2008).

There is a need to make a clear distinction among data, information and knowledge based on the existing literature. Knowledge is very distinct from data and information. Whereas data are a collection of facts, measurements, and statistics, information is organized or processed data that are timely (for example, inferences that can be made from the data collected within a specified time frame to ensure its applicability) and accurate to indicate its reliability and originality (Hoffer, Prescott and McFadden, 2002; Watson, 2001), but knowledge is information that is contextual, relevant, and useful to undertake action to solve a particular problem.

Expressed simply, to know is to construct categories of thought with which one can appraise the world, making its interpretation and transformation possible. Knowledge management (KM) may also be defined simply as *doing what is needed* to get the most out of knowledge resources. Knowledge management is also a set of processes that seeks to change the organization's present pattern of knowledge processing to enhance both it and its outcomes.

Knowledge management is also a process that helps organizations identify, sort, select, organize, systematize, disseminate, and transfer important information and expertise that are part of the organization’s memory and that typically reside within the organization. The information technologies that together make knowledge management available throughout an organization are referred to as a knowledge management system (Smith and McKeen, 2003).

It focuses on organizing and making important knowledge available, wherever and whenever it is needed. Knowledge management (KM) has been the subject of much discussion over the past decade. Organisations are often told that they will not survive in the modern Knowledge Era unless they have a strategy for managing and leveraging value from their intellectual assets, and many KM lifecycles and strategies have been proposed. However, it has become clear that the term "Knowledge Management" has been applied to a very broad spectrum of activities designed to manage, exchange and create or enhance intellectual assets within an organisation, and that there is no widespread agreement on what KM actually is. Knowledge management involves IT applications that are termed as "knowledge management applications", ranging from the development of highly codified help desk systems to the provision of video conferencing to facilitate the exchange of ideas between people.

One fact that does seem to be agreed on is that different situations require different knowledge management strategies. But the range of different "Knowledge Management Strategies" on offer can be confusing and it is often unclear where to begin in choosing a strategy for a particular situation. Knowledge Management can be recognized as a process where the aim is to increase, renew, share, or improve the use of knowledge represented in any form of intellectual capital including structural, human and social (Seemann et al., 1999). Although various forms of knowledge classification might exist in the literature, the popular one is to classify knowledge as either *explicit* or *tacit*, and either *individual* or *collective*. Another classification comes from the work of Boisot (1998) where he considers knowledge as assets that can be located within a three dimensional space defined by axes from "non-codified" to "codified", from "concrete" to "abstract" and from "undiffused" to "diffused". Similar distinction has been made as: "Tacit knowledge is that stored in the brain of a person. Explicit knowledge is that contained in documents or other forms of storage other than the human brain. Explicit knowledge may therefore be stored or embedded in facilities, products, processes, services and systems. Both types of knowledge can be produced as a result of interactions or innovations. They can be the outcome of relationships or alliances" (Uriarte, 2008: 4).

This classification involves passing through the following phases:

- *Scanning:* insights are gained from generally available (diffused) data
- *Problem-Solving:* problems are solved giving structure and coherence to these insights (knowledge becomes 'codified')
- *Abstraction:* the newly codified insights are generalised to a wide range of situations (knowledge becomes more 'abstract')
- *Diffusion:* the new insights are shared with a target population in a codified and abstract form (knowledge becomes 'diffused')
- *Absorption:* the newly codified insights are applied to a variety of situations producing new learning experiences (knowledge is absorbed and produces learnt behaviour and so becomes 'non-codified', or 'tacit')
- *Impacting:* abstract knowledge becomes embedded in concrete practices, for example in artefacts, rules or behaviour patterns (knowledge becomes 'concrete')

The above phases can actually form a cycle in the sense that once *data* is filtered to produce important *information* and such information takes an abstracted and codified form in order to generate useful *knowledge*. In the process of applying such knowledge in different circumstances, new experiences could arise but in a non-codified form that help us generate data for a new cycle of knowledge creation. The speed at which this cycle operates may differ in each sector of an economy where in some rapidly developing economic sectors new knowledge is being created and applied in quick succession, while in already developed sectors, the cycle time is much longer.

Likewise, knowledge managers also classify the knowledge management. In classifying knowledge management, the most influential and helpful classifications is based on a combination of knowledge *accessibility* (i.e. where the knowledge is stored or located and the form in which it is stored, be it electronic, print, pictorial, video) and knowledge *transformation* (i.e. the flow of knowledge from one place to another and from one form to another, from a

complex to simple to improve understanding). The classic literature from Nonaka and Takeuchi (1995) explain knowledge processes that transform knowledge from one form to another as follows:

- *socialisation* (from tacit to tacit, whereby an individual acquires tacit knowledge directly from others through shared experience, observation, imitation and so on);
- *externalisation* (from tacit to explicit, through articulation of tacit knowledge into explicit concepts);
- *combination* (from explicit to explicit, through a systematisation of concepts drawing on different bodies of explicit knowledge); and
- *internalisation* (from explicit to tacit, through a process of "learning by doing" and through a verbalisation and documentation of experiences).

The process of knowledge creation is based on the double spiral movement between tacit and explicit knowledge. This can be represented in a tabular form as follows:

Table 1: Spiral of organizational knowledge creation

	To tacit knowledge	**To explicit knowledge**
From tacit knowledge	Socialization	Externalization
From explicit knowledge	Internalization	Combination

Knowledge can be shared and help in undertaking collective interest. In sharing this knowledge, information and communication technologies play a central role since they constitute the space where diverse types of knowledge interact in order to develop productive processes. Such interaction will be discussed in the chapter dealing with comparison of indigenous and scientific knowledge later on. To capture knowledge through different ways, there is a need for proposals and strategies to be designed for knowledge management that may arise from forming an automated systems such as creation of data bases which will help in organizing people's knowledge in the areas of agriculture, business, health and natural resource management.

In many parts of Africa, a very few extension and research institutes have been proactive in exploiting advances in communication and information technology, for example by using them to establish links to each other, to the outside world and to farmer organizations (FAO and World Bank, 2000). This document identifies three areas of progress in connection with the advances in agricultural science and the way knowledge is generated. This includes:(1) the changing relationships between governments and people where economic liberalization, decentralization and democratization have altered the way services are provided and knowledge is diffused; (2) the revolution in information and communication technologies where information is shared widely, quickly and cheaply; and (3) new concepts of learning and problem solving. Agricultural knowledge management needs to seize these opportunities to reduce the pre-existing shortcomings such as timely response to market opportunities and searching for agricultural

inputs. This will enable farmers to diversify their production and add value to their products to participate in the global markets.

In this light, knowledge management proposals and strategies need to recognize that:

- Explicit form of knowledge becomes information that can be managed by storing using devices and disseminate it through various digital and traditional formats;
- Information serves a basic input for individual and collective learning for the people and social groups to generate new knowledge;

Experiences of individuals and social groups can be converted into knowledge which is considered as tacit knowledge, it is hardly stored nor can it be captured but can be shared through face-to-face interaction. It serves the interests of the highly marginalized societies and not considered in the formal education. Based on the above descriptions, we can find a number of definitions for knowledge as summarized below (see for more details in Uriarte, 2008):

- Knowledge is information associated with rules which allow inferences to be drawn automatically so that the information can be employed for useful purposes;
- Understanding and recall of information measured by depth, scope, and ability to integrate to resolve problems;
- Knowledge is information that is relevant, actionable, and at least partially based on experience.

These definitions commonly hold the fact that irrespective of sources of knowledge (formal or tacit), it is systematized information required to solve human problems. As a result, knowledge is an asset and it needs to be managed like any other resources. Knowledge management may involve:

- the broad process of locating, organizing, transferring, and using the information and expertise within an organization;

- information or data management with the additional practice of capturing the tacit experience of the individual to be shared, used and built upon by the organization.

These two definitions consider the relevance of undertaking certain activities to manage knowledge including locating, using and transferring knowledge through combining explicit and tacit knowledge where and when needed. The idea and understanding of knowledge management has evolved through time:

- in the 1970s emphasis was placed in the information and technology transfer contributing to the understanding of how knowledge is produced;

- in the 1980s the development of artificial intelligence and expert systems have given rise to the concepts of knowledge acquisition which has created a means for the knowledge management; there is a technological base for knowledge management;

- in the1990s discussions on knowledge management started in the academic circles with the emergence of journal publications with greater focus on business related transactions; subsequently towards the end of 1990s the knowledge management approach has become an alternative to the failed total quality management.

There are also different aspects of knowledge management that needs attention in these course where the activity is supported by different technologies. The concept of agricultural sensors, machine learning and knowledge filtering are useful to consider.

1.2 Agricultural sensors

The application of knowledge management tools include the use of agricultural sensors. Once the knowledge is produced through a continuous scientific research, the application of knowledge can be supported using modern technologies such as the use of sensors. For example, information can be collected whether or not the nutrient available in the soil following application of certain chemicals such as fertilizer is adequate to support growth of plants, when to apply what amount of inputs and under what conditions. The use of such sensors enables us to monitor humidity, temperature, density of weeds and all factors affecting agricultural production (Walker et al., 2008). A better use of technology can also reduce the use of chemical products such as fertilizers, herbicides and other potentially polluting products such as nitrates where such process could help farmers harvest healthy grain.

The use of sensors is common in monitoring temperature in a warehouses where agricultural products are stored to reduce the risk of perishability of vegetable products. The use of wireless sensors to monitor environmental quality (air, water and soil) and weather data communication (from particular center) to actual users to enable them take pro-active measure in controlling certain diseases and pests associated with environmental change are a recent practice in the application of technologies in knowledge management (Wang et al., 2006). The application of agricultural knowledge in this way can help stallholder farmers increase their productivity and thereby food security. The level of knowledge of farmers in using this technology might be low in developing countries vis-à-vis the developed world.

Agricultural sensors are used in livestock research and production processes to monitor animal behavior, movement, response to different kinds of feeds and weather conditions. This is a data collection strategy to analyze the system and introduce necessary changes to enhance livestock productivity (milk, beef and other products). The use of sensors help identify sick animals and prevent spread of potentially harmful diseases.

This application is common in different countries. It serves as a controlling strategy to monitor cattle grazing in an open access system and in order to improve and maximize milk production efficiency by increasing milking sessions per day. On a larger scale, sensors could be used in controlling pollution that can affect the functioning of the agriculturally important insects

enhancing pollination. For example, one can control for pollution level that does or does not affect bees.

1.3 Machine learning

The use of sensors in data collection actually involves machine learning. The machine once adjusted or programmed responds properly to the external environments and in such away records data, processes it and generate information that helps farmers make quick decisions. It is sometimes called artificial intelligence. This does not necessarily means machine learning is entirely free from making errors. The human element in the programming process could affect the performance of the machine. Machine learning refers to the changes in systems that perform tasks associated with artificial intelligence involving recognition, diagnosis, planning, robot control and prediction (Nilsson, 2005). If we consider the entire machine as a hard system and the way it operates as a soft system, changes in one of the components of the soft system leads to changes in other components of the system, which would ultimately affect the outcome prediction as the figure below demonstrates. Knowing how machines learn would help us understand how humans learn.

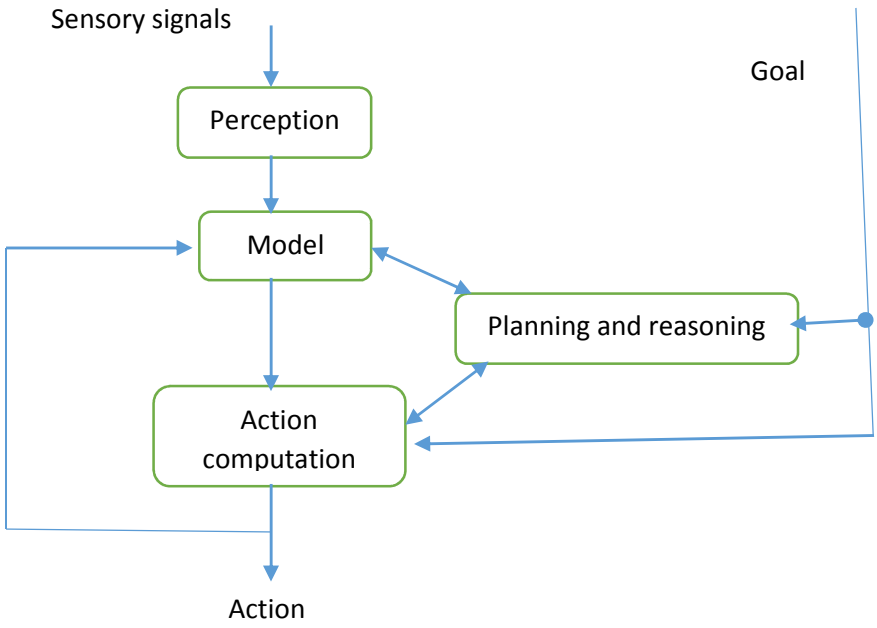

Figure 2: An artificial intelligence system. Source: Nilsson (2005:2).

Figure 2 indicates how a machine becomes an agent of humans. It receives certain signals and tries to model the relationships based on internally adjusted structure and produce certain outputs that necessitate action. The modeling process involves planning and reasoning for certain action to be carried out. The goals set can be achieved through learning from action that in turn makes

the modeling and action an iterative process. Machines that can adapt to the changing environment do not need constant redesigning of the tasks to be performed. They can be used to capture a large set of inputs, encoding them and produce desired outputs (Nilsson, 2005). An example for this could include application of a drip irrigation system in response to the level of moisture available in the soil and temperature regulation in a warehouse.

1.4 Knowledge filtering

Knowledge is acquired through a selection or filtering process as individuals use a filtering process that determines which pieces of information to retain. The decision to retain or to reject depends mainly on the perception of the *relevance* of the information in the immediate context (Plotkin, 1994). The basic components of such a process involve *the receiver* (the person who must decide which pieces of information to add to the reservoir of knowledge), judging the *relevancy* of that information to the receiver and *filtering* where even some of the irrelevant ones can be retained at a subconscious level and recalled from memory as needed. Eventually, a broader range of information could be perceived as relevant to meet the diverse interests of potential users.

There are certain factors which influence the filtering process (Godbout, 1999):

a) **Authority/Credibility of Source of Information** - The receiver is disposed towards information that comes from an authoritative source which increases reliability for decision-making. For example, policy information originating from headquarters bears more weight than the same information coming from the district office. To overcome credibility gap, filtering through the use of experts or researchers is often needed.

b) **Organizational Biases -** closed-mindedness or a prejudice prevents a person from making fair judgement where subjectivity dominates. When organizations remain closed from exposing themselves to external influences, they tend to be biased, which in turn undermines their prospect to filter different sets of knowledge and use the relevant ones.

c) **Filtering Behavior** – along with increasing sources of information and data, there is a need to develop a systematic approach to improve our performance in filtering in knowledge management. Lack of this strategy will overwhelm the actors to be flooded with a lot of information and spend more energy to sorting out the information than in making it useful to their job.

Therefore, our strategy in the formal knowledge filtering process requires:

- focusing on ***relevancy screening*** which will serve to manage the large set of information to be processed,
- ***knowledge appreciation*** where selecting and prioritizing by considering relevance will help in maintaining quality

d) **Relevance in terms of time and scientific acceptability –** judging knowledge in terms of these factors is essential to evaluate whether or not it is serving its purpose and will enable the organization to make progress.

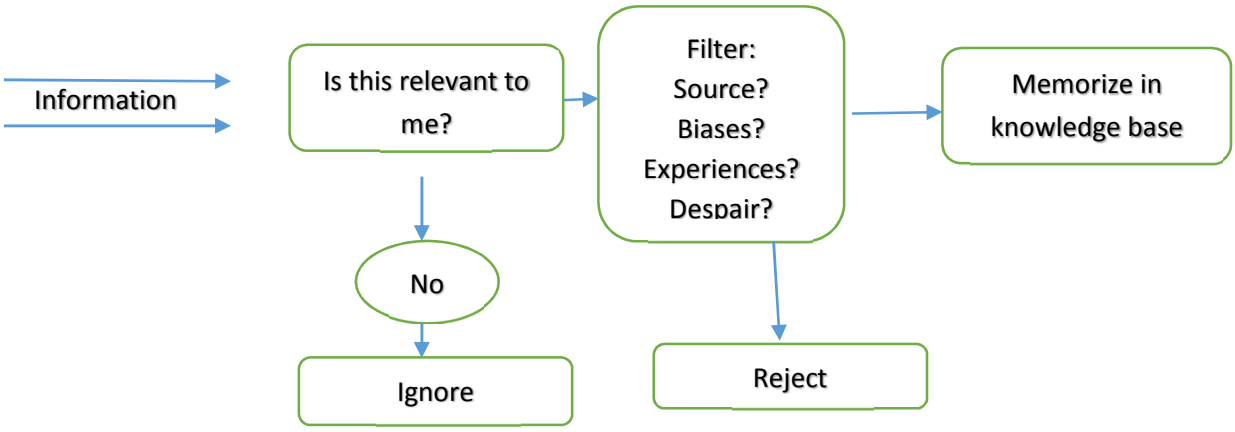

Figure 3: The informal knowledge filtering process (Source: Godbout, 1999)

Class Activity: Take an example from your experience on agricultural knowledge management in soil and water conservation technologies. Then indicate the following procedure to learn how farmers manage knowledge.

a) Indicate the different sources of knowledge
b) Compare and rank the relevance of knowledge based on aspects of its usefulness to respond to the current problems farmers are facing
c) Take additional information from the internet "google.com" on the current available technologies
d) Relate what has been obtained in (c) above with what farmers in your village experienced and identify the knowledge gap
e) Suggest some of the ways through which the knowledge gap can be filled

Chapter 2: Soft systems thinking and knowledge management

Objectives

By the end of this chapter, students are able to:

- distinguish hard and soft systems
- explain the important of soft systems thinking in knowledge management

- recognize how policy environments affect knowledge management

2.1 Introduction

Given the number of impressive projects throughout human history, it perhaps surprising that it is as recently as the 1950's and 1960's that ways of defining and carrying out projects were set down formally in a methodology to be followed by aspiring project managers. What is less surprising is that engineers played a big part in that development. The thinking of engineers extended from designing and making single objects to creating systems, the latter thought of as both a connected set objects and the way of using them. In the 1950's phrases such as 'the systems engineer' and 'systems engineering' became current, and methodological accounts of how to do systems engineering something intuitively grasped by the builders of the Great wall and the engineers of the American telephone network began to appear. Hall's classic account of 1962, A Methodology for Systems Engineering was generalized from the experiences of Bell Telephone Laboratories in carrying out research and development projects, and the approach is now well established.

SSM is best understood in relation to its origins. It is the problem solving approach develop from systems engineering. The failure in systems engineering when it has applied directly to social science systems has led to the development of the soft systems methodology. It is a response to carrying out of technological projects failure when attempts were made to apply it without considering socio-economic dimensions, which is often messy and changing. In that sense, soft systems methodology captures ill-defined problem situations with which managers have to cope in their day to day professional lives. Systems engineering can thus be recognized as hard systems while soft systems methodology is the soft systems. There are differences between hard systems (mechanical, e.g. a tractor operating on the farm) and soft systems (social systems, e.g. water distribution systems in irrigated farming) where the integration of both is needed in knowledge management. For the sake of understanding, the two can be distinguished as follows:

Table 2: Difference between hard and soft systems

Hard systems thinking	***Soft systems thinking***
• the world is systemic	• the world is not systemic but considered as if it is
• a system has objective	• a system has no objective but individuals using it (objective setting is part of the problem)
• system images are compared with processes, inputs and outputs	• system images are concerned with

	social actors, their activities and relationships
• processes are functionally articulated into a goal seeking whole	• boundaries and goals are permanently (re) negotiated
• systems images are used to construct models to represent the world	• system images are used to construct windows to study the world

2.2. Assumptions of SSM

There are five assumptions in the application of the soft systems methodology in the knowledge management process.

1. It is the process of managing, taking a particular view on what managing is and what a knowledge manager does. Knowledge manager in any field of activity is reacting and trying to cope with an ever-changing flux of interacting events and ideas. Managing means reacting to the flux: perceiving and evaluating it, deciding up on action which itself becomes part of the on-going ideas/events in flux, leading to new perceptions and evaluations and further actions.

2. Given the above broad view of meaning SSM assumes that different individuals, being relatively autonomous, make different evaluations leading to different actions. The manager has to hope with these differences. The figure shows the interaction of events and ideas through time leading to new decisions and action. This indicates how knowledge required to solve old problems may not be relevant to solve new problems. Thus, new knowledge needs to be generated to solve new problems through time. For instance, we need a new crop variety to perform under moisture stress or a new antivirus for a newly invented computer virus. The knowledge manager should either invest in the creation of knowledge needed to solve the problems or search where this knowledge is available in a larger system or learn from others who experienced similar problem and the knowledge they used.

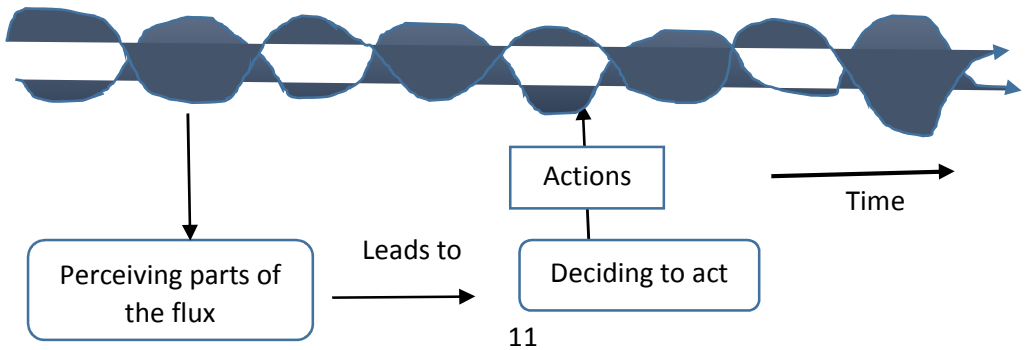

Figure 4: Lifeworld: a flux of interacting events and ideas.

3. The systems ideas are helpful in consciously articulating the processes of knowledge management. As a system connects actors trying to improve performance within or across organizations their interaction enhances knowledge management through creation or sharing knowledge.

4. The concept of SSM is largely rooted in that of the "designed and natural" systems. But the concepts of those systems lack adequacy in describing the complex human situations. The new concept going along these two systems is "human activity system" aiming at constituting interconnected links to contribute to a purposeful whole.

The readiness to talk of purposeful human activity system (HAS) only in terms of a particular interpretation (a bias) implies that:

a) There will be multiple possible descriptions of any named real-world purposeful action and

b) Any description of purposeful activity will have to be explicit concerning assumptions about the world.

To respond to (minimize) the above bias (specificity), the development of SSM includes:1) the accounting to the need to describing any human activity system in relation to particular image of the world and 2) accepting that any real-world purposeful action could be mapped by several HASs descriptions based on different assumptions. This leads to the fifth assumptions.

5. SSM learns by comparing pure models of purposeful activity (in the form of models of HASs) with perceptions of what is going on in a real world problem situation. For instance, we could learn about real prisons (HAS) by comparing what goes on in it with a set of activities in the models to solve the problematic situation (rehabilitation system, punishment system, a system to protect society and storage system). The knowledge manager can look into these alternatives for action (changes to be introduced) to prevent crime based on their costs and benefits in promoting behavioral change to potential criminals who could otherwise be a threat to the peace and security of the society.

6. SSM is an articulation of a complex social process in which assumptions about the world - the relevant myths and meanings as well as logic of achieving purposes that are expressed in the systems models- are teased out, challenged and tested. This makes the methodology having a real participatory nature.

2.3 The Stages of Soft Systems Methodology

Since SSM supplements "experience" by an explicit use of systems thinking, it involves " debate that helps to define changes which would bring about improvement, and seeks to motivate people to take action to implement the defined changes.

There are seven stages in SSM. Users of the SSM cycle do not necessarily move straight forward from stay 1 to 7 because for different problem situations different stages can be emphasized. It embraces flexibility as far as the logical connection b/n stages are kept in mind.

Stages 1 & 2: Finding out (Sense making)

This stage combines entering the considered problematic situation and expressing the problem situation.

There are three phases in these stages

1. Pictures of the situation are assembled by recording elements of slow- to-change structure. Which gaps on knowledge exist?
2. Recording the dynamic elements of continuously changing process in identifying aspects sensitive to time, for instance, new innovation, and
3. Forming a view of relating structure to process (looking into the knowledge level of the actors and how it affects work process in an organization) to create a climate of the situation.

These phases will lead to getting clear/rich picture of the situation of an organization.

Sense-making is an essential step in organizational analysis and change. Soft systems approach takes into account sense-making in analyzing organizational change processes to improve performance. Sense-making enables people to create their own situation and start to take rational action by themselves based on the meanings they are able to derive out of their analysis. The understanding often developed is influenced by their interactions with members of their organizations and participation in different activities. Sense-making is an invention where people develop their own interpretations, revise them and undertake some actions and evaluate the consequences of their actions. It is useful to recognize that in sense-making, the meanings people develop and attach to their experiences are fundamentally fluid, unstable and idiosyncratic, and that there is no as such communalities (Allard-Poesi, 2005). In applying the soft systems methodology to manage organizational change, the knowledge management should emphasize how to learn and accommodate the diverse and sometimes contradictory ideas and understandings in the change process.

Allard-Poesi (2005) characterize sensing making as:

- An invention process as related to past experiences,
- Useful tool for doing where actions are interpreted within an organization,

- An on-going tensional process where social reality "as an ongoing construction elaborated through interactions, a fragile and temporary order that people continuously define and redefine through their actions and experiences",
- Grasping people's meanings in a more detailed, situated and concrete manner by observing and analyzing their interactions in organizations,
- Developing a grounded understanding by entering the world of the informants and taking their point of view into account

Stage 3: Formulating Root Definitions (Rds)

The knowledge manager is expected to design mechanisms of solving the problem by designing the system. It involves writing down the names of some systems for carrying out purposeful activity.

An essential activity in this stage is trying to formulate root definitions based on the CATWOE questions from which models can be built. This can be described as:

a) C –*customer*: a customer is an individual or organization which could be victims/beneficiaries of the purposeful activity?

b) A- *actors*: these are again individuals or organizations or groups which will be involved in undertaking activities in inducing change. The knowledge manager could rise the question "Who would do the activities and what level of capacity exist?"

c) T- *Transformation* which includes the conversion of inputs into outputs through a certain process. The changes to be introduced to undertake purposeful activity require different kinds of inputs for different levels and types of outputs. The knowledge manager asks the questions "What kinds of inputs generates which types of outputs?"

d) W –*Worldviews*: different individuals do have different world views which are influenced by the previous exposure and expectations over outcomes of certain actions. Thus, the knowledge manager needs to understand the different world views (windows of thoughts) and asks the questions "What view of the world makes this definition meaningful?"

e) O – *Owner*: These are stakeholders who have shared concerns over the outcomes and may be a barrier or cooperator in the process of implementation of the changes. They need to be carefully identified at earlier stage. The knowledge manager could ask the question "who could stop undertaking a specific activity?"

f) E –*Environment*: there are several factors (social, ecological, economic, and political) external to the system but affect the smooth functioning of a particular system. A useful question is "Which constraints in our environment does this system take as given?

Stage 4: Building Conceptual Models

The building process consists of describing the activities that have to be carried out in the system named in the root definitions and structuring them according to logical dependencies. In this case, emphasis would be placed on the operational part of the system that would achieve the transformation. However, any system model is a combination of an operational system and a monitoring and controlling system. It is thus useful to unpack the concept 'monitoring and control' by asking the question; how could the system fail? Along these, one can identify three aspects that can be considered as possible sources of a system's failure, including:

- *Effectiveness*: which involves the right thing to do where one has to be linking objectives with outcomes
- *Efficiency*: that indicates the identification of the resources needed and reducing costs needed to generate better outcomes, i.e. making the transformation processes easier and cheaper. For example, the use of information technology to monitor work processes.
- *Efficacy*: this involves the use of appropriate means and instruments, as a measuring processes and performance.

Therefore, any monitoring and control system in the process of building conceptual models based on the systems named in the root definition must pay attention to all the three aspects. If we consider nested layer of systems, the effectiveness of a smaller scale system is determined by the nature of the larger scale system in which it is operating. The poor performance of a small-scale system is attributed to the ineffectiveness of the larger scale system. Thus, building a system model relies on the nature of the wider system. Knowledge needed by a unit in an organization to improve performance and competitiveness depends on the overall efforts of an entire organization in managing knowledge transfer.

Stage 5: **Comparing models and "Reality"**

At this stage, the models from stage 4 provide the knowledge manager a means for perceiving reality and initiating a discussion from which "changes" to improve the problem situation. The key tasks include focusing on differences between models and perceived reality. Such comparison of the differences help to refine further and narrowing the gap between the perceived reality and the models.

Stage 6. Defining changes.

The purpose of comparison from stage 5 is to use the differences between models and reality to discuss possible changes which could bring about improvement in the problem situation. The models of SSM are different from the "designs "of hard systems and the purpose is to create a coherent debate to "define" possible changes. The source of information for the knowledge manager to define changes is the comparisons made at stage 5 which ultimately leads to the question: how can we define systemically desirable and cultural feasible changes? In this case, the *systemically desirable* changes fulfil certain requirements such as instituting mechanisms for assessing effectiveness, making sure resources are appropriate, ensuring that logical dependents

are reflected in real- world sequential actions. Whereas, *culturally feasible* changes place emphasis on the myths and meanings of the "defined" changes in addition to the facts and logic associated with differences between models and the reality. Indeed, it can be difficult for professionals to identify requirements for culturally feasible changes. If both logical and cultural criteria are not there, the chance of achieving changes is very minimal even though cultures are not completely static.

Stage 7: Taking action

This is the stage where the implementation of the proposed action takes place. It is the stage at which the knowledge manager ensures that the changes are accepted as "systemically desirable and culturally feasible "where the soft systems methodology in the knowledge management is completed by implementing changes. This methodology as knowledge management tool can be applied in different organizations and sectors of the economy. Changes in agricultural policy in a specific setting often fail as they try to implement changes that are culturally undesirable while the knowledge managers have clear technical knowledge and better technological innovations. Based on the assumptions and stages of the soft systems methodology, the following theoretical conclusions can be made:

- The methodology treats "what to do as well as "how to do as part of the problem.
- It accepts that real-world action will be much messier than the pure models, and uses the models to structure a debate in which different objectives, needs, purposes, interests and values can be discussed.
- It is a learning, not an optimizing, system and does not rely only on the views of outsiders.
- Ending a systemic change applying the soft systems methodology is an arbitrary act. Since there are flux of events and ideas moving on, there are no often permanent solutions, which makes the methodology a never ending iterative learning process. This is partly attributed to the definition of the knowledge itself where it remains dynamic and contextual often determined by the socio-cultural setting and economic development of a country or a region. As the process involves comparing, acting and learning, the methodology ends by enabling relevant actors (knowledge managers and producers) to shift from questioning "what to do " to ' how to do it ', which means that ends are agreed.

The nature of knowledge management is affected by the nature of the knowledge management environments including rules and procedures as well as policies that affect the operational processes at lower levels. In the notion of the knowledge systems, it means that what happens in the larger scale system affects decisions and operations at lower scale systems. Operational process are those that use knowledge but apart from routinely produced knowledge about specific events and conditions.

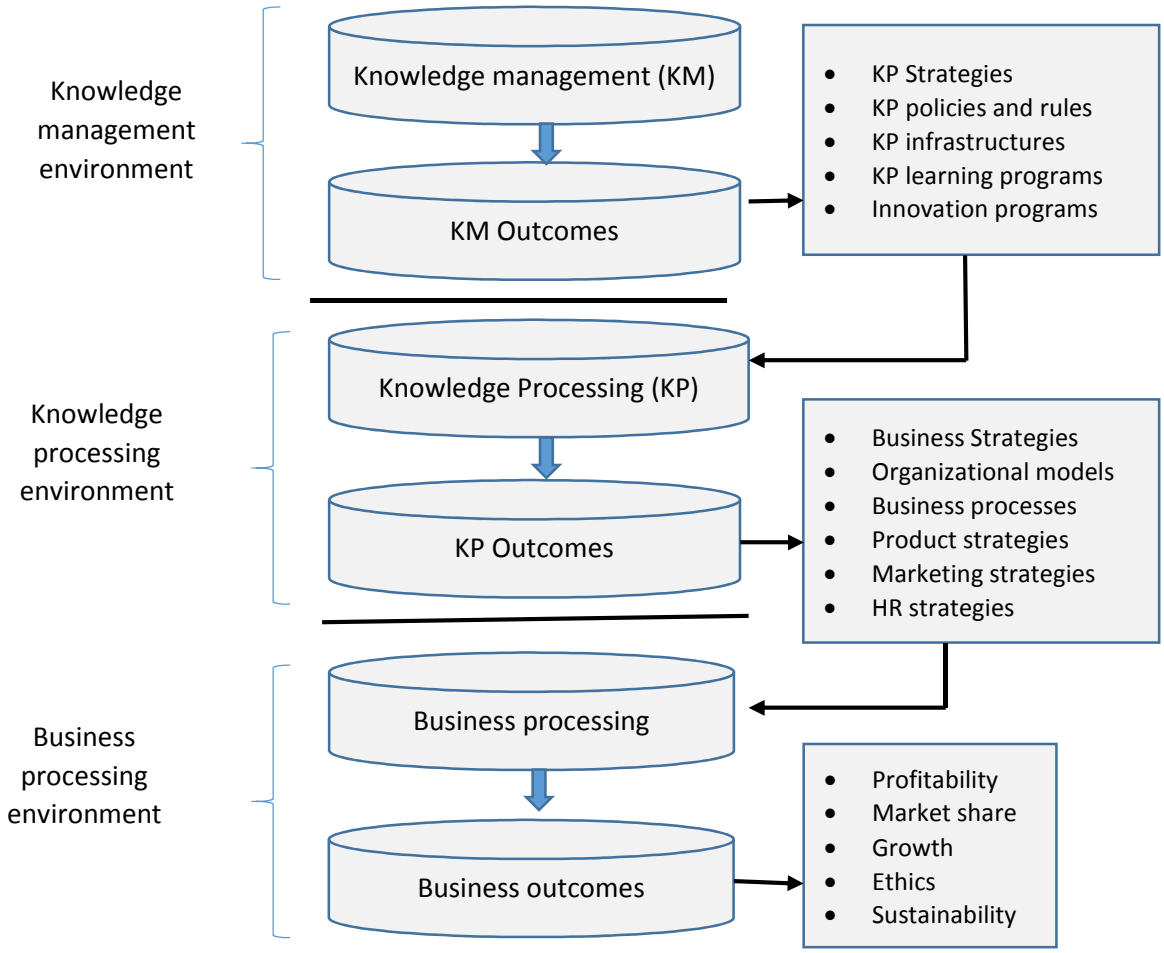

Figure 5: The three-tier framework (Source: Firestone and McErloy, 2005:190)

The three-tier framework indicates three important processes in knowledge management including operational businesses process, knowledge processes and processes for managing knowledge processes. The lower level which stands as business outcomes are expressed in terms of profit, market share of an organization of its growth and ethical improvement are highly affected by the knowledge processing outcomes which are expressed in terms of having a set of good business strategies, operational models, product strategies and so on. For this to occur, there is a need for basic capacity to process knowledge and use it, investment in knowledge processing infrastructure, innovations and having clear rules and policies.

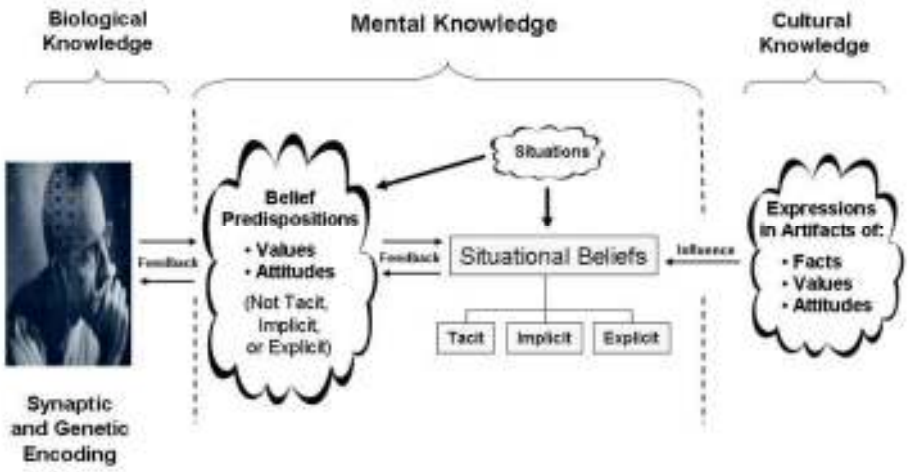

Figure 6: The three types of knowledge (source: Firestone and McErloy, 2005: 198).

Essential to consider is also the distinction between individual and collective knowledge where interaction process results in the production of collective knowledge. When collective knowledge fails to solve a new problem, then we need new knowledge which may exist elsewhere. The leaning programs in the knowledge management environment seek to have external knowledge or creation of new knowledge through organizational investment.

Firestone and McErloy (2005) identify three types of knowledge based on forms of existence and levels of development where environmental and social factors affect our beliefs and values. But there is no clear cut distinctions across levels but interaction and feedback. What is encoded genetically can be improved though observing our environments and analyzing situations which could be implicit or explicit. This can be further advanced through social interactions and learning from others. The three types of knowledge are highly interlinked. The authors categorize the knowledge as follows (p.198):

(1) Tested, evaluated, and surviving structures of information in physical systems that may allow them to adapt to their environment (e.g. genetic and synaptic knowledge).

(2) Tested, evaluated, and surviving beliefs (in minds) about the world (subjective, or non-sharable, mental knowledge).

(3) Tested, evaluated, and surviving, sharable (objective), linguistic formulations about the world (i.e. claims and meta-claims that are speech- or artifact-based or cultural knowledge).

Class Activity: Application of the Soft Systems Methodology

One of the reasons for a lower agricultural yield in developing countries is the infestation of pests and diseases that affect crops on the field. As an approach, an integrated pest management (IPM) has been advocated to overcome the problem. IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Based on this technical definition, students are required to exercise a soft systems methodology where IPM is considered as a system with different components and the interaction among these components determines the final goal or outcome, which is control of the pests and diseases. The level of control in this case depends on how the different components are effectively integrated, which means the outcome is affected by the use of inputs (the transformation process). The existing literature might have concluded how an effective IPM system has to function, an imagination of the real world. However, farmers could deviate in some ways from such a standard as influenced by their exposure (awareness) and knowledge and skills (the real world). Based on this information, try to apply the soft systems methodology following the seven stages, wherever needed by combining the steps. Use sense-making as a tool to compare the perception about the real world with actual reality.

Chapter 3: Knowledge systems and its dynamics

Objectives

By the end of this chapter, students are able to:

- Define what a system is, its classification and how systems thinking is essential in knowledge generation, transfer, sharing and storage
- Explain the dynamism in knowledge to solve systemic problems

The previous chapters have dealt with the idea of knowledge and the different types of knowledge. While discussing about knowledge systems, the idea of systems and how systems function and contribute to knowledge creation and management should be clear. Moving from disciplinary approaches to systems approaches and more styles of problem solving requires a great leap. Scientists of different professions have been searching for new approaches to meet the challenges presented by complex problems in which there is no opportunity to reduce the number of factors that needs to be handled. This need has led them to develop more holistic approaches based on systems thinking.

Definition: A system is a set of parts that behave in a way that an observer has chosen to view as coordinated to accomplish one or more goals. The concern here is an observer's choice of parts to study. It is best not to think that systems are real.

3.1 Major systems premises

1. *Holism*- Systems based methodologies are based on the assumption that the world can be viewed as consisting of structural wholes or systems that maintain their identity or integrity under a range of conditions and that exhibit certain general properties emerging from their wholes.

2. *Transformations* -Inputs to a system are transformed through major functions that can be described or developed; as a result of transformation an output from the system is produced.

3. Control -systems are conceived as having the capacity to maintain key components within an appropriate range of values in the face of external disturbance.

4. *Communication*- is related to a system's ability to communicate information in order to control what happens within a system and the forces that come in externally.

5. *Hierarchy* -the notion of hierarchy of systems (sub-systems) is the systems version of reductionism to its properties of components.

Example: individuals----- populations---- communities---- ecosystems

(lowest) (highest)

6. *Emergent properties*- In systems it is often said that the whole is different from the sum of its parts. That difference is the emergent property and, in any give hierarchy, emergent properties uniquely pertain to particular hierarchical levels. In going up the hierarchy, the emergent properties at lower levels will disappear. Human synergy relates to interacting humans.

An example:

> For example, say person A alone is too short to reach an apple on a tree and person B is too short as well. Once person B sits on the shoulders of person A, they are more than tall enough to reach the apple. In this example, the product of their synergy would be one apple. Another case would be two politicians. If each is able to gather one million votes on their own, but together they were able to appeal to 2.5 million voters, their synergy would have produced 500,000 more votes than had they each worked independently.
>
> Synergy usually arises when two persons with different complementary skills cooperate. The fundamental example is cooperation of men and women in a couple. In business, cooperation of people with organizational and technical skills happens very often. In general, the most common reason why people cooperate is that it brings a synergy. On the other hand, people tend to specialize just to be able to form groups with high synergy.

It is important to see the distinction between the reductionists and holistic thinkers in terms of their approach to problem-solving. Reductionism can either mean (a) an approach to understanding the nature of complex things by reducing them to the interactions of their parts, or to simpler or more

fundamental things or (b) a philosophical position that a complex system is nothing but the sum of its parts, and that an account of it can be reduced to accounts of individual constituents. However, the development of systems thinking has provided methods for tackling issues in a holistic rather than a reductionist way, and many scientists approach their work in a holistic paradigm. When the terms are used in a scientific context, holism and reductionism refer primarily to what sorts of models or theories offer valid explanations of the natural world; the scientific method of falsifying hypotheses, checking empirical data against theory, is largely unchanged, but the approach guides which theories are considered. The conflict between reductionism and holism in science is not universal--it usually centers on whether or not a holistic or reductionist approach is appropriate in the context of studying a specific system or phenomenon (Checkland and Poulter 2006).

A system observer:

- will identify some entities and define them
- perceives (invents) some principles of coherence which makes it meaningful
- identifies mechanism of control of system's entities to keep identity at least in the short-term.

3.2 Classification of systems

- *Natural systems*- associated with the origin of the universe. They are systems not other than they are/unchanged/, are evolution - made, irreducible wholes.
- *Designed physical systems* - made by man, designed for a purpose
- *Designed Abstract Systems* - structured set of thoughts representing the conscious output of human mind. Eg. AKIS.
- *Human activity systems*- less tangible than the natural and designed systems. Eg. political, economic and social systems

There is also another classification of systems.

- living and non-living systems
- concrete and abstract systems
- closed and open systems

The third classification was made by Jordan in 1968. He started from intuitive guesses using three organizing principles to perceive a group of entities as a system.

These are:

- *rates of change* - static and dynamic systems
- *purpose* - purposive and non-purposive systems
- *connectivity* - organismic and mechanistic systems

In conclusion, all systems need to have in common identifiable entities and connections among them; however, he failed to recognize the observer/describer of a system and ascribed the purpose, or its lack, to the systems itself. Thus, there is no still generally accepted classification of systems. Hence, the classification of systems emphasizes the purpose and interest for which it serves. System's thinking stimulates human's imagination.

3.3 Knowledge dynamics

The dynamics of knowledge can be seen in relation to the concepts of open & closed systems.

What makes knowledge to have dynamic nature?

Human activity systems (HAS) are open systems. HASs involve seven features: *the purpose that defines the existence of the system itself, the elements, connections, the boundaries, the inputs (knowledge and information of each actor), the internal processing unit (the result of elements working together) and the output*.

Knowledge dynamics occurs whenever change in one of the seven features takes place. For instance when the purpose of a system changes, it leads to changes in other features of a system. Thus the elements of the system need new knowledge and information for optimum performance of the system.

- Knowledge is constituted by the ways in which people categorize, code, process information's and impute meaning to their daily life experiences.

- There is no need to equate knowledge to professional science. Every body has certain aspects of knowledge. It is not the property of the educated alone.

- Knowledge emerges out of a complex process involving social, situational, cultural and institutional factors.

- The complexity of knowledge process is affected by various social contingencies such as:
  - The skills
  - Orientations
  - Experiences
  - Interests
  - Resources &
  - Patterns of social interaction

Knowledge has a 'complex' nature because of the variation among elements of a system in terms of the above mentioned social contingencies.

- Therefore, knowledge is neither accumulation of facts nor is fully unified or integrated but rather fragmentary, partial and provisional in nature because people work with a multiplicity of understandings, beliefs and commitments.

Conclusion: Knowledge dynamics recurs to react to changing or newly emerging agricultural problems or to react /adapt to externalities.

An example: Locking into Gender elements of knowledge dynamics

Knowledge dynamics, power relations among social actors, local groups' networks and information management are highly interrelated in understanding knowledge management. power relations in gender thinking does not imply power struggle because gender does not focus on struggle for power but rather on how development interventions emphasize on knowledge sources, needs, roles, responsibilities and other social contingencies and adjust targeting accordingly. In this case it is important to address how women can get access to institutions and make use of their knowledge and information for decision making and skill improvement with respect to the nature of enterprises they are engaged in. Moreover, institutions such as research, credit and extension need to create opportunity for women to raise issues that touch their daily-life reality and to be served by 'men biased' development institutions.

As women form part of local groups they require certain information from their own community members. Identifying the source of information and studying how information exchange takes place from within leads to a clear understanding of the indigenous knowledge systems of women. Any external intervention should uplift this pattern rather than distorting it; if it does, it could cause discontinuity in the information systems. The previous sections gave emphasis to knowledge dynamics that focuses on the nature of problems, knowledge required to solve a problem and the context in which a particular knowledge works change over time. For this topic a lesson matrix is prepared.

Questions:

a) identify a specific project where men and women have participated

b) Discuss how men and women's knowledge have been used I the implementation of the project

c) Indicate the possible difference in needs and priorities

3.4 Knowledge Dynamics in practice

The concept of knowledge dynamics is helpful to recognize the context in which interventions and technologies work efficiently. Knowledge dynamics means the change in knowledge and information required as the context in which social actors operate change because of certain factors

(resource, institutional, political, natural, demographic, policy, etc…). For example, women's needs change because of either of the above factors and hence the knowledge and information needed to address their basic needs also changes. The cases below exemplify this situation.

In any intervention scheme, knowledge alone is not suffice for realizing desirable result. Conversely, practicing is impossible unless one has required knowledge. Putting knowledge into practice entails personal efforts as well as outsiders' input in the form service or cooperation. The following case focuses on this concept.

In central Ethiopia, most farmers face severe problem of feed shortage for their livestock because of limited grazing space available. To solve this problem farmers came up with the idea of feeding mollases - a bi-product of sugar; which is available at sugar producing industries. They cannot afford to get it home individually due to high transport cost. To respond to this problem, they organized themselves and got the resource through their application to the Ministry of Agriculture. Once the feed is available, new questions come in: to which livestock to feed, who should feed them (men or women), who needs new knowledge on feeding practices (men or women)? Women are closer to livestock than men in many parts of the country. So any service or training should be channeled to women. This case shows that new knowledge of feeding is necessary for women because of change in resource (availability of grazing land) which happened most probably due to demographic change. The case also implies that the existing knowledge is not enough; it requires training to practice or put the knowledge into action.

3.5 Contextualizing External Knowledge

The means external institutions need to consider indigenous realities in which their technologies or innovations are expected to work. Understanding the context should be the primary task of these institutions. The following case presents a technology situation that failed to consider the household context. A new variety of bean has been introduced to farmers of eastern Ethiopia. The bean has a good quality in terms of increasing yield and matures in short time as compared to local variety. It is preferred in water stress areas. Hence, men appreciated the technology. Nevertheless, women complained on the quality of the variety in relation to their home criteria. This leads to the suggestion 'external knowledge of researchers should work not within the context of men only but of the household in general'.

Discussion Questions

Discuss the following questions for the next 20 minutes and present your results.

In relation to the above case;

A. What could be the reason(s) for women's complaints?

B. What would these imply for the research on this variety of bean?

3.6 Knowledge processes, transfer and sharing

Studying knowledge processes is valuable in order to understand the roles and functions of the different actors involved at various phases in which knowledge is transformed from its abstract to the more concrete and applicable forms. What are the processes? The processes involve certain steps: knowledge generation /production/ creation, knowledge dissemination, knowledge transformation (oral, written, simple, meaningful, and relevant), knowledge exchange, knowledge utilization and knowledge storage and retrieval. Generally, there is no as such clear demarcation among these steps in the process. For example, in farmers' experimentation knowledge can be generated and exchanged without undergoing any transformation. And for these processes to take place, building and strengthening supporting institutions are necessary. The understanding of the production, reproduction, and transformation of knowledge must be situated in terms of the "life- worlds "of the individuals and groups involved in the process. In the agricultural development process knowledge generators include farmers, researchers, change agents, policy- makers, project managers, investors, system scientists; national and international NGOs, etc. On the basis of the above explanation, KIS is defined *as* a *network of actors (organizations, institutions, farmers, policy-makers, extension agents, etc...) that are involved in the generation, transformation, dissemination, exchange, utilization, storage and retrieval of knowledge & information and are working synergistically towards improving domain of human activities*.

In this case, knowledge and information systems give due concerns to: interface between real world and knowledge about it as well as goodness-of-fit between the collective knowledge of local actors and the environment they seek to control, or adapt to, to reach their objectives. Therefore, functional differentiation, integration and coordination are typically concerns of knowledge management. And performance could be improved by mobilizing the countervailing power of the clientele.

Knowledge transfer and sharing also differ slightly while the former has been debated as transfer implies changing of hands while sharing does not. It is essential to make reference to the following distinction made on the basis of Paulin and Soneson (2012:83). Knowledge sharing can be defined as:

- ✓ "The exchange of knowledge between and among individuals, and within and among teams, organizational units, and organizations. This exchange may be focused or unfocused, but it usually does not have a clear a priori objective."
- ✓ "An exchange of knowledge between two individuals: one who communicates knowledge and one who assimilates it. In knowledge sharing, the focus is on human capital and the interaction of individuals. Strictly speaking, knowledge can never be shared. Because it exists in a context; the receiver interprets it in the light of his or her own background."

Whereas knowledge transfer:

- ✓ "Includes a variety of interactions between individuals and groups; within, between, and across groups; and from groups to the organization."
- ✓ "The focused, unidirectional communication of knowledge between individuals, groups, or organizations such that the recipient of knowledge (a) has a cognitive understanding, (b) has the ability to apply the knowledge, or (c) applies the knowledge."

Important in the concept of knowledge transfer or sharing is the concept of knowledge barriers. It refers to the situation where knowledge transfer fails to take place due to cultural, technical and limited human capital within an organization to make use of existing knowledge. Effective removal of this barriers is required to make knowledge transfer successful and cause the desired impact in terms of human and social development. While referring to knowledge barriers, Attewell (1992) considers the idea as "lack of knowledge" about a new technology. However, a further elaboration in the literature shows that lack of knowledge should be context specific which depends on the barriers for knowledge sharing, inadequate knowledge attributed to level of education in a certain area or subject, not being part of the network or having a few or no contact points (Paulin and Soneson, 2012). Knowledge barriers exist even within an organization when senior staff are reluctant to share their knowledge with the junior staff (Bundred, 2006). Based on this argument, we can imagine an inverse relationship between knowledge sharing and knowledge barriers. Factors enhancing knowledge sharing are at the same time reducing knowledge barriers.

Knowledge sharing is essential to achieve the following objectives and realize the benefits associated with them:

- Connecting professionals across platforms, across distances.
- Standardizing professional practices.
- Avoiding mistakes.
- Leveraging best practices.
- Reducing time to talent.
- Building reputation.
- Taking on stewardship for strategic capabilities.

3.7. Knowledge systems perspectives

"When the centipede was asked in which under it moved its hundred legs, it became paralyzed and starved to death because it had never thought of it before and had left its legs to look after themselves "(Koestler, 1968). This expression implies that the actors in the system adjust themselves in a certain way which is hard to predict to achieve the objectives in a synergistic way.

Features of KIS perspectives

- They stem from reflective practice rather than from scientific inquiry; (stimulation of imagination)
- Different actors at many different levels make decisions affecting the innovation of agriculture.
- Continuing power struggles among actors is an indicative for the type of innovation.
- Complex innovation theaters have to accommodate arbitrariness, allowing those concerned to make their own judgments in terms of means and ends by creating space for contextualization, (re) appreciation of views, positions, and relationships among social actors.

3.8 Social network analysis

Social network analysis helps to understand the pattern of relationships among social actors at different levels and the influence of these relationships on individual or group behavior. Effort to explain the pattern and features of social connections and how they structure behavior have led to development of prominent social network theory. Strong connection where network members have frequent interaction, everyone will be receiving same bits of information from everyone else leads to successes. For instance, members of a village community who are connected to other villages are likely to receive new bits of information than those who are not. The same can apply for social strata. Individuals connected to people of different level of social strata tend to receive different information than those within same social stratum. The proposition of this theory is that connections that cross boundary (geographic/social) provide access to new sets of information which can influence behavior of individual actors through diffusion process. Along this, making distinction between strong and weak ties is important to examine the features of social networks where a researcher could identify indicators for weakness and strength of networks (Borgatti and Halgin, 2011).

In network analysis, one can look at the vertical and horizontal relationships where the former helps in having access to new information while the latter is essential in the dissemination of new information. A group of farmers with strong vertical links are more dynamic than others limited to horizontal links. An important step in network analysis is examining and understanding the frequency of communication which serves as an indicator for strong relationships (Ramirez, 2013).

An example: Sharing of information on agricultural technologies (Beyene, 2010).

Farmers may make use of their social networks established on the bases of kinship, friendship, business connections (through being a member of different cooperatives, producers cooperative, marketing cooperating, credit and saving group, conservation and environmental management group). They develop social capital that helps as an asset to mobilize resources of which information on relevant technologies available elsewhere in the network is important. An informal seed sector or farmer-based seed system in many parts of Ethiopia operate using social networks as source of information. Farmers' access to quality seed is facilitated by networks. In

this scenario, the more farmers invest in creating social network, the greater will be the chance to have access to reliable and timely information to make decisions and undertake actions. Interventions aiming at improving seed supply systems should not only focus on how to increase seed supply through the inclusion of the informal sector into seed programs, but also emphasize the role of social network and its instrumentality in facilitating seed and information exchange.

Writing a term paper

Possible areas of term paper titles

You are required to choose among the following possible topics to work on your term paper.

1. Improvement of Indigenous practices
2. Introduction of new technology to a particular social system
3. Sustainable resource management (natural and human)
4. Participation of farmers in agricultural research processes
5. Knowledge culture and technology in agricultural knowledge management

If you find out some other potential topics that might be related to (or different from) one of the above topical guides, you are very much welcome. Remember that these four points are not exactly topics (themes) for your paper. You can relate the theme to one of them.

Requirements of the paper

1. Clarity of the language
2. Clear handwriting
3. The problem should reflect the real word
4. Problems have to be seen systemically (not systematically)
5. The roles, functions & contributions of all relevant actors around the problem have to be clearly sorted out.
6. The necessary policy environments that need to be suggested to seek continuity.
7. The paper size should not exceed 4 pages but must not be less than 3 pages.

8. Clear structure (title, introduction of the problem, tools to solve it and conclusions that can be drawn).

The paper is considered as a learning exercise to enable you relate theoretical views and practical matters treated in the class to your own "piece of thought" of the real world situation; for instance in your region or country.

Chapter 4: Knowledge management, technology and tools

Objectives:

By the end of this chapter, students will be able to:

- Describe the role of information technology in knowledge management;
- Identify the specific tools available in using the technologies to manage knowledge and information; and
- Indicate the limitation of the information technology in knowledge management

4.1. Knowledge management technologies

Effectiveness of the knowledge management is determined by the organizational process in which knowledge is managed and the human factors that affect the quality of the process which nearly takes 80% of the efforts. The presence of technology can contain the remaining 20%. Knowledge management tools include the use of documents and information about living experts who provide advice and share their skill with colleagues which can be much more efficient, easier and quicker than the use of documents. Other tools include the use of enterprise portal where a single point is used to have access to knowledge easily and timely and the lessons learned or the knowledge base where reflections over experiences are crucial.

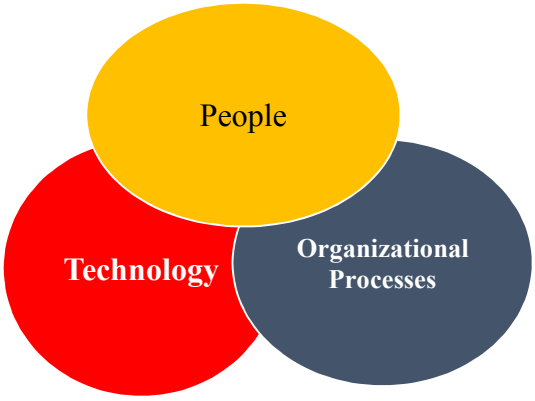

Figure 7: Components in knowledge management

A more useful tool is the development of "communities of practice" which enables groups engaged in related activities to come together and share knowledge. The size of the group should be large enough to have a critical mass to obtain rich knowledge and small enough not to inhibit interaction among group members. It has been often emphasized that "A less centralized informal leadership of a community of peers, practitioners and professionals is the preferred structure since decentralization and informality allow for openness and reciprocity in interaction" (Uriarte, 2008:91).Technology has a role in enhancing social interaction. When this is supported with efficiently designed organizational processes, it can enhance knowledge management processes. The mere presence of technology does not provide a guarantee unless investment is made in human capital development (the people).

The purpose of using knowledge management technologies as tools is to:

- Enhance and enable knowledge generation, codification, and transfer;
- Generate knowledge (e.g., data mining that discovers new patterns in data);
- Code knowledge to make knowledge available for others; and
- Transfer knowledge to decrease problems with time and space when communicating in an organization (Ruggles, 1997).

Based on Rollet (2003), knowledge management technologies can be classified as communication, collaboration, content creation, content management, adaptation and E-learning, networking and artificial intelligence. For a successful knowledge management, the integration of the cultural dimensions of an organization and technologies at use are important. A mere focus in technology will not bring success in any knowledge management project.

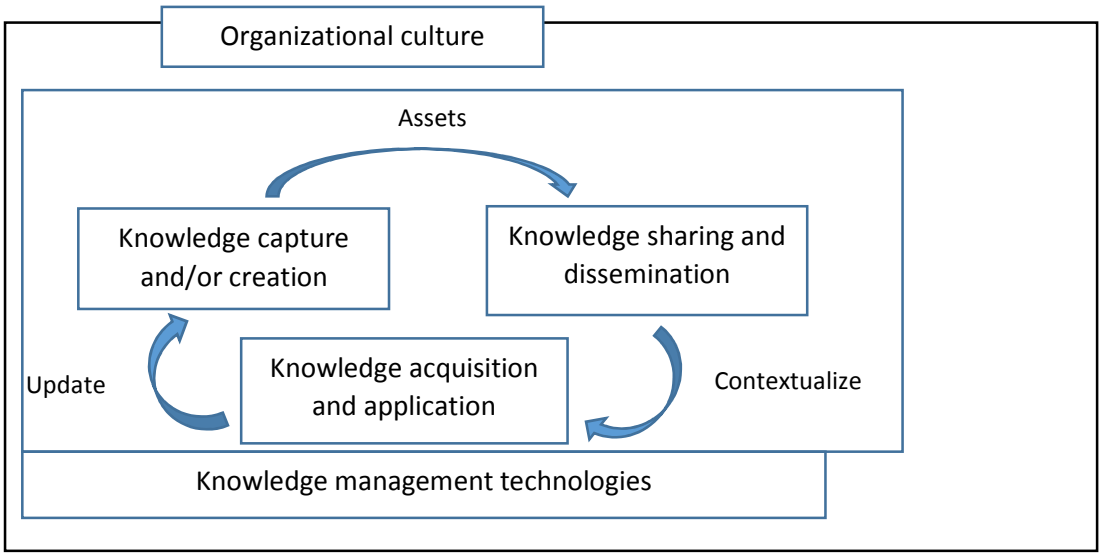

Figure 8: The technology component in an integrated knowledge management cycle (Source: Rollet, 2003:219)

A knowledge captured or created can be shared like any other assets through the use of certain technologies and the user can contextualize the knowledge. Once contextualized, it can be used to

solve the problem and this process of application will generate some experiences and with additional information the knowledge user can update himself/herself as the case allows. Such cycle in the use of knowledge management technologies can be widely applied in business, agriculture and manufacturing. The process remains iterative and is never-ending. Data mining and knowledge discovery take a crucial part of the cycle as it helps updating based on the available large set of database and subsequent statistical analysis.

Communication and collaboration technologies are also essential in knowledge sharing and dissemination. [1]Networking technologies (such as extranet and intranet, web browsers) and artificial intelligence technologies (such as expert systems and visualization) are quite useful in the knowledge management cycle. There are tools designed for the knowledge acquisition and application including the use of artificial filtering tools employing the intelligent agents, which are computer program using some software that can gather news and acts autonomously on its own initiative and has intelligence to learn, and improves its performance in executing certain tasks (Dalkir, 2005). An example is responses received in the publication of manuscript review processes, scheduling of appointments and air traffic control.

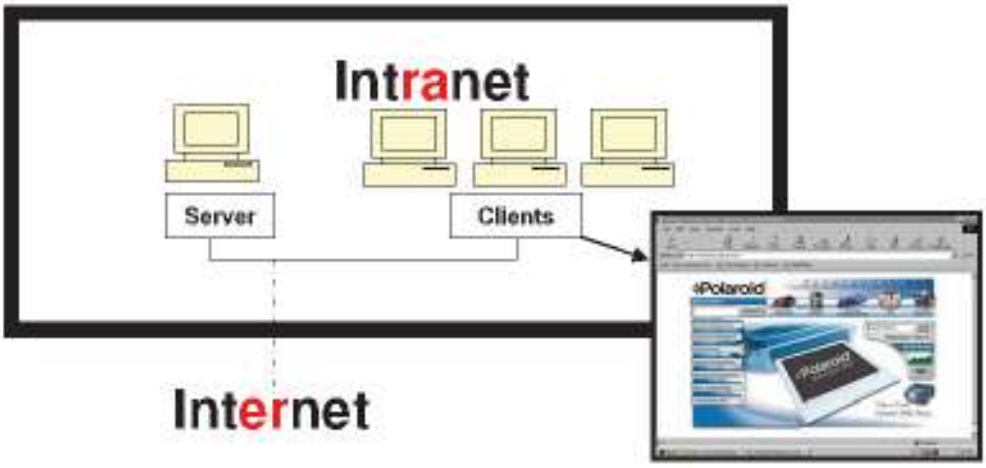

Figure 9: Intranet and Internet networks

4.2 The role of ICT in knowledge management

Since knowledge management practices focus on the collection and codification of knowledge, there is a need to adopt a knowledge-centered approach. The practices involve the process of

[1] Intranet refers to intra-organizational network used to share information within an organization whereas extranet is inter-organizational network where different organizations can secretly share information (as in business, security).

capturing knowledge in formats that can be stored and retrieved. In a knowledge-centered approach, knowledge management largely depends on the creation of databases, expert systems, corporate portals, digital, directories, navigators and other information technology solutions. The success in such efforts depends on how we apply ICT in facilitating an effective architecture that can bring appropriate knowledge to the point of action whenever needed (Velden, 2002).

Although the theory of knowledge management puts greater emphasis in people, organizations practicing it actually emphasize the use of applications of information and communication technology, which is pivotal to capture the explicit knowledge, and to transfer it in a timely efficient manner, whereas tacit knowledge cannot be codified using information technology and made accessible to others. And it can only be learned through social interaction (Brown and Duguid, 2000).

Vedeld (2002:33) indicates that in supporting knowledge management for development, ICT should offer tools:

- to compare data, information, and knowledge;
- to develop alternative scenarios;
- that support online communities of practice;
- that help make information and knowledge accessible based on people's social, cultural and educational background (incorporating language translation, social translation, and formatting tools); and
- that help people to present their information and knowledge in appropriate and effective ways

Thus, the design and application of the ICT tools need to recognize the social context in which the tools are used, the perceptions and priorities of people, diversity in terms of gender, social class and ethnicity in order to address different needs and holistic knowledge systems rather than expert systems in order to enhance knowledge sharing. These factors are crucial in the use of ICT to address problems of knowledge management in a flexible way and to contribute to development.

4.3 Application of ICT in Agricultural Knowledge management

Effective knowledge management can be realized when the right knowledge and information is delivered to the right person at the right time using an effective channel which enable users to perform their tasks efficiently. In the agricultural sector, the outcome of the effective knowledge management is expressed in terms of its impacts in improving productivity and performance of the agricultural sector.

Box 1: Ethiopian Case Study on Application of ICT in Agricultural KM (Source: UNDP, 2012:21-23)

In Ethiopia the use of ICT for the accumulation and dissemination of knowledge and information is still low. Currently, among the various ICT related initiatives, radio is widely used to share and inform users on agricultural issues, including new and upgraded farming techniques, production management, market information, and other issues. Due to its strategic importance in reaching the majority of the smallholders, attempts are being made to strengthen the delivery of knowledge and information through radio program.

The initiative of Farm Radio International (FRI) is one best case in the use of ICT for agriculture. FRI, a Canadian based not-for–profit organization, started its operation in Ethiopia in June 2011. It operates in direct partnership with some local radio broadcasters where it supports them to build the necessary skills to develop content that responds to the needs of local small-scale farmers. In order to provide the radio broadcasters with news and resources that help meet the needs of small-scale farmers, FRI produces a weekly publication called farm Radio Weekly that is delivered to e-mail inboxes every week with free subscription. FRI also prepares and collects agriculture related knowledge and information and product radio script that is used by the partner broadcasters. Apart from such traditional ICT tools (i.e., radio and TV), the use of modern ICT (Computer, internet, mobile telephone, etc) remains very low in the country. However, some activities that make use of ICT tools in agricultural knowledge and information management are underway and are worth mentioning.

A project on improving productivity and market success (IPMS) of Ethiopian Farmers was implemented with the objective of assisting the Ministry of Agriculture to develop a knowledge management system. This IPMS project has developed web-based portal and also established knowledge centers. The Ethiopian Agriculture Portal aggregates information from diverse national and international sources. It contains technology, market related as well as extension packages for a wide range of crops, forest products and livestock. In addition, it deploys agricultural research outputs drawn from national and international research institutes, and higher education institutions. In response to the unavailability or poor internet network in many rural areas, the project has also developed an offline version of the portal that provides access to most of the features of the online version. In addition, *woreda* knowledge centers are established in each of the pilot learning *woredas*, where it operates. Each center is equipped with computers, a printer, a TV set, DVD player, and telephone line and access to internet connection among others. These centers provide the respective word extension personnel easier access to agricultural information and thus empower them to be better prepared to discharge their duties. At present the IPMS project only operates in the ten pilot learning *woredas*. Any attempt to scale up the activity to other *woredas*

and FTCs has been hampered by lack of electricity, internet connection, computer skills, and system. It carries out trading budget among others.

The Ethiopian Commodity Exchange (ECX) is yet another notable organization that has embarked on some modern types of ICT- based information management system. It carries out trading of the agricultural commodities on its trading floor located in Addis Ababa and disseminates price information in real time to producers, consumers, and traders using electronic price tickers as well as its website. At present, there are 30 price tickers installed in towns across the country and it is projected to reach 150 by the end of 2012.

The price tickers are also used to transmit any change of price information directly in real time to the users. In addition, ECX has developed a prototype for data dissemination using short message services (SMS) and interactive voice response (IVR). In 2012, there were about 200 thousand users of the SMS service, and about 40 thousand IVR users per day of which, the majority (65 percent), were from outside Addis Ababa. Although progress has been made in using ICT to provide a wide range of knowledge and information, it is still low. Innovative approaches such as ICT kiosks that serve as centers for providing a range of knowledge and information are not yet widely available in the country. In rural parts of Ethiopia, where access to information on individual basis may be costly and also unavailable, such arrangements are believed to have the potential to bring the required information to the rural community in the most cost effective way.

Continuous interaction among the stakeholders in the agricultural sectors ranging from farmers all the way to the agricultural policy-makers is a good indicator for effective knowledge management. In the African context, the process of ensuring effective knowledge management in the agricultural sector is heavily influenced by a number of constraints including (1) inadequate means of capturing, systematizing and sharing the available knowledge, (2) inadequate analysis of the agricultural sector communication of the stakeholders, (3) use of less effective media (UNDP, 2012).

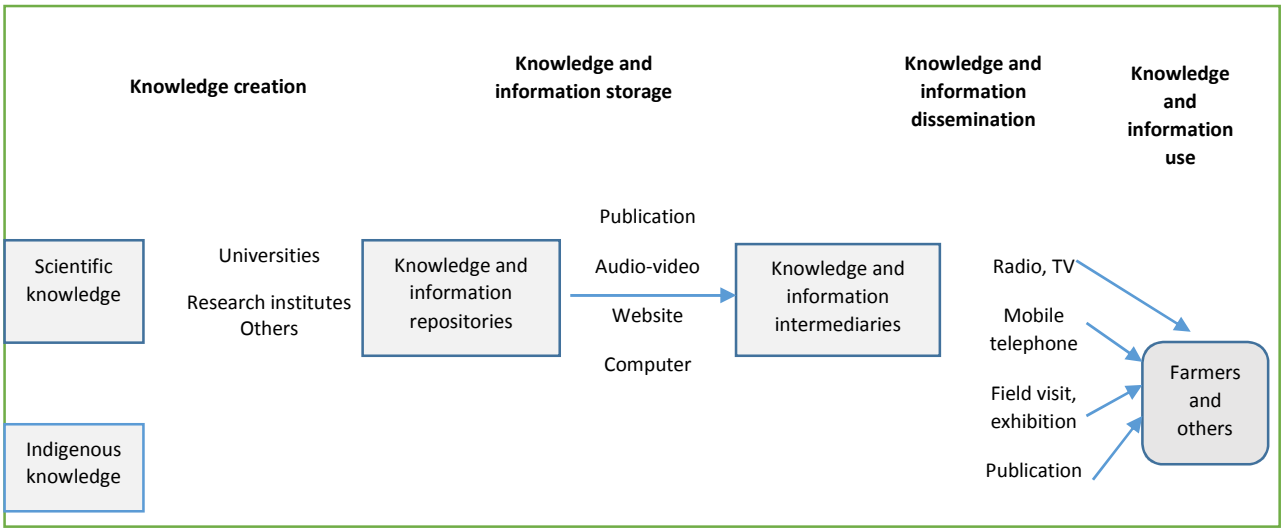

Figure 10: Tools of information and knowledge management in agriculture (source: UNDP, 2012:18)

From Figure 10, one can see that agricultural information and knowledge created based on indigenous and scientific knowledge sources at universities and research institutes is stored in various forms prior to its dissemination. The main repositories for such knowledge can be in the form of publications, audio-visuals, computerized data bases, and websites. The stored knowledge and information is then disseminated to ultimate users, including farmers, agro-product processers, development agents and traders through intermediaries notably during trainings, field visits, exhibitions, publications, and using traditional forms of ICT (TV and radio), modern forms of ICT (internet, mobile phone, etc), and others. The above steps-like in the knowledge management process can be expressed in a cyclical pathway where the application and use of knowledge leads to creation of new knowledge to deal with new problems and meet new demands within the society.

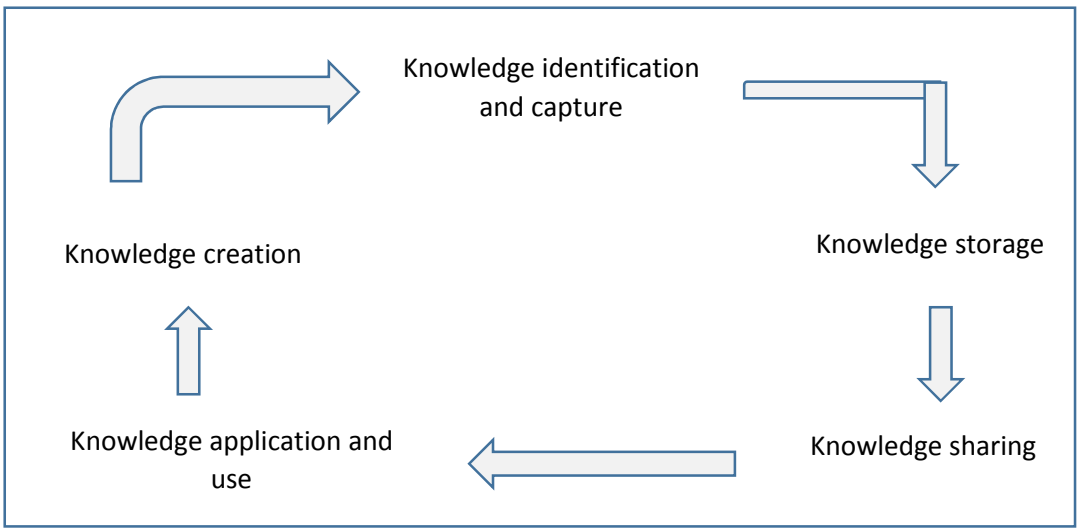

Figure 11: Knowledge management processes (source: Cong et al. 2007:253)

If knowledge management processes become effective and farmers are made aware in how to use technology, then the role of extension agents can change from supplying technology to transferring knowledge and information packages. Extension service of this kind becomes mostly knowledge intensive and better respond to the needs of the farmers timely. For this to take place, a heavy investment should be made in human capital development and information technology infrastructure. In such a case, ICT service will help extension agents engage fully in the knowledge management activities where they will be able to gather, store and disseminate knowledge and information that farmers may need in a timely manner. In the Ethiopian context, for example, priority in the expansion of ICT can be given to the *woreda* level farmers training center (FTC) where there are agricultural offices involved in agricultural knowledge management.

There are different tools and techniques available for knowledge management using ICT. Though it varies from one to the other literature, one can identify five essential categories of technology requirement in agricultural knowledge management. These include (1) database and data warehouse technologies which are used to store and retrieve large amount of data at

affordable cost including temporal historical data on crop production and protection as well as meteorological facts and other useful data required for further analysis and decision support, (2) data mining techniques which enables us to extract new finding and meaningful patterns from large database from which extension agents can develop useful advice and provide farmers with the necessary information, (3) an expert system which is an intelligent computer program that is used to solve problems going beyond the capacity of humans to provide solutions, (4) a geographic information system (GIS) which uses a software to generate data for capturing, managing, analyzing, and displaying geographically referenced information that shows relationships, patterns, and trends in the form of maps and (5) simulation and modeling where different scenarios of initial situations are used in order to support environmental characterization, optimizing crop management, pest/disease management, impact study of climate change, yield forecasting and effective crop scheduling (Sadaan, 2001; Dey and Sarkar, 2011).

4.4 Using mobile and videos in agriculture

The use of mobile phones enabled farmers to make quicker decisions than ever before. They will have access to different sources of information including market prices of their produces, weather information and share these pieces of information with their network members. The use of short message services (SMSs) and voice recording have contributed to the significant improvements in communication and decision making. Exchange of information using mobile phones not only enhances the pace of communication but also extend the chance of making choices among available alternatives. For example, farmers' choose appropriate varieties, the type of fertilizer suitable for the soil type they operate on, and where to sell their produces.

However, the technology is not affordable to many farmers in developing countries. The cost of maintenance has become so high. In areas where access to power is limited or non-existent, farmers cannot use the technology. Though entrepreneurial skills are growing in many rural parts of Africa, communication among actors along the value chain is constrained due to limited power infrastructure. Where power exists, the network quality is poor and communication becomes difficult. In another circumstance, language barrier and farmers low level of education undermine the use of the technology. A recent study assessing the potential barriers and advances in the use of mobile technology for agriculture indicates that low level of literacy constrained the communication of farmers with information centers for market, pesticides and weather. Thus, the use of mobile as technology in knowledge management has a number of barriers. Investment in ICT infrastructure cannot contribute to agricultural development unless supported by development in other sectors such as education and electric power supply (Chhachhar and Hassan, 2013).

An alternative that could resolve the constraint posed by education could be the use of videos in the transfer of knowledge and information within the agricultural community. As communication and information technology expands very rapidly, the importance of videos has increased. Videos can be used flexibly for educational purposes and one can make use of compact disc do

document and display them. They can be multiplied easily and distributed to rural communities so long as electric power exists. With little cost, establishing a group of farmers watching agricultural videos in a village has been effective in many developing countries. They can repeatedly watch the video individually or in a group as many times as possible to develop better understanding of the educational materials included in the video. For instance, a study report indicates that farmers who watched a Rice Advice Video by the Africa Rice Center with eleven learning modules have decided to pay for the video and buy it (Mele, 2011).

4.5 The use of Metadata and Schema in knowledge management

Metadata is usually termed as 'data about data' or 'information about information'. It is generally engaged for describing the properties of information resources, in order to facilitate their categorization, storage, search and retrieval in digital collections. If metadata is stored in a structured and standardized manner, it may generally support the automation of search and retrieval mechanisms, the comparison between descriptions of different resources, the reusability of descriptions in different applications, as well as the interoperability between different storage systems (Manouselis et al., 2009). An example of metadata created by FAO in order to enhance information sharing and managing knowledge can be presented as follows. It provides detail framework for gathering and systematizing information about an organization.

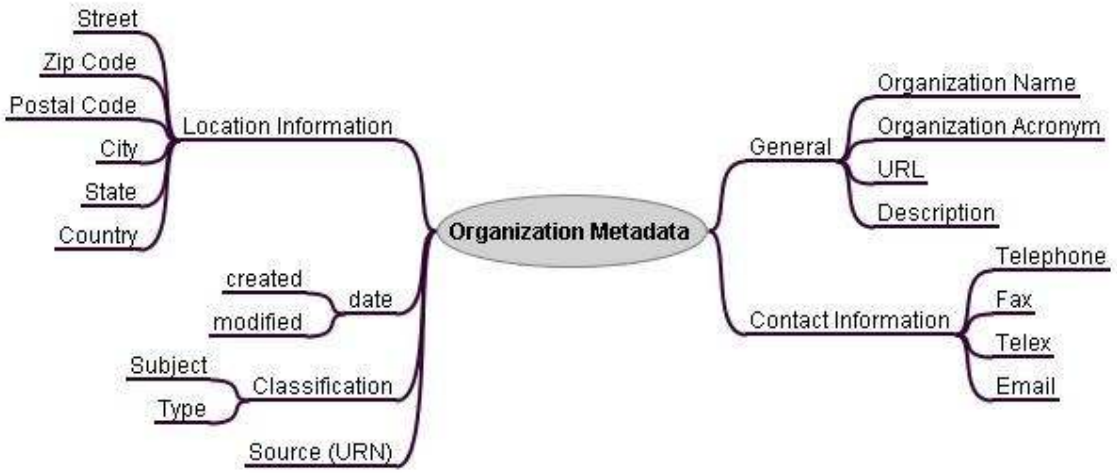

Figure 13: A Metadata for organizational profile (source: FAO, 2008)

Metadata is used as a framework for organizing information and indicates how different pieces of information in a particular material are related. We use schemas to make category of information needed or to be collected in order to explain relationships. For example, the pattern of agricultural information sharing in particular village can be represented using a schema. In this context, we can start by identifying the type of information shared, who shares which type of information with whom, how they use the information obtained and what are the outcomes of using each type of

information. Each of these categories of information (schema) can be further adequately described, examined and eventually generate insights on how to help farmers to make use of information to improve their farming systems and their livelihoods. Therefore, the use of metadata as a knowledge management tool requires special skills and one may be required to follow certain procedures.

4.6 Recent techniques in knowledge management using ICT

There are certain mechanisms in the documentation of information and the use of this information to generate insights and create structured knowledge. These include:

- *Cloud computing* - is a technique of using internet as a storage of information (webmail, online file storage) instead of keeping it on hard drive. Cloud computing helps individuals to have access to information and resources on computers operated by others in remote locations.

- *User-generated content* – includes different contents such as video, discussion form posts, digital images, audio files, and other forms of media that are created by consumers or end-users of an online system or service. They are also available for use by other consumers and end-users.

- *Big data/open data* - is the concept used to describe very large, complex and rapidly-changing datasets. The concept of big data and open data are related but do differ in that not all big data may be open for different reasons (e.g. political for security reasons or economic by companies making profit). An example of big data could be explaining the global impact of climate change on agriculture in the developing world. This might be complex and large but a team of scientist may not be interested to release such data. The degree of sensitivity of the data may prevent or permit its openness. For instance, FAO may release yearly global agricultural yield based on country level data allowing researchers to compare and contrast differences. In this context, big data is referring to the size while openness indicates the extent to which generators of data are really democratic or transparent.

- *Precision agriculture* - is a recent farming approach involving the concept of observing, measuring and responding to inter and intra-field variability in crops. The system uses technology on agricultural equipment such as tractors, sprayers, harvesters as well as ICT facilities such as GPS and GIS to ensure effective and efficient use of land resources. The GPS facility and GIS software are used to provide accurate data which will help farmers make decisions and develop solutions (McBratney et al., 2005).

4.7. Intellectual Property Rights and Knowledge Management

Intellectual property rights addresses the rights of individuals to their own creative work that they are legally entitled to possess and all other individuals would hold the duty not to use it without their permission. In other words, they are labelled as intangible resources or assets (Hall,

1992). The users of the property are legally obliged to recognize the right holder to make use of their work. For instance, in the case of agriculture, those breeders who invented new breeds and varieties and agronomists who discovered new techniques of farming hold intellectual property rights. The same principle applies to other sectors such as manufacturing and entertainment industries. In general, the intellectual property rights can be protected in three ways: copy right, patents and trademark. Breaching either of these three laws is recognized as violation of rights or infringement. Copyright is infringed when someone exercises the exclusive rights of the copyright owner without the any permission although the infringement occurs unintentionally. Copyright owners could take the case to the court to defend the illegal appropriation where the court may analyze and compare the copyrighted work and the disputed work (Breitwieser and Foster, 2012).

Researchers working at a university developing a technology or newly manufactured equipment or machine in industry carry a patent right to protect the developer of the technology from any violation by others. Patent rights can be protected through securing trade mark from the licensing office[2]. Comparing copy righted material and patent rights to inventions, the former can be loose and hard to control. The expansion of communication and information technology has put a limit to the intellectual property rights protection. For instance, published materials are so huge in extent and many of them are available in soft copies in order to make knowledge accessible to everyone. In the process, the violation of copy rights involving plagiarism becomes frequent (Hall, 1992).

In connection with the fact that copy rights protection induces monopoly of agricultural knowledge and hence limiting access to this knowledge by the poor countries, new forms of copy rights have been introduced: the creative commons and open-source licensing. The aims of creative commons is to avoid registration of one's work and the work can be released simply under the terms of use the owner puts. The simplicity of the procedure makes the knowledge accessible to others quickly and easily. Copy rights are protected within the law but users of the intellectual resource can copy, use, edit, remix and distribute but for non-commercial (educational) purposes. The open source licensing is commonly used to share software for free, use them and change them to make them suitable for a specific purpose. There are a number of software materials developed that can be downloaded and used freely. There are also video materials that are available openly for use by others. In the end, the growing interest in creative

[2] A trademark is a word, name, or symbol that indicates the source and origin of goods and services. A patent is a limited-term monopoly granted by federal statute to inventors of new, useful and non-obvious inventions. Copyright is a property right, owned by the author of original works of authorship for a limited term of years, as set forth in the copyright law. Copyright does not protect facts, ideas, processes, concepts, systems of operation, or principles. [Downloaded at: https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf] on July 20, 2015.

commons and open source licensing facilitates knowledge management as both provide a large data set and information that can be synthesized (Laurent, 2004). These initiatives help us save financial resources needed to have access to knowledge or create them.

Discussion questions:

1) Discuss the role of ICT in the agricultural development process.
2) What are the underlying challenges in the proper use of ICT in knowledge management? Please provide specific cases as examples to support your answers.
3) What are the efforts made in your country to invest in ICT infrastructure?
4) How do you evaluate the role of culture in using ICT?

Chapter 5. The Advantages of Studying Knowledge Systems

Objectives

By the end of this chapter, students will be able to:

- Explain the reasons for examining knowledge systems and the contribution of the ICT in improving knowledge sharing;
- Describe how knowledge management becomes crucial in policy formulation and the link between knowledge and policy-making;

Development in human knowledge always goes against absolutism and the essentiality of massive participation is driven by the notion of constructivism. The study of knowledge systems is crucial in designing ways of knowledge sharing, exchanging and dissemination using ICT tools. The basic objective of knowledge management is to transform information and intellectual capital into valuable assets through strengthening, improving and propelling any organization, contributing to agricultural development by making use of existing information and knowledge.

Some of the roles of ICT in examining agricultural knowledge systems are:

- Building and kinking a national agriculture research information system including research outcomes, projects, institutions and researchers in different countries and regional research information systems that works as a portal for all the national agriculture research information system; e.g CGIAR, and FAOSTAT, for the storage and dissemination of statistical information

- Developing an information system where researchers share knowledge about the existing indigenous agricultural practices which are useful for sustainable agricultural development, where such knowledge could be kept for the future generations and will not disappear due to advancement of technologies;

- Developing models for decision-making in the allocation and use of agricultural resources including water (crop-water requirements) and land, estimation of potential and actual yields, quantitative assessment of water resources for the purpose of planning and managing the efficient use of the resource; expert systems tools for the provision of advice and decision-making on land and water use and management options, based on existing information and knowledge. For example, World Overview of Conservation Approaches and Technologies (WOCAT) serves as a tool in decision making on land management and to disseminate knowledge on soil and water conservation (SWC) globally and to identify options for overcoming land degradation problems (Rafea et al.,2003): i) policy designing, implementation and evaluation and 2) improving performance of institutions.

There can be several advantages of studying the knowledge systems of a particular region or country at large. The following three are most relevant to the social and economic situations of different countries.

5.1 Policy designing, implementation and evaluation

With simple definition, policy involves economic and political decisions made to achieve general goals. Policy makers develop program and formulate projects at macro and micro-levels to convert policy proposals into practices. These projects and programs can have specific objectives and target groups in such a way that the combined effect of different projects and programs jointly contribute to the overall policy goals.

During designing, appraisal and implementation, policy is on the level of analysis. These stages are contingent to each other.

Questions:

a. Do you see difference between planning and policy-making?

b. What relationship do they have?

Styles of policy formulation

There are two styles

1. An expert style

- The communication between policy relevant actors during the process of analysis is negligible or is a considered as secondary activity.

- The effect of implementing policies formulated in this style becomes continuous production of discontinuities.

- This style of policy formulation is often directed to reducing heterogeneity through standardization.

The style assumes linearity:

Policy formulation ⟶ implementation ⟶ evaluation

Since cultural perceptions and social interests are not getting considerations, the implementation stage is accompanied by unexpected/unanticipated and often undesirable consequences.

This suggests that instead of asking why a certain policy, project or program did not work out as planned it is important to concentrate on the emergent forms of interaction, strategies, discourse, & actors involved in intervention practices.

2. *Participatory style*

Some of the features of the participatory style in policy formulation include the following:

- Various types of policy relevant actors participate and communicate actively during the process.

- Ensures knowledge generation, transformation and utilization in the process of investigation due to the high level of actors involvement.

- It is the information and knowledge obtained through scientific research involving local groups that yield better opportunity for informing policy - makers.

- The assumption of linearity does not work unlike the expert style. There is continuous redesigning of policies through revising the planned objectives of projects and programs and changing them to respond to the real needs of the target groups.

- Instead of standardization, there is targeting of policies to specific situations and cultural interpretations.

For instance, similar policy decisions may not favor;

a) traditional and progressive farmers

b) the poor and the rich

c) landless and land owners

Therefore, using the experiential knowledge of either groups will lead to policy bias. Even if any policy does not equally favor different target groups, it has to be associated with compensation for slightly disfavored groups. Knowledge managers can rely on the available data concerning the target groups in order to implement agricultural policies for promoting changes. A commonly used participatory in the designing of policies us the consensus conference method (CCM).

- CCM was practiced initially by United States in the public health sector and, later on, the approach is developed by Danish board of technology (DBT) in to a general tool for technology assessment.

- CCM is recently practiced in the Dutch agriculture genetic modification of plants and animals.

- The method arranges a high quality debate on potentially controversial and complex societal problems with active participation of actors.

In CCM, panel discussions are commonly organized.

Panel types

a. **Laymen panel /question panel**– this consists of individuals having no special knowledge about the policy being developed

b. **Expert panel**–a panel consisting of individuals who have special knowledge on the subject and hence can provide an expert analysis based on existing data and information and who can apply ICT to synthesize existing knowledge applicable to solving a problem.

One of the constraints in combining individuals from both panels is the differences in knowledge may inhibit effective participation, which was mentioned as barriers to knowledge sharing.

The role of the policy analyst is to play a mediating role without advocating or opposing the views /issues raised by either of the two

The analyst can also use specific criteria for selection of participants in the panel (sex, age, level of education, disciplines)

Question: What is the advantage of organizing panel discussions in participatory policy analysis?

- In CCM, an expert is not a special kind of person, but each person is a special kind of expert, especially with respect to his/her problem (Hisschemoler, 1993). Therefore, community participation and collaboration are essential in the process. When this is supported with the improved technology to process data, knowledge could be easily generated and analysis could be carried out efficiently to make decisions. The two components are inseparable and one would complement the other in the knowledge management process.

Figure 14: Technological change and community participation in enhancing policy analysis

In CCM, if a certain policy problem is not equally important for relevant actors, an intractable controversy will emerge. A controversy is intractable if the policy relevant actors cannot come to negotiated agreements in the policy analysis process. To overcome the controversy problem in participatory policy analysis, problem structuring is very helpful. Problem structuring involves a high degree of consensus on relevant values and norms and certainty about relevant knowledge for

policy analysis. During these processes of structuring, policy relevant actors (laymen and experts) continually arrange debate to clarify the policy problem situation. There are four policy problem types. Look at the table below.

Table 3: Problem structuring with certainty of knowledge and census on norms and values

		Consensus on relevant norms and values	
		No	Yes
Certainty about relevant knowledge	No	unstructured	Moderately structured (ends are clear)
	Yes	Moderately structured (means is clear)	Completely structured

Source: Hisschemoller, 1993:247

Question: Do you see any relationship between structured problem and standardization of the expert style?

Structured and moderately structured policy problems can move straight from recognition to resolution but unstructured policy problems are too controversial and ambiguous.

Solving an unstructured policy problems requires problem structuring, which is essentially a political activity, involves development of new insights and constructive views from the policy relevant actors on what the problem is about.

It is sometimes difficult to make clear distinctions between policy environment and problem environment since policies aim at problem solving. Look at the chain exemplified below.

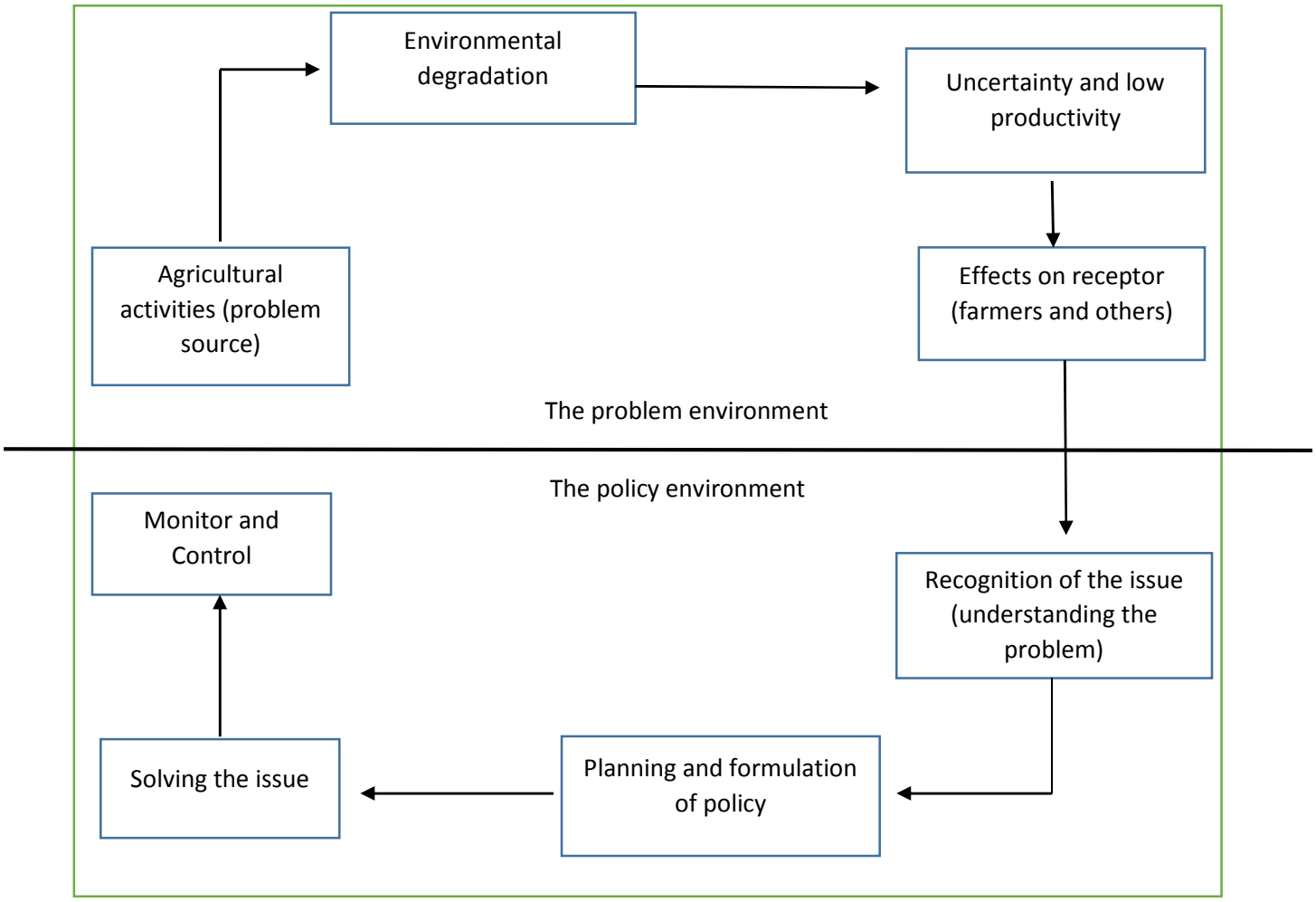

Figure 15: The problem - policy environment cycle.

It is important to note that there are different *problem structuring methods*. These methods use collection of participatory modelling approaches that aim to support generation of knowledge from diverse collection of actors in order to address a problematic situation with shared concern. The problem is normally characterized by high levels of complexity and uncertainty. This is required to respond to differing perspectives, conflicting priorities, and prominent intangibles among social actors which are the norm rather than the exception. Typically, the most challenging element in problem structuring is the framing and definition of the critical issues that constitute the problem, as well as understanding the systemic relationships between these issues (Shaw et al., 2006). There are different methods available for problem structuring: soft systems methodology, strategic choice approach and the strategic options development and analysis.

The soft systems methodology builds ideal conceptual models, to be later compared with the perceptions of the current system, and attempt to propose viable changes that could make the systems more suited to the needs of actors in the system. The Strategic Choice Approach (SCA) aims to assist in the identification of relationships between seemingly unconnected sectors. Participants try to clarify situations and resolve uncertainty by raising and comparing alternatives for making decisions of strategic nature.

The Strategic Options Development and Analysis (SODA) bring out and register problematic situations using the cognitive mapping tool. When the participants get their visions for such situations, one must make a collective and consensual assessment scenario, so that, with the new representation, we can propose a set of actions and commitments. Of these approaches the soft systems methodology might be more important in knowledge management as its use can be fine-tuned to a particular sector, in this case agriculture.

5.2. Improving Institutions' Performance

The study of knowledge systems is also essential to induce changes in the performance of the institutions where these institutions make use of diverse knowledge from different actors who undertake various tasks. In this case it is assumed that performance is improved through transforming the structure and function of relevant institutions and changing policies favoring such transformation. There are two types of institutions: the old and the new, where such classification is based on mode of operation where the old ones are not ready to learn in a flexible way while the new ones try to update themselves constantly using new knowledge and information obtained from different sources. Here, the role of knowledge managers in both types of institutions differs, which has been summarized as follows using a table.

Look at the comparison given below between old & new (desired) institutional settings.

Table 4: Comparison of the old and new institutions

Themes	''old'' institutions	''new'' institutions
1. Mode of decision - making	Centralized and standardized	Decentralized and adapted to the context (flexibility, multiplicity)
2. Mode of planning	Static design, fixed	Evolving design, wide

and technology delivery	packages, supply-push	choice, demand-pull
3. Response to external change	Collect more data before acting	Act immediately and monitor consequences
4. Field learning	By 'rural development tourism' and questionnaire surveys; error concealed	Learning by dialogue & participatory inquiry and methods; error embraced
5. How those in institution at the top learn ?	Self-deceiving; misleading feedback from peripheries give falsely favorable impressions of impact	Learning through feed back; adaptive and iterative process
6. Linkages and alliances	Institutions work in isolation	Institutions linked formally & in formally to each other.

Source: Pretty and Chambers (1994)

Discussion Question: Describe the characteristics of knowledge managers in the old and new institutions. Please provide examples based on a case or a case study you are familiar with.

The practical importance of systemic thinking and other participatory social research methodologies is they help to gather realistic information through systemic inquiry (qualitatively) that would give answers to certain policy questions:

These questions may include;

a) What factors constrain the old institutions' performance?

b) What should be done to bring context change?

c) Which challenges should institutions face to enhance their performance?

d) How can indicators for improved performance be identified?

In general, the new institutional settings suggest enhancing participation in development interventions which has an implication for a knowledge management strategy. From sociological point of views, contextual (process) planning of systemic inquiry can easily respond to the above policy questions. This approach guides to the exploitation of local diversities. To achieve this three aspects have to be *integrated*.

These are:

a) *Participatory methods* - support local innovativeness

b) *Interactive learning environment* - encourages participatory methods by creating attitude changes, in which each knowledge source is valued and recognized.

c) *Institutional support* - for scaling up (dissemination) of the methods

This condition provides the best opportunity for building upon already existing knowledge of the producers through facilitation. Facilitation of learning processes with local groups leads to changes from the Transfer of Technology (TOT) to new professionalism.

TOT		New Professionalism
Adoption	→	quality of decision making
Applied communication	→	soft systems methodology (SSM)
Scientific truth	→	consensus (negotiated agreements)

In general, systems approach help as a tool to improve performance of institutions through enabling them to shift to the 'new' line of thinking that goes further away from *controlling with* emphasis on *enabling*.

The classical theory underlines the adoption and diffusion of innovations where farmers adopt innovations through a certain process. The processes through which they receive information and examine the innovation and make decision are often called diffusion of innovation adoption processes. Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. In this case, the decision to adopt involves fives steps ranging from knowledge to confirmation (Rogers, 1995).The culture of a society can affect the rate of adoption partly due to the information sharing nature of the society and partly due to the sociocultural acceptance of an innovation. If participatory methods in assessment of an innovation are introduced, they can enhance the rate of adoption because the uptake environment can easily expand as information crosses villages and territorial units.

In innovation adoption decision process, social play crucial role. There is a positive relationship between social media and innovation where those advertising their products using social media became much more flexible, are innovative, reduce cost of product development than others who do not use social media. A recent survey shows that companies using social media are able to make more profit than others. The use of social media as a knowledge management is adopted by a number of companies in order to improve their competitiveness. Therefore, a shift towards new professionalism where learning and exchanges are central, social media facilitates the process of learning for producers (Barnes and Jacobsen, 2013).

Group Assignment Understanding the Agricultural Knowledge and Information Systems

Mission statement: identify a specific research, extension and education system that has long been involved in the agricultural research, extension and community support programs. There are also some NGOs and state agencies that directly intervene in the transfer of different technologies to different target groups. However, we still lack concrete information how the technology

generation, transfer and utilization system works, in particular how farmers, researchers and development agents interact and the actual role of each actor in the prevailing systems. In its next 10 years plan, the system is expected to improve its community services to contribute to the betterment of farmers' livelihoods. You are requested to come up with a proposal on how to improve the agricultural knowledge systems of the locality you have identified.in undertaking this task, please stick to the following questions in gathering information.

a) actors involved in the agricultural knowledge and information systems
b) the nature of linkages and interactions among these actors (motivations and commitments, opportunities and constraints, perceptions about one another and the influence of this on communication) and whether this is changing over time.
c) the type of information and technology involved in the system to characterize relevance of the inputs to the system
d) Provide indicators whether change in national policies and other factors have ever had an influence on the nature of relationships and hence on the performance of the system.
e) Develop a system that closely displays the nature of the linkage and describe it.

Chapter 6: Indigenous and scientific knowledge systems

Objectives

By the end of this chapter, students will be able to:

- Define different types of knowledge domains with reference to the scientific and indigenous knowledge;
- Explain the usefulness of indigenous knowledge in natural resource management
- Identify some of the challenges and strategies in indigenous knowledge management

There are terms that seem to replace the word 'indigenous knowledge', including traditional knowledge, local knowledge, "unscientific" or farmers' knowledge. "Scientific" knowledge is often referred to as western knowledge. Some of the examples of indigenous knowledge in agriculture include conservation practices, rotational cropping, use of wild medicinal plants (human and livestock) and weather forecast. Indigenous knowledge is traditional knowledge existing within local communities and societies for a long period of time and used by people living in a specific locality, which are close to nature. It differs from the knowledge generated by national and international research institutes since it is based on experiences and adaptation to local cultures and environments that have developed through time (Parajuli and Das, 2013).This implies that the indigenous knowledge base is indefinite and their implementation involves an intimate relationship with the belief system. Such knowledge is difficult for western science to understand (Gadgil et al., 1993).

The distinction between indigenous and scientific knowledge becomes vivid as one discusses the property rights to a specific domain of knowledge. Let us ask the question: Is knowledge a private or public property? This dichotomy comes into picture as privatization of knowledge through intellectual property rights and the public good nature of it as everyone tried to get it using different mechanisms. As business expands and knowledge loses its public nature, a number of transnational companies are patenting the ancestral knowledge of indigenous peoples, and then trying to earn royalties from these same rural populations for using the seeds that they have patented. The biotechnology companies, instead of recognizing those who conserved genetic resources, make profit from large scale sales of outputs where knowledge is commoditized. This has an implication for the protection of traditional knowledge.

On the other hand, as knowledge production and exchange as well as sharing of it comprises the use of different means of communication as it gets digitalized, the scientific knowledge becomes intellectual common goods which can be copied and multiplied making reproduction costs too small while benefiting the larger global public. For example, what has been produced can be published and reaches ultimate users of the knowledge, where benefits from knowledge produced will exceed the costs incurred in the production process. Such costing is never done for the traditional knowledge produced over the years through a wide range of local experimentation. Human knowledge is the heritage of all of humanity as it signifies the socio-historical development of peoples. Development in human knowledge should start from the historical recognition of the contributions made by ancestral knowledge that gave a way to enter

into dialogue with scientific knowledge. In any case, indigenous peoples have contributed to today's world and to global knowledge where one can witness by clearly observing the products that have originated from indigenous peoples (Moore et al., 2007).

Indigenous knowledge is intangible, in contrast to knowledge that can be made explicit and become information. It has not been valued very greatly nor favored in productive processes and in formal education. However, marginalized communities have principally relied upon tacit knowledge for their own development, survival and resistance. It finds its validity in the experiences of people and social groups since it is difficult to capture. It belongs to the person or group who has lived with it.

6.1. Differences and similarities

What are the differences?

There are three basic differences between indigenous knowledge (IK) and scientific knowledge (SK)

a) Substantive grounds

This refers to the subject matter history and distinctive characteristics of indigenous and scientific knowledge.

IK is anchored to a particular “social group” in a particular “setting” at a particular time.

IK is concerned with immediate and concrete necessities of people daily lives whereas SK makes (constructs) general explanation and does not give emphasis to daily lives.

IK encompasses non-technical insights-ideas, wisdom, perceptions and innovative capabilities.

b. Methodological and epistemological differences

SK is open, systematic, objective and analytical. It builds on prior achievements for advancement; however, IK is closed, non-systematic, holistic rather than analytical, without an overall conceptual framework.

- IK advances on the basis of new experiences, not on the basis of deductive logic (Banuri, et al, 1993).

- IK supporters attack on the dogmatism and intolerance of scientists towards insights and methods of inquiry outside the established and institutionalized science.

- IKSs have of closed nature

C. Contextual differences

- IK is specific to local context in terms of social group and time (temporal and spatial differences) whereas SK is diverted from such epistemic framework to attain universal validity.

6.2 The Danger of Dichotomizing between IK and SK.

This notion reflects the similarities between the two.

- In the face of evidence that suggests contact, diversity, exchange, communication, learning, and transformation among different systems of knowledge and beliefs, it is difficult to adhere to the view that separates IK and SK.

- Evidences from the past indicate that the failure of technical solution-oriented development policies and, programs is attached to making a clear distinction between IK and SK. This ignored the contexts in which they were implemented (Agrawal, 1995).

- Thus emphasis must be given to the continuous interaction or interweaving of IK & SK in which SK provides theoretical framework and IK helps to discern the cultural situation in which policies are implemented.

Bridging the dichotomy implies associating science with culture making the indigenous of the "western" knowledge.

- The above situation can happen if there is a suitable environment for conservation of indigenous knowledge.

The existing literature indicates that at present many indigenous knowledge systems are being eroded due to changing natural environments and socioeconomic and cultural changes on a global scale. Practices vanish while becoming irrelevant and inappropriate for newly arising challenges. Introduction of modern technologies cause the disappearance of many indigenous practices. But together with these, useful skills, technologies, artifacts, effective strategies in solving the problem could be lost. For example, the use of modern technology to increase food production at global scale has contributed to the disappearance of indigenous knowledge systems with respect to the natural resource management (Rajasekaran et al., 1991).

Through the conservation of genetic resources, local crop varieties may yield better under stressful conditions than higher yielding crop varieties introduced to increase food security. An example is a number of sorghum varieties introduced in Ethiopia. A genetic resource conservation efforts of farmers that had included the use of farmers' experience might have resulted in a need to keep a balanced mix of local and introduced varieties so that producers can reduce risk. Indigenous knowledge is, thus, relevant for the development process where different development practitioners (CBOs, NGOs, governments, donors, local leaders, and private sector initiatives) recognize, value and appreciate it in their interaction with the local communities. However, there is a need to understand such knowledge and validate it against its usefulness in attaining their aims. In such a system, one can simply argue that indigenous knowledge becomes part of the global knowledge where it can be preserved, transferred, or adopted and adapted elsewhere. In that sense, the development strategy of a particular country interacts with indigenous knowledge and therefore while designing or implementing development programs the strategy to be put in place can either rely entirely or substantially on indigenous knowledge, override or incorporate it. Acceptable conclusions can be made based on determining whether indigenous knowledge helps in solving existing problems and achieving development objectives or there is a need for a combination of indigenous and scientific knowledge, leaving choices, the rate and the extent of adoption and adaptation to those in need of it.

These are guiding questions to conservation of IK. Most theorists recommend isolation, documentation, and storage of IK in international, national, and regional archives. However, if this is a case, what is the difference between IK & SK? There are two conditions that contradict the above recommendation: 1) if IK is inherently scattered and local in character, and gains its validity from being deeply implicated in people's lives, then the effort to isolate and document it is contradictory, and 2) because of the dynamic nature of IK and its changing character with the changing needs of peoples, the above strategy of conservation seems ill-suited in preserving IK. It is often argued that if indigenous knowledge systems are disappearing, the primary cause will be modernization and cultural homogenization. They are under threat from modern technology because even in remote areas the powers that push global or just non-local content such as radio

and television broadcasting and advertising among others, are much stronger than those pilling local content.

Moreover, as indigenous knowledge is stored in people's minds and passes to generations by words than being in a written form, it is vulnerable to change. Such threats to indigenous knowledge can be overcome through introducing intellectual property rights that protects the rights of indigenous people. For example, laws enacted by the Zimbabwean Government to prevent the act of the Missionaries, the indications of colonialism, that strongly opposed traditional medicine and used education to undermine the traditional knowledge was an important example. In this regard, the government passed the Traditional Medical Practitioners Council Act of 1981 (79) has complemented the initiatives of the World Health Organization (WHO) which had passed a declaration calling on countries to promote the role of traditional practitioners in the health care systems of developing countries and to allocate more financial support for the development of traditional medical systems (Chiwanza et al., 2013).

This case indicates that knowledge management serving public interest should also involve protection of individual or groups' rights towards ownership and recognition. While such laws protecting rights to products of indigenous knowledge (e.g. local medicine, inventions) is easily enforced in the developed nations, it has become challenging to craft and implement such laws in developing nations, for instance, in indigenous biodiversity conservation. Market development and greater emphasis on the short term gains from investment associated with land use change have become the principal threats to protection of indigenous knowledge and rights. In peripheral areas where modernization did not affect peoples' livelihoods much, the role of indigenous knowledge in managing ecological systems and people-nature interaction have remained intact (Ghorbani et al., 2013).

Questions:

1. What do you understand by indigenous knowledge conservation (for example, conservation of knowledge about biological diversity/genetic resources)?
2. What are the factors that contribute to the erosion of indigenous knowledge
3. How is it possible to conserve indigenous knowledge?
4. What institutional support should be in place to facilitate the process of conservation (For example, disappearance of a natural variety)? .

6.3 Indigenous knowledge in biodiversity management

Indigenous knowledge serves the local rural people in various sectors of their life, ranging from maintaining the soil fertility in the agricultural fields by using mulching method to use water for grinding and milling food grains through water mills or using a shin agriculture to get rid of pest to selective burning method in forest to foster nutrition. Rural people use these methods based on their indigenous knowledge for their survival which are economically feasible and environmentally friendly and socially acceptable. Rural people using their indigenous knowledge

systems have developed useful skills to adapt to harsh conditions arising from nature such as trying to mitigate and minimize the effect brought by the climate change in agriculture and other sectors of an economy. A knowledge used by the indigenous people in the past to cope with extreme climatic events can be important knowledge base to use for minimizing the devastating effect brought by climate change and many other environmental problems (Gadgilet al.1993).

A wide range of traditional practices for ecosystem management exist including multiple species management, succession management, landscape level watershed management, and mechanisms of responding to different ecological systems. Such traditional knowledge and management systems are characterized by the use of local ecological knowledge to interpret and respond to feedbacks from the environment to guide the direction of natural resource management. These traditional systems had certain similarities to adaptive management with its emphasis on learning through feedback, and its treatment of uncertainty and unpredictability intrinsic to all ecosystems (Berkes et al. 2000).

While indigenous knowledge plays a central role in biodiversity conservation, biodiversity in turn supports the survival of indigenous people using these biological resources. Thus, they can always be encouraged to conserve those resources for their survival. This goes with the argument that people without or with little alternatives tend to manage their resources than other having a lot of options for their survival. This makes indigenous people possess better indigenous knowledge than those exposed to the modern world. Thus, indigenous people and their socio-cultural relationships with biological and ecological systems will contribute to the sustainable conservation of biodiversity, an example being in-situ conservation where resources are conserved in their natural state (Shresthaet.al, 2008).

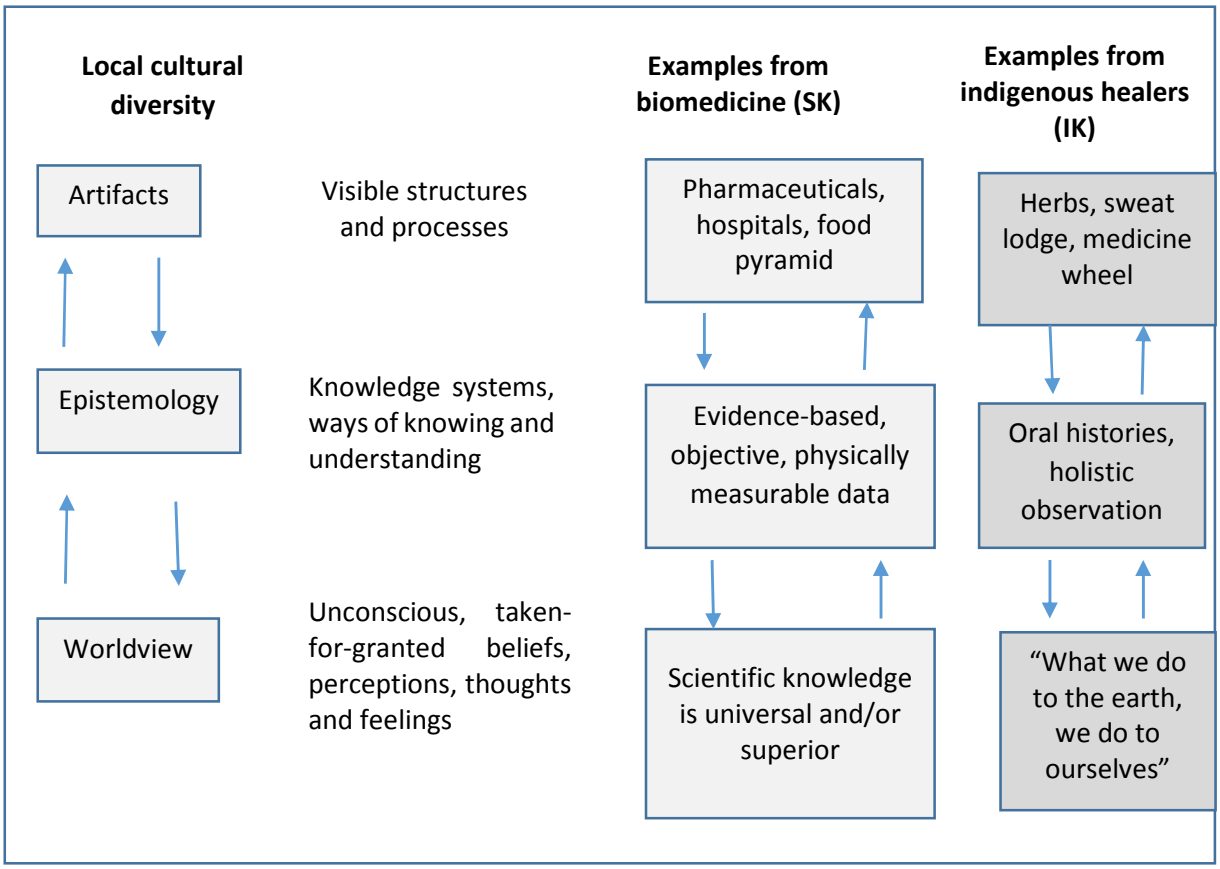

Figure 16: Comparing the epistemology and world views of indigenous and scientific knowledge

Source: Parajuli and Das, 2013:222.

There are a number of cases available in the literature on the importance of indigenous knowledge and successful practices. The best example comes from Ethiopia among the Konso people in the conservation of soil resources using terracing, mixed farming, crop rotation, fallowing, contour plowing, surface mulching, fertilization and agro-forestry, a description of all of them is indicated in the following box (Mulat, 2013:4-5).

Box 2: Indigenous knowledge of Konso People in Ethiopia

A. Terracing. The Konso Cultural Landscape is characterized by extensive dry stone terraces which witnesses hundreds of years of persistent human struggle to harness the hard, dry and rocky environment, which has resulted in the beautifully outlined rows of dry stone terrace. The terraces retain the soil from erosion, collect maximum water and discharge the excess, and create terrace saddles that are used for agriculture. The terraces are the main features of the Konso landscape and the hills are contoured by the dry stone terraces that could reach at some places up to 5 meter high. The dry stone walled towns (Paleta) of the Konso are located on high hills selected for their strategic and defensive advantage. These towns are circled by, between one and six rounds of dry stone defensive walls, built using locally available rock.

B. Contour Ploughing- In several cases, farmers applied different methods of soil conservation. Cultivating crops on the contour where the slope was steep is one of them. Most of the farmers, as I observed, used contour ploughing in order to minimize runoff and erosion.

C. Crop Rotation- the use of crop rotation is another widespread phenomena in the area where maize, ground nut and sorghum grown rotationally. Crop rotation is used by the farmers important for different reasons including soil fertility, thereby improved crop yield. The farmers of the area know that as of the scientific method improved soil fertility can be achieved by alternating high residue producing crops with the growing low residue producing crops.

D. Fallowing- Fallowing is applied with a very limited extent since land scarcity is stated to be a major constraints to production in the area. This partially aggravated by the topography of the area. Thus, it seems likely that the extent of fallowing and limited periods involved is a consequence of the agricultural land in the finding.

E. Mixed Cropping- mixed cropping is widely practiced in the area. Farmers used to inter-planting two or more crops together with some root edible plants. The great majority of the cases are a mix of maize and groundnuts. Mixed cropping in the area helped the potential to reduce erosion by having a crop on the land for a longer period of the year. Also, it served for them to cultivate different crops at one time on a single farm land. However, the crops in the area are widely similar growing seasons and thus the potential for this benefit is not as such. Nevertheless, the inclusion of leguminous plant may improve its nitrogen fixation process for cereal crops. This shows that most of the farmers have an awareness of the potential for maintaining soil fertility and how to be cost effective by using their indigenous knowledge of mixed cropping.

F. Surface Mulching- Most farmers is using surface mulches on their fields, thus providing a protective cover at a time when crop cover is not present. Some farmers left crop residue while others used by branches. The benefit of protective covering was widely appreciated, as was the improved infiltration rate afforded by the techniques and reduced evaporation rate. Further stated objective is the addition of nutrients to the soil through the decomposition of the organic matter. However, the density of mulch viewed in many fields was below the level required to be most effective as protective cover since the use of residence as animal food was witnessed in many households of the area.

G. Fertilization- Fertilization is the other widely practiced activity of indigenous soil conservation mechanism in the area. This is because the area is known in having continuous cropping activity. Thus, farmers used it to retain the fertility of the soil. This importance is reflected in the very high frequency with which both inorganic and organic fertilizer used to apply in this area. But according to informants the most widely used forms of fertilizers are manure, house hold garbage and humus because of lack of capacity to buy modern fertilizer and fear of long term consequence of modern fertilizers in the land by most farmers. This also shows that farmers have highly inclined to use their own indigenous fertility maintaining mechanisms than the modern one.

H. Agro Forestry- the use of agro forestry for soil conservation is the most widely practiced activity in the area. It is very common to see different types of small and big trees inside and just outside the farm land of Konso. The best example is *Moringa stenopetala* (locally also called to be Moringa) which has several purposes; used for shade, it has a very high nutrition quality. Moringa leaves serve as their main diet and is used as a medicine for various diseases. Other tree species in Konso are: *Juniperus procera, Euphorbia spp Terminalia browenii, Olea africana, Ficus sori, Cordia africana, Sterculia africana, Accia*

abysinica. Among these, *Juniperus procera* has a high significance in Konso's rituals. At usual, these trees are naturally occurring once. In fact, the protection of these big trees in the area is also for ritual practices and shading services for some sort of meeting to the local community. Thus, it seems that in addition to trees role for indigenous soil conservation practices in agro forestry form, it has strong attachment the society cultural practices.

I. Field Boundaries- It is also common to see ridge covered with grasses between plots of farm land. The dividing line, boundary, and the land before and after the ridge is the property of two different individuals. This structure is important for soil conservation which can reduce the intensity of erosion in the farm fields. But the uses of this structure are not noticed by most farmers.

The case study has shown that farmers' perception of soil erosion problems increased with decreasing the size of the farmland where over cultivation by undermining the prospect for fallowing reduces soil recuperation. It indicates that reliance on subsistence farming makes farmers more aware of problems associated with soil erosion in small size of the farm land than the farmers owning the larger size of farms (Mulat, 2013). At present, such knowledge has been disseminated to wider parts of the country. A number of scientific research on Konso soil conservation culture witness its usefulness in environmental protection where UNESCO recognizes this practice. Managing such knowledge and scaling up of best practices requires the use of information and communication technologies. Such knowledge serves scientists on the one hand to start their experiment and farmers as well to improve land productivity. This makes the interaction of farmers and scientists operating in different domains of knowledge to work jointly for better results. As a result, one can conclude that making distinction as indigenous and scientific knowledge is potentially ridiculous. It is important to talk of multiple domains or types of knowledge with differently logic and epistemologies. However, the existing debate in the literature indicates that the distinction is unavoidable as far as both serve different interests (of scientists and local people).

Specific strategies for protecting, systematizing and disseminating such knowledge on environmental protection will benefit different groups of people (farmers, traders, policy-makers) in different ways. One of the strategies could be paying greater attention to the socio-cultural institutions that support the sustainability of such practices passing over from one to the other generation. A simple documentation of the indigenous knowledge using information technologies will do little in terms of knowledge management. A second strategy could be relying on local groups that can be formed on the basis of local interests that serve the purpose of information management.

6.4 The role of local group in information management

In 1970s and 1980s, researchers in the Consultative Groups for International Agricultural Research (CGIAR) centers were trying to impose the beliefs, values and concepts of professionals. Local groups and institutions were relatively neglected in agricultural research, extension and development. This has happened when agricultural development strategies were focusing on technology rather than on the organizational and institutional setting.However, after

recognizing the failure of such approach, CGIAR came to revisit their approaches and methods in that local groups are fundamental for sustainable development.

There are four types of local groups.

- community development groups
- farmer experimental and village research groups
- farmer to farmer extension groups
- natural resource management groups

Each group has to communicate with one another to promote sustainable agricultural development and also they facilitate information exchange within and between groups. Therefore, agricultural knowledge manager is responsible to integrate the knowledge and information systems of the four local groups to improve performance of the agricultural sector.

Functions of local groups

- improve access of rural population to information
- improve flow of information to government and NGOs
- create framework for cooperative action
- assist some groups to gain new access to productive resources

Forming local groups is a typical and useful strategy for conservation of indigenous knowledge overcoming the problems associated with simple documentation while favoring the principle of IK embedded into specific cultural context. How to form local group networks enable them to continuously interact with institutions driven with scientific knowledge is a challenging question. Managing information at different levels is only possible if local group networks are built and strengthened. Management of indigenous knowledge can be successful through forming local groups and networks. Two aspects are critical in managing indigenous agricultural knowledge systems: creating and strengthening farmers' organizations and establishing farmers training centers.

a. Creating and strengthening farmers' organization

This can be recognized as one of the knowledge management strategies. However, in practice, it is considered as the missing link in agricultural research and extension system. Organizing farmers helps ''exert pressure'' on research and extension organization and also provide relevant knowledge of the problems that need to be addressed through research and extension. Along this,

it is argued that "the movement towards stronger participation by farmers in agricultural research and extension is fueled by a growing realization that the socio-economic and agro-ecological conditions of (especially low-income) farmers are complex, diverse and risk-prone, and that conventional approaches, based on research station trials followed by unidirectional technology transfer, are unlikely to be fruitful. Close engagement with farmers through the cycle of diagnosis, experimentation and dissemination increases understanding of these conditions, of the opportunities and constraints farmers face, and of their own technical knowledge" (Farrington, 1998:1). What matters more is not just having an organization of farmers, but the use of such organizations in the creation and dissemination of knowledge. In such circumstances, knowledge management will not be confined to making repositories of explicit knowledge but also consider the implicit knowledge that can only be obtained through interaction.

b. **Establishing farmers' training centers (FTC)**

This gives a wider opportunity for improving the communication and learning process between the local groups and outsiders. It also helps in establishing rural producers' cooperatives. For example, the establishment of the district level knowledge center and farmers training center in Ethiopia has overcome the cultural barriers to agricultural knowledge sharing. A related study shows that such center enables people to respond to their colleague and public inquiries regarding certain knowledge at anytime and anyplace as a learning center (Lemma, 2009). Such strategies help in sharing explicit as well as tacit knowledge because socialization among farmers help in sharing tacit knowledge through frequent communication. And access to information technology helps sharing of the explicit knowledge. For example, a free call line for Ethiopian farmers to radio information portal to inquire for different kinds of information on farming practices and crop husbandry is effective in the sharing of explicit knowledge.

Table 5: Application of IT in the facilitation of knowledge sharing

Characteristics of knowledge sharing	**Explicit knowledge**	**Tacit knowledge**
Characteristics	Codified knowledge in documents, data bases. Easy to modify, copy and share	Intuitive, knowledge based on context and embedded in practice. Difficult to articulate, share, modify and copy
Management	Organize, categorize, refine and share	Common practice, mentoring, apprenticeships, project teams, informal networks
Use of IT	Very useful	Limited/indirect

A recent review shows that a total of 8,500 farmer training centers (FTCs) have been established and 63,000 field extension workers were trained in Ethiopia where the country's extension approach follows FTC-based extension system, in which the FTCs are positioned to facilitate

agricultural knowledge and information exchange among researchers, extension workers and farmers (UNDP 2012). Despite these initiative in the agricultural knowledge management, there are major constraints that inhibit effective agricultural knowledge management: (1) inadequate infrastructure and localized technical information, and (2) budgetary shortfalls limiting the capacity to invest in the ICT infrastructure where these limitations are common across sub-Saharan Africa. Even where the infrastructure is available, extension agents lack skills of using the internet and computers to deliver the services they are expected to.

Discussion questions:

What should be considered in establishing farmers training centers to enhance knowledge management?

6.5 Knowledge management strategy

To apply and gain benefits from KM applications, there is a need to have a knowledge management applications. There are two important objectives of knowledge management including innovation and reuse. Innovation involves the generation of new knowledge or new linkages between existing knowledge sources while reuse forms the basis for organizational learning and should be viewed more as a dissemination of innovation. There are important frameworks that need to be considered in the knowledge management strategy which are also seen as *knowledge management initiatives* (Sveiby, 2001):

- *External structure initiatives* – which include the gaining of knowledge from customers and offering customers additional knowledge.

- *Internal structure initiatives* – which include building of a knowledge-sharing culture, create new revenues from existing knowledge, capture the individual's tacit knowledge[3], store it, spread it, and reuse it, and measure knowledge-creating processes and intangible assets produced.

- *Competence initiatives* – which include creation of careers based on KM, creation of microenvironments for knowledge transfer, and learn from simulations and pilot projects.

These initiatives will contribute to the attainment of the following knowledge management goals (Dalkir, 2005: 291):

- Maximize the returns on KM investment in knowledge—people, processes, and intellectual capital.
- Exploit intangible assets (e.g., know-how, patents, and customer relationships).

[3] Effective sharing of highly tacit knowledge requires a significant amount of intense social interaction (Leonard and Sensiper, 1998).

- Repeat successes and share best practices to others and reciprocate the same.
- Improve innovation and the commercialization of ideas to generate profits and expand networks for success.
- Avoid knowledge loss and leakage after organizational restructuring in order to maximize benefit from knowledge generated from within an organization

There are important questions that can be raised during knowledge application by an employee in an organization that need to be answered quickly:

- What have already been written or published on this topic?
- Who are the experts in this area, and how can I contact them?
- Have any of our partners, contacts, and clients addressed these issues?
- What sources did we use to prepare the publications on this topic?
- What are the best websites or internal databases to find more information?
- How can I add my own experience in applying this particular piece of knowledge?

Questions for reflection

1. What are the potential barriers in designing strategies for knowledge management?
2. Indicate the relationships among the knowledge management initiatives indicated earlier with specific reference to their complementarity.
3. What roles do farmers' training centers play in knowledge sharing?

6.6. Other forms of indigenous knowledge management and dissemination

While a maker movement approach is essential in supporting local innovativeness and the creation of new knowledge the storytelling and narratives are important tools in the preservation and dissemination of context specific knowledge. Each of these is described as follows.

Maker movement – is a situation in which individuals or groups of individuals create and market products using recyclable materials. Farmers can develop a modified farm implements or storage facilities using recyclable materials from metals or wooden materials that can increase farm efficiency. This can be considered as a component of indigenous knowledge systems. For example, farmers in eastern Ethiopia make use of underground sorghum storage facilities that prevents problems of weevils and other insects that could potentially attack grains. There are also a number of local small scale enterprises established in the country to support innovativeness of the youth in creating a wide range of equipment that respond to local needs. The idea of maker movement comes up in connection with the efforts that people engaged in inventing something simple and suitable to solve their own problems no matter how their level of education and professional orientation is (Dougherty, 2012).

Storytelling and narratives are quite effective in the utilization of indigenous knowledge. A maker could tell his/her stories of how a new technology has been invented that may encourage others to follow the track. Storytelling is one way of preserving indigenous knowledge where these stories are handed down from one to the other generation. In the African context elders are

typical storytellers on how they managed certain challenges on their agricultural fields, in treating their animals and responding to weather or climate effects and thus inform young farmers the new skills available. This is the way indigenous technical knowledge can be transmitted. This information can be presented in the form of narratives. The documentation of such information in the form of videos where elders tell the story and perhaps demonstrate the technical skills provide options for the dissemination of indigenous knowledge through codifying it (Sole, 2002).

Project work

Identify an agricultural development project implemented in a particular village where this project has been trying to solve a particular problem that farmers have been experiencing. Based on this evidence in the project implementation:

a) Identify and analyze the actors and their roles
b) Examine the nature of knowledge they brought to the implementation of the project
c) Describe how they shared their knowledge (focusing on media used, mechanisms put in place, effectiveness in communication)
d) Locate the challenges (if any) met in the process of knowledge sharing and what precautions need to be made if the same project is required to be implemented elsewhere

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