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The role of information and knowledge management in fisheries development

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ABSTRACT

Beginning from the last decade of the 20th Century, we have seen an explosion in information growth. This explosion is mainly brought about by the advent of information and communications technology, which facilitates the spread of digital information that has contributed most to the information explosion. Information, however, must be managed and transformed into knowledge, which must then be harnessed and disseminated to the relevant agencies and target groups for the implementation of development projects. Social and organization structures are critical to knowledge management and effective dissemination.

This paper highlights issues pertaining to information and knowledge management with special reference to how research and development knowledge in fisheries can be translated for effective fisheries development. The best use of the opportunities offered in the information age and the knowledge economy to overcome the challenges for social change in fisheries development is discussed.

Keywords: information and knowledge management, research, fisheries development

Malaysia has embraced the knowledge revolution in business and everyday life like few other countries in the region. The terms k-economy, and the description 'smart' are used in everyday speech by senior political leaders and members of the public. The theme of this conference is therefore most appropriate and we could start by asking ourselves what role does information and knowledge management play in fisheries development?

A knowledge economy and smart actions of any kind imply that we base our actions here on the best available knowledge and information and we are active in seeking our, creating and using new, relevant knowledge as well as existing knowledge. This is particularly true in time of change such as we now live in and in important sectors, such as the fish sector.

Malaysia is an important fish producing and eating country and, like all other countries, is undergoing many changes in its fisheries. To meet the fish challenges of the future, Malaysia will have to make optimum use of all the latest tools – and high on the list of these tools are data, information, knowledge and knowledge management.

Malaysia already has a track record of basing its fisheries management and development on the best available knowledge. In recent times, a good example was the formulation in the 1960s of cockle aquaculture regulations based on scientific knowledge of size at maturity and spat settlement characteristics. Incidentally, I believe that the actual culture techniques for cockles were developed by fishermen, not by scientists, a fact we should keep in mind when thinking about where knowledge is generated.

Malaysia also has an excellent and comprehensive Fisheries Act, updated in 1993. This act synthesizes a vast amount of national knowledge on fisheries and would not have been possible without considerable expert input.

Malaysia's rapid economic development, however, has put stresses on the aquatic environment from the loss of coastal habitat through land reclamation, sedimentation of corals in parts of Malacca Straits, coastal pollution from land and ship based sources and overfishing of stocks.

1. Introduction

In the last decade, we have often heard warnings from administrators for us to be prepared for the k-economy as the world moves towards globalization, for organizations to work towards knowledge management and for all employees to be k-workers. It is not surprising that many of us are lost in a world that is churning up new terms and new demands by the day. Amidst all this confusion, we appear to be drowning in a flood of information. How to transform information

into knowledge has also generated numerous active discussions. In the case of knowledge management, the sense of fuzziness is felt not only among laypersons like you and me, but even among specialists in the fields, who have yet to come to complete agreement on what it stands for.

There are mainly two schools of thought on what knowledge management is all about. One school is more involved with knowledge as an asset, and therefore is more concerned with managing the asset in the form of information resources. The second school is more concerned with the competency aspect of an organization. Knowledge management therefore deals more with building up competence, and learning loops in the organization tend to take precedence over the management of assets (Godbout undated). Social and organizational structures are also important aspects in knowledge management as well as in knowledge transfers for achieving development goals.

Our paper attempts to first describe how data and information should be collected, how information should be managed, and how its transformation into knowledge should be facilitated. This knowledge must be managed and must reach out widely so that even those at the grassroots can make use of it effectively for development projects. The best use of the opportunities offered in the information age and the knowledge economy to overcome the challenges for social change in fisheries development is also discussed.

2. Data and Information Collection

Data and information are two separate entities with different meanings. Data are defined as raw materials for information, and need to be organized, contextualized and related to particular situations before they could be transformed into information which is defined as ideas, facts, imaginative works of the mind and data of value potentially useful in decision-making, questions answering and/or problem solving (Kaniki 2002).

Along the road to creating and managing knowledge, the collection of reliable and accurate data and information must be given the highest priority because inaccurate and incomplete data and information may jeopardize the planning and policy formulation process. Williams and Choo (2003) noted that good science information and the right kind of science are critical for natural resource management such as those for fish and water. National fisheries agencies need to give absolute priority to collecting and maintaining the most accurate and basic data on which to monitor developments in fisheries. Cochrane (2002) observed that many fisheries agencies do not give sufficient attention to the collection of data and information, and their attempts to manage fisheries are therefore flawed from the onset. He also noted that in some instances, although reliable data are available, storage, processing and analysis of the data are not done properly. To this list we would add data access.

Recognizing the importance of storing, processing and analyzing and making accessible aquatic resources data, WorldFish Center, with funding provided by the Asian Development Bank, initiated the Trawl Base project from1998- 2000. This project aimed to provide documentation and retrospective analyses of trawl surveys conducted in eight countries in the South and Southeast Asia regions. Demonstration and training in the use of the database system, FiRST (Fisheries Resource Information System and Tools) were conducted. This database system currently contains data on about 21,000 hauls/stations provided by the participating countries together with published data from Singapore, Myanmar and Pakistan.

3. Information Management

The boom in information and communication technology brought with it an information explosion. The explosion is contributed mainly by the phenomenal increase in digital information, as demonstrated by the volume of digital information (740,000 terabytes) versus the volume of published information (285 terabytes) produced in a year (Anon 2000). However, the fear that digital information may replace paper texts is perhaps unfounded. Canada, which is one of the most connected countries in the world is also well endowed with books - 275 million copies in its libraries (Lawrence 2000).

Access to reliable information is critical for research and development (R&D) activities. Library services play a central role in enabling users to transform these information into knowledge. When planning a library, the information systems design phase has to be preceded by an information audit to establish clearly the present and future needs of users- what they ought to have, what they would like to have, what they ask for and what they actually use (Lourduswami 1996).

Managing published information in the printed form has been a time-honoured role familiar to libraries and information service providers, but managing digital information presents many new challenges. Unlike hard copies, digital information is not well documented and requires more effective organization to improve the system of search and retrieval (see Williams and Choo 2003). Horrocks et al. (2002) noted that web information would greatly benefit from some structure and explicit semantics to improve the system of information retrieval and recall. Although a lot of information is available on the Internet, trusted sources are still needed to filter and interpret it (Dreyer 2000; Pfeizer 2000). Quality control of data and classification of digital information are of great importance in the knowledge transformation process - how to integrate and manage all the various forms of information (published, unpublished, printed and digital) pose as the other challenges to information providers in the digital age (see Williams and Choo 2003).

The information and communication technology age brings with it several advantages for information dissemination and management. The Internet allows the linking and networking of libraries and facilitates faster access to information. Steps have already been taken by Fathom.com to connect six major libraries in the world, including the British Library and the Smithsonian Institute (Lawrence 2000) providing users with greater access to documents from the linked libraries. When computer hardware is already in place, sending information through the Internet is also much cheaper than other forms. Emailing a 40-page document from Chile to Kenya costs less than US 10 cents, faxing costs about $10, and sending by courier $50 (The Human Development Report 2001).

One great benefit brought about by the information age is the development of structured information systems such as FishBase and ReefBase which have proven to be very popular with users (see Williams and Choo 2003). These structured information systems are electronic encyclopedias, providing an excellent way of bringing together scattered information for easy access. FishBase is developed by WorldFisch Center in partnership with 890 collaborators. It receives about 4 million hits per month, and has 27,060 species and 27,975 references in its database. ReefBase, which is a global information system on coral reefs, is a project of the WorldFish Center and is a collaborative effort among numerous collaborators and partners. Up to 3 January 2003 ReefBase, which was launched on 2 April 2002, has recorded 3,855,862 hits.

4. Knowledge

The definition of knowledge is ambiguous and varied and often treated as an abstract entity associated with the human mind. Liyanage and Jones (2002) noted that knowledge is a perspective, a critical insight, an analytical tool, an asset, and a distinct capability that can be put into action within an organization or an individual.

Knowledge initially resides in the mind of humans as tacit knowledge (Polanyi 1958- quoted from Liyanage and Jones 2002) and has to be codified before it can be disseminated and translated into effective actions (Liyanage and Jones 2002). In this sense, it is critical that new knowledge obtained by scientists from research and development should not remain as tacit knowledge, but should be transformed into explicit knowledge (example through publications) and communicated to others to allow the transformation of knowledge into useful actions. Liyanage and Jones (2000) noted that without diffusion, knowledge is only a highly priced commodity with no currency. Knowledge developed through research, especially public good research, has to reach the grassroots in order to benefit the community and to upgrade technology and improve productivity. Continuous R&D leading to new knowledge is also a necessity to allow an organization to be at the forefront of technology and development.

5. Knowledge Management

Godbaut (undated) acknowledged that knowledge management is a very complex discipline since knowledge is both a resource and a process. One definition defines knowledge management as "the organizational activity of creating the social environment and technical infrastructure so that knowledge can be accessed, shared and created" (Logan undated- quoted from Wissensmanagement). InformationWeek (1998- quoted from Wissensmanagement) defined it as "the concept under which information is turned into actionable knowledge and made available effortlessly in a usable form to the people who can apply it".

Knowledge management practices in an organization include simple procedures such as the use of the telephone and intranet, and the utilization of coffee break, debriefing and learning sessions; coffee break for example can be an ideal situation to allow employees to catch up with each other – an invention that creates space, time and environment conducive to knowledge sharing (Liyanage and Jones 2002).

Selecting the right knowledge management initiatives for people in different levels of the organization with different needs is critical. Powell and Egmon (2002) noted the importance of knowing the people within an organization and to be able to identify their needs according to Maslow's hierarchy of needs. Knowledge management initiatives suitable for those lower in the hierarchy, for example those who are concerned with satisfying physiological needs will be very different from those who have reached the self-actualization level.

Learning is an integral part of knowledge management. Inculcating learning in an organization has been identified as the biggest challenge faced by technology managers (Liyanage and Jones 2002). Communities of Practice (COP- involves a group of people who share a concern or a passion about a topic, consequently deepening their knowledge and expertise by interacting with each other on an ongoing basis) is becoming increasingly popular in big companies (such as Chrysler, Microsoft and Hallmark Cards) as an effective learning tool to master knowledge challenges (Wenger et al. 2002). Wenger et al. (2002) noted that COP is not a new concept and could trace its origin to our ancestors- the cave dwellers who often gathered around the hearth to discuss strategies for hunting; there is a need, however, to give this practice a new and more focused role in knowledge management within an organization or between organizations. COP can help to establish baseline knowledge so that people can focus on more advanced issues, and help an organization retain a competitive edge (Wenger et al. 2002), an aspect critical to commercial firms and also to R&D organizations when they compete for research funding. COP can exist within an organization as well as among organizations.

6. R & D Knowledge Management for Fisheries Development

Sagasti (1995) noted that although great advances in science and technology have been made since World War II, too little of the modern science and technology has been directed at development. Mobilization of developed country scientists to deal with problems encountered by developing countries has also not been very successful, and the science and technology capabilities of developing countries are far too limited to deal adequately with the enormous problems of development in a fractured global order. He contended that knowledge plays a critical role in the process of development, which could be redefined in terms of the capacity to generate, acquire, disseminate and utilize knowledge, both modern and traditional. Development in the fisheries sector is usually narrowly interpreted as the initiation of exploitation of new fisheries resources, or improvement in fishing gear, or improvements in fish product, but the modern concept recognizes also the need to achieve sustainability, and to consider the needs of disadvantaged groups such as women and minority ethnic groups (Williams 1998). R&D, which contributes to new knowledge and innovation will therefore play a critical role in fisheries development.

Knowledge for fisheries development differs in some respects from that for aquaculture development. For fisheries, one of the overriding concerns today is the management and governance of the natural fisheries resource, and this field is now subject to a great deal of social science research as well as biological and ecological research. It is among the most difficult field of research at present and the role of research is very difficult and often ridden with conflict over the results and their implications. For aquaculture, research is much more production oriented and akin to the types of technology development that has shown so much impact in agriculture. However, aquaculture researchers are more and more challenged to look to environmental and social aspects of their field.

Nevertheless, research is an essential element in the development and sustainability of both fisheries and aquaculture and most countries are having difficulty directing enough research resources to such research. In developing countries, the challenges are greater.

Overall, only about 4% of the world expenditure on R&D and about 14% of the world's supply of scientists and engineers are in developing countries (Carnegie Commission on Science 1992- quoted from Sagasti 1995). In Malaysia, the R&D expenditure is low (about 0.22% of the Gross Domestic Product), compared to 1.6% for Singapore, 2.5% for South Korea and 2.8%-3.5% for other advanced countries (undated report from IRPA Agro-industry Panel). Under the Seventh Malaysia Plan (1996-1999) a total of RM159.85 million of public funds were spent on the agro-industry sector. The amount allocated to fisheries was the highest in

the agro-industry sector - RM24.46 million or 15.3% of the total allocated for agro-industry.

Malaysian fisheries scientists are fortunate to have a clear development agenda, although a challenging one. The third revision of the National Agricultural Policy (NAP3) of Malaysia has set high development goals for the fisheries sector. By 2010, aquaculture production is expected to reach 600,000 tonnes requiring almost a six-fold increase of the present production level, a target that may be difficult to meet within the stated time frame. Capture coastal fisheries production is to be sustained at 900,000 tonnes with offshore fisheries to reach 450,000 tonnes by 2010. In recent years, changes to the organizational structures in the Department of Fisheries (DOF) for the conduct of scientific research and technology transfer have been made to bring about more rapid transfer of technology for commercialization of fisheries research. DOF therefore has an opportunity to examine its research programs and their impacts, and to determine the relevance of these programs in meeting development goals. The role and effectiveness of the Extension Division in knowledge transfer is also critical, to ensure that national development goals are met. The following five suggestions, which may enhance knowledge management and technology transfer for fisheries development.

6.1 Communities of Practice

The initiation of topic specific COPs with members from the Fisheries Research Institute (FRI), WorldFish Center, Lembaga Kemajuan Ikan Malaysia (LKIM) and like minded university faculty and students may help facilitate more rapid infusion of knowledge among workers and facilitate more effective knowledge transfer to the commercial sector. According to Wenger et al. (2002) COPs are hugely responsible for the resounding success for high-tech industry in the Silicon Valley and for automobile industry in Detroit. WorldFish Center, FRI and LKIM share common objectives - enhancement of fishermen's livelihood and commitment to sustainable fisheries development. COPs will serve as excellent platforms for the meeting of minds and will foster growth of knowledge and wisdom.

6.2 Reconciling Indigenous/Local Knowledge

All over the world, the knowledge of indigenous people, for example in the fields of biotechnology, fisheries and aquaculture, has been well acknowledged. Selection of fauna or flora for bioprospecting relies heavily on indigenous knowledge. Unfortunately in the past in fisheries science, there have been tendencies for local knowledge and wisdom to be ignored. The Atlantic cod fishery collapse in Canada offers a case in point. In the early1980s, observations of the inshore fishermen on overfishing in the Canadian Atlantic coast were ignored since scientists deemed the data collected by the inshore fishermen "invalid". Finlayson (1994) observed that the cognitive cultures of the inshore fishermen and science were dissimilar - science will confer the status of "valid"

only on very specific forms of data presented in a very specialized way. In this case the insistence of the scientists for such data contributed to a great extent to the cod fishery collapse.

The development of cockle culture by fishermen here in Malaysia is a good example of the power of local knowledge.

Therefore, reconciling indigenous or local knowledge with R&D knowledge is one area, which calls for better understanding and management. Indigenous knowledge is often passed down from one generation to another by word of mouth; in the process, the preciseness and accuracy of the information may be diluted with time. Better means of documenting, managing and preserving potentially useful indigenous knowledge should be given more attention. The code of conduct for responsible fisheries (FAO 1995) recognized also the importance of indigenous knowledge. Paragraph 6.4 recommended that conservation and management decisions for fisheries should be based on the best scientific evidence available, also taking into account traditional knowledge of the resources and their habitat. Paragraph 12.12 suggested that states should investigate and document traditional fisheries knowledge and technologies, in particular those applied to small-scale fisheries, in order to assess their application to sustainable fisheries conservation, management and development. The importance of indigenous knowledge is also stressed in the World Summit on Sustainable Development (WSSD). Paragraph 38 (r) of the plan of implementation of the WSSD (see WorldFish Center 2002) advocates the promotion of the conservation, and sustainable use and management of traditional and indigenous agricultural systems and the strengthening of the indigenous models of agricultural production. Paragraph 42 (l) of the plan recommends the promotion of the effective participation of indigenous and local communities in decision and policy-making concerning the use of their traditional knowledge.

6.3 Impact Pathways Analyses

In mission driven organizations with clear development goals such as DOF, FRI and WorldFish Center, real impacts are required of the research. Members of the Consultative Group of International Agricultural Research (CGIAR), such as WorldFish Center, are feeling an increasing pressure to be more impact oriented in their choice of research projects and in their delivery, with the focus on delivering more specific development impacts, such as poverty alleviation or livelihood enhancement. Recognizing the need to have more direct impact in our research programs, or to work with others to ensure that our research has impact, WorldFish Center has an ongoing set of activities to incorporate concepts and techniques to evaluate the impacts of our research programs. A framework for conducting ex ante and ex post impact pathway analyses helps us determine the relevance of our research projects and whether they are aligned with our goals. This approach will lead to better targeting of our research to ensure that

the knowledge obtained will meet development goals, will affect the people and environment we have selected, and will allow improved resource mobilization in anticipation of needs. We intend to go even beyond this approach, however, and to look very carefully at the full pathways through which the research results are likely to flow. Having examined these impact pathways, we then will examine the waypoints at which gaps in dissemination could occur and look at way to bridge the gaps. We are currently working on the first 3 case studies for this approach and hope to publish these later in the year. The three examples are: improved fish strains, fisheries management information and databases.

We know that researchers are not responsible for all steps along an impact pathway, and so we need to get together with other parties – fisheries managers, fish farmers, ministers advisors, etc, to get their views on what the needs are from the scientific results at various steps along the way.

We would be very happy to work with other fisheries research agencies to further develop this approach. We believe that it will reveal much about how results of research and the knowledge it generates moves through the social institutions involved in developing fisheries.

6.4 Policies and Strategies for Technology Transfer

Strategies for technology transfer are often not given sufficient thought and planning during the R&D project formulation phase and in part our impact pathways approach described above was developed to tackle this challenge. Developing clearly spelt-out policies and strategies for technology transfer for R&D projects will assist researchers and extension workers to keep their focus on the work ahead, on how the transfer of technology is to be executed on completion of the research project. In our experience, extension agents working in technology transfer should be closely linked with the researchers and should receive the latest research information as well as feedback the problems from the field. WorldFish Center has already developed the policies and strategies for technology transfer for the genetic enhancement of tilapia (GIFT) project, and the Center is working towards establishing similar guidelines for the other non-genetic programs. WorldFish Center looks forward to working with DOF in similar endeavours, and we welcome the opportunity to learn and to grow together with our Malaysian partners.

The speed with which technology transfer occurs should have bearing on how well Malaysia can meet its National Agricultural Policy goals for the end of this decade.

6.5 Education and Training: Communication skills

Education and training are key tools for capacity building and technology transfer. For technology transfer to be effective, communication skills are

essential. Kaniki (2002) noted that in many African, Caribbean and Pacific countries, the greatest barrier to agricultural development is not the lack of information or knowledge but the poor communication of information. This observation holds true for many developing countries in Asia as well. Kaniki noted that in agricultural communications, the values, needs and environment of stakeholders must be given priority; the language or code used in developing a message is also an important factor that affects the message itself. Extension workers must therefore be given appropriate training so that they can successfully extend the intended knowledge to the stakeholders many of whom are lowly educated. Similarly, researchers may have to gain broader communication skills to interact more fully in the technology transfer process from the grassroots fishers and fish farmers to the Minister.

7. Conclusions

In fisheries development, knowledge management begins with the need to collect reliable and accurate data and information as the highest priority because inaccurate and incomplete data and information may jeopardize the planning and policy formulation process. In the information and communication technology age, the flood of digital information calls for better classification and control to facilitate its transformation to knowledge including for fisheries development.

Continuous R&D leading to new knowledge is a necessity to allow an organization and the country to stay at the forefront of technology and development. Knowledge plays a critical role in the development process. The challenging development goals set by the third revised version of the National Agricultural Policy requires the Department of Fisheries, Malaysia to set a clear but ambitious research agenda to help the country meet the Policy goals. Fortunately, in the current age in Malaysia, practices and initiatives, which may enhance knowledge management and technology transfer for fisheries development are available for effective fisheries development.

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