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FACILITATING SUSTAINABLE AGRICULTURE: INTEGRATING INDIGENOUS KNOWLEDGE IN CURRENT AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEMS

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ABSTRACT. There is a disparate comparison of non-adoption of sustainable agricultural practices (SAPs) and blaming farmers, their farms and methods of conventional farming practices in the most cases. Some of the trends like the recognition of the importance of farmer's ITK (Indigenous Technical Knowledge), farmer's participation, the emergence of non-government organizations (NGOs) within the agricultural knowledge and information system, and synergy processes among all determinants of agricultural knowledge and information system, are the main topics in facilitating sustainable agriculture. The challenge for the current agricultural knowledge and information systems toward sustainability is to find better ways to learn about indigenous institutions and practices and where necessary adapt modern techniques (i.e., "sustainability sound practices") to the local practices. As such, this study aimed at reviewing three case studies concerning integration of indigenous knowledge in the agricultural knowledge and information systems to represent indigenous knowledge outcomes on the effectiveness of different projects and extracting solutions for incorporating indigenous knowledge in current agricultural knowledge and information systems toward sustainability. In the all case studies, indigenous knowledge provided problem-solving strategies for local communities and helps shape local solutions to revitalizing farming system and environment. Also, in this paper integration and co- management of indigenous and non- indigenous knowledge subsystems has been addressed. Finally, recommendations for integrating indigenous knowledge in the current agricultural knowledge and information systems toward sustainability have been proposed.

Key words: Indigenous Knowledge System (IKS); Agricultural Knowledge and Information System (AKIS); Problem-Solving Strategies; Sustainability.

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INTRODUCTION

Agriculture has changed substantially, especially since the end of green revolution, food and fiber production soared due to new technologies management, using chemical inputs, specialization and government policies that favored maximizing production level. Although these changes have had many positive outcomes and reduced many challenges in farming, there have also been significant hazards. Prominent factors are topsoil depletion, groundwater contamination, the decline of farmer community, straitened condition for farm laborers, low productivity, effectiveness, diversity, and the lack of integration among economical, social and environmental aspects of the sustainable agriculture especially in the developing countries. Sustainable development requires a long term perspective and broad-based participation in policy formulation, decision-making and implementation at all levels (Johannesburg Declaration, 2002). A prerequisite for ensuring sustainable agriculture and rural development is the design and implementation of appropriate and well-targeted policies that take into account the interactions between macro-economic, agricultural and other sectoral policy concerns at national, regional and local levels. Dominant forces that act against the effectiveness of sustainable agriculture are: short-term social, political and economic benefits; top-down and non-participatory agricultural extension approaches, liberalization rules; and the continuing concentration of financing, agricultural trade, and food processing have depopulated rural areas and resulted in non sustainable agriculture. Therefore, in order to support sustainable agriculture, all subsystems should work systematically and synergistically to achieve economically profitable, socially acceptable, and environmentally sound aspects of sustainability. Some of the trends like the recognition of the importance of farmer's ITK (Indigenous Technical Knowledge), improving farmer's participation, the emergence of non-government organizations (NGOs) within the agricultural knowledge and information systems, and synergy processes among all determinants of agricultural knowledge and information systems, are the main topics in facilitating sustainable agriculture. As such, in this paper we have concentrated on “indigenous knowledge” and how it can be used and integrated in current agricultural knowledge and information systems toward sustainability. First, we address the concept of “indigenous knowledge” (IK). Indigenous knowledge is the locally accepted knowledge – knowledge that is unique and consistent to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making

in agriculture, healthcare, food preparation, education, natural-resource management, and a host of other activities in rural communities (Warren, 1992). Indigenous knowledge is the information base for rural communities, which facilitates communication and decision-making. Indigenous Knowledge Systems (IKSs) are dynamic, and are continually influenced by internal creativity, innovation and experimentation as well as by contact with external systems (Flavier *et* al., 1995). The literature on IK does not provide a single definition of the concept. Nevertheless, several traits and characteristics distinguish IK broadly from other knowledge systems. IK is unique to particular culture of rural communities and a non-defined area. It is the basis for local planning and decision-making in agriculture, health, natural resource management and other activities. IK is embedded in community practices, institutions, relationships, customs and rituals. It is essentially "tacit knowledge" (implicit knowledge) that is not easily codifiable and recognizable. Indigenous knowledge provides the basis for problem-solving strategies for local communities, especially for less-privileges areas. IK is an underutilized resource in the development process. Learning from IK, by investigating first what rural communities know and have, can improve understanding of local conditions and provide a productive context for activities designed to upgrading sustainable agriculture development projects. Understanding IK, not only can increase responsiveness to farmers, but also it increase the effectiveness of projects. Adapting international practices, such as "FAO and World Bank assistance programs", to the local setting can help improve the impact and sustainability of development assistance. Sharing IK within and across rural communities can help enhance cross-cultural understanding and promote the cultural and social dimension of development. Most importantly, investing in the exchange of IK and its integration into the rural and agriculture development projects can help to increase productivity, sustainability, effectiveness, and social and economical indicators, such as poverty reduction.

Exchanging, disseminating and applying "Indigenous knowledge" (IK) process:

The integration of IK into the agricultural knowledge and information systems toward sustainability is essentially a process of exchange of information from one community to another or from one project to another project. The process of exchange of IK within and between communities, projects and development plans involves basically eight stages (*Fig. 1*) :

- Rapid Appraisal of Agricultural Knowledge System (RAAKS);
- Integration process of academic and indigenous knowledge systems (Integration);
- Networking processes;
- Storage;

- Transfer;
- Dissemination;
- Applying;
- Permanent integration as one subsystem in the current agricultural knowledge and information systems toward sustainability.

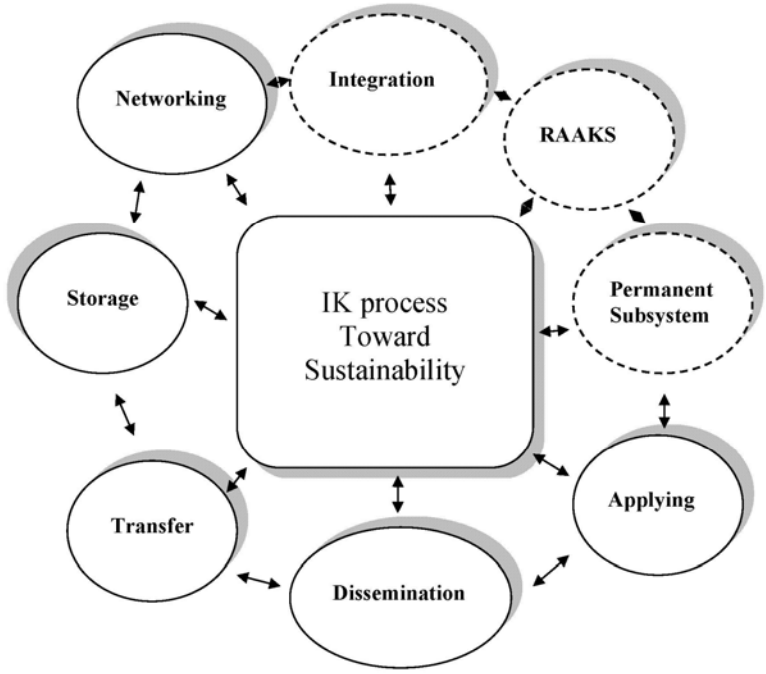

Figure 1 - Exchanging, disseminating, and applying "Indigenous Knowledge" (IK) toward sustainability, which begins with "RAAKS" "(Rapid Appraisal of Agricultural Knowledge System)".

According to *Fig. 1*, the IK process begins with recognition and identification of rural communities processes of indigenous knowledge, one stage mostly disregarded in the integration of indigenous knowledge systems toward sustainability. Also, stages of integration (Integration of academic and indigenous knowledge systems) and permanent subsystem mostly overlooked in the developing indigenous knowledge systems. Overall, the characteristics of indigenous knowledge systems, which distinguishes them broadly from other knowledge systems are: Locally acceptable farming methods, tacit knowledge, first hand knowledge and experience, transmitted orally and unwritten, experiential based knowledge, learned through repetition, constantly changing and adapted over many years and are coincide with conditions. Therefore, the challenge for the current agricultural knowledge and information systems toward sustainability is to find better ways to

learn about indigenous institutions and practices and where necessary adapt modern techniques (i.e., "sustainability sound practices") to the local practices. Only then will sustainable agriculture knowledge be rendered relevant to the local community needs. The key factor in the adaptation process is the involvement of farmers who possess indigenous knowledge. For instance, a study of 121 rural water projects in 49 countries found that 70 percent succeeded when the intended beneficiaries participated in project design, compared to a 10 percent success rate among programs where they did not (World Bank, 1999).

METHODS

In the fallowing, three case studies have been addressed to extracting solutions for integrating indigenous knowledge in the current agricultural knowledge and information systems toward sustainability. Also, an effect of indigenous knowledge on the effectiveness of projects has been addressed.

Case study 1: Adoption of modern bean varieties in Columbia and Rwanda (World Bank, 1999)**.** "Two or three varieties of beans considered by the scientists to have the most potential had achieved only modest yield increases. They then invited the women farmers who possessed valuable "indigenous knowledge" about bean cultivation to examine more than 20 bean varieties at the research stations and to take home and grow the two or three they thought most promising. The women farmers planted the new varieties using their own methods of experimentation. Their selections outperformed those of the scientists by 60 to 90 percent". Therefore, in this case, IK could help adaptation process of modern cultivation techniques.

Case study 2: Communities ensure transparency in the distribution of food aid (Upadhyaya and Katmandu, 1993)**.** "Communities ensure transparency in the distribution of food aid to ensure that food aid reaches the intended population, a food for work program of the Nepalese government assisted by GTZ, consulted with the villagers. It was jointly determined that using local distributors and community-based supervision would be the most appropriate way to distribute food. Instead of using covered trucks, bullock carts were used for transportation. This approach yielded various benefits. Hiring bullock carts provided additional income for rural communities as opposed to using city-based truck companies. The load of a bullock cart is a local standard, and the amounts delivered could be easily calculated by the people of the community. Any missing portion could easily be estimated publicly and any loss or inappropriate allocation could be questioned in public. Other WFP programs in the country have eventually adopted this approach". Therefore, this case indicated that, using locally adaptable standards and means of transport, facilitates transportation of staples at the local level.

Case study 3: Senegalese rural women abolish female circumcision in their community (Easton, 1998) "Senegalese rural women abolish female circumcision in their community. Women of Malicounda decided that the problem they wished to address was the custom of female circumcision - a pattern in Bambara/ Mandingue and Pulaar communities. By informing themselves on practices elsewhere and on the effects

of circumcision on girls' health and sexual life, they developed an arsenal of arguments and eventually convinced the village council to abolish the practice officially. Not satisfied with this result, they subsequently created a team in order to visit neighboring villages, speak to women there and help them win cases in their own communities. In January of 1998, a congress of 16 villages from the region, all of Bambara or Mandingue lineage, met to discuss the change in practices and adopt the "Declaration of Malicounda." Word of their initiative traveled to the Casamance region of southern Senegal, where another group of sixteen villages, all of Pulaar lineage, assembled for a similar conference and declaration. In fact, President Abdou Diouf of Senegal himself proposed the "Oath of Malicounda" as a model for national adoption". Therefore, in this case, public based opinions can help to converting discriminatory practices. Such as this result, land reform measures in order to aggregating farming lands can be effective.

Example of exchange of IK. Transfer of the Washamba agricultural system to Rwanda adaptation and re-transfer. The Washambaa of the Usambara Mountains in Tanzania had developed a land use system emulating the climax vegetation of the deciduous natural forest. They integrated an annuals and perennials on the same plot in a multi-story arrangement. The principles were transferred to Nyabisindu, Rwanda in a GTZ assisted project; and special multipurpose contour bunds with trees shrubs and fodder grasses were added to the system. The adapted practice was later re-transferred to the Washambaa once dense population and need for firewood had depleted the soil cover and demand for dairy products had initiated the introduction of improved cattle breeds. Thus, indigenous knowledge provides problem-solving strategies for local communities and helps shape local solutions to revitalizing farming system and environment.

A recent trend in the scientific community is to create IK databases and systems. For instance, Gosart (2009) states that: “While composed with assistance and help from the indigenous peoples, these information resources often bore little relevance to the needs of the communities from whom the information was taken”. These results indicated that, we need the design and implementation of appropriate and well-targeted policies that take into account the interactions between macro-economic, agricultural and other sectoral policy concerns at national and local levels.

Integrating indigenous and non indigenous knowledge systems toward sustainability. Local indigenous knowledge systems of farmers have traditional knowledge of the local conditions, environment and social and economical problems. This knowledge indifferent areas, has great importance to project planners. Indigenous traditional knowledge and language are parts of the definition of indigenous autonomy socially, economically and environmentally. Recognizing the difference between indigenous and non-indigenous knowledge supports and emphasizes the integrating the two as complementary, rather than treating them as similar bodies of information or separate subsystems. But, there is a “power struggle” between the two knowledge subsystems, that eroding the credibility of both. Instead, by joining the advantages of indigenous and non indigenous approaches in the context of an "interactional approach", a symbiosis can result, enhancing the depth and breadth of both systems.

Co-management of subsystems of indigenous and non indigenous knowledge toward sustainability. Indigenous resource management measures are known in many communities in the Asia - pacific region (Johanes 1978; Ruddle and Akimichi 1984; Ruddle and Johanes 1985; Akimichi, 1986). When traditional knowledge with own originality, come in an interactional relationships with other knowledge subsystems, the integration is a powerful tool. Important examples are to be found in resource management socially, economically and environmentally, where science-based managers and traditional hunters, trappers, or fishermen work together giving equal weight to both types of knowledge.

Table 1 - A selection of terms and names for alternative systems of participatory learning and action (source: Pretty, 1994, adapted from Adnan *et al.*,1992)

Alternative systems of participatory learning and action (PLA)	Description
AEA	Agro-ecosystems Analysis
BA	Beneficiary Assessment
DELTA	Development Education Leadership Team
DPR	Diagnostico Rurale Participative
FPR	Farmer Participatory Research
GRAAP	Groupe de Recherche et d'Appui pour l'Auto-Promotion Paysanne
MARP	Methode Accélérée de Recherche Participative
PALM	Participatory Analysis and Learning Methods
PAR	Participatory Action Research
PRM	Participatory Research Methodology
PRAP	Participatory Rural Appraisal and Planning
PTD	Participatory Technology Development
PUA	Participatory Urban Appraisal
PFR	Planning for Real
PD	Process Documentation
RA	Rapid Appraisal
RAAKS	Rapid Assessment of Agricultural Knowledge Systems
RAP	Rapid Assessment Procedures
RAT	Rapid Assessment Techniques
REA	Rapid Ethnographic Assessment
RFSA	Rapid Food Security Assessment
RMA	Rapid Multi-perspective Appraisal
ROA	Rapid Organizational Assessment
RRA	Rapid Rural Appraisal
SB	Samuhik Brahman (Joint trek)
SSM	Soft Systems Methodology
TFD	Theatre for Development
TFT	Training for Transformation
VIPP	Visualization in Participatory Programs

Participatory action research (PAR), as a tool to facilitate structural and functional relationships between indigenous and non indigenous knowledge subsystems toward sustainability: create a partnership between traditional knowledge subsystems and other knowledge subsystems (such as science-based and academical management) through complementary action plans, participatory action research (PAR), joint ventures, capacity-building and maintenance, and co-management techniques. As such, a selection of terms and names for alternative systems of participatory learning and action, not only as approaches that facilitating the effectiveness of sustainable agriculture, but also methods that increase linkages and networking processes among different subsystems, has been rendered. Generally, for achieving sustainable agriculture, we needs alternative systems of participatory learning and action *(Table 1)*, that can increase synergy and networking relationships, more accurately among different actors and upgrading the effectiveness of total sustainable agricultural knowledge and information system (SAKIS).

Fig. 2, shows the overarching effect of indigenous knowledge on four most important topics in the rural and agricultural development. As before explained, the key factor in the adaptation process is the involvement of farmers who possess indigenous knowledge. Thus, according to *Fig. 2*, adaptation process is the first and basic stage for participatory interventions in the rural communities, to improve productivity, effectiveness and sustainability of current agricultural knowledge and information systems.

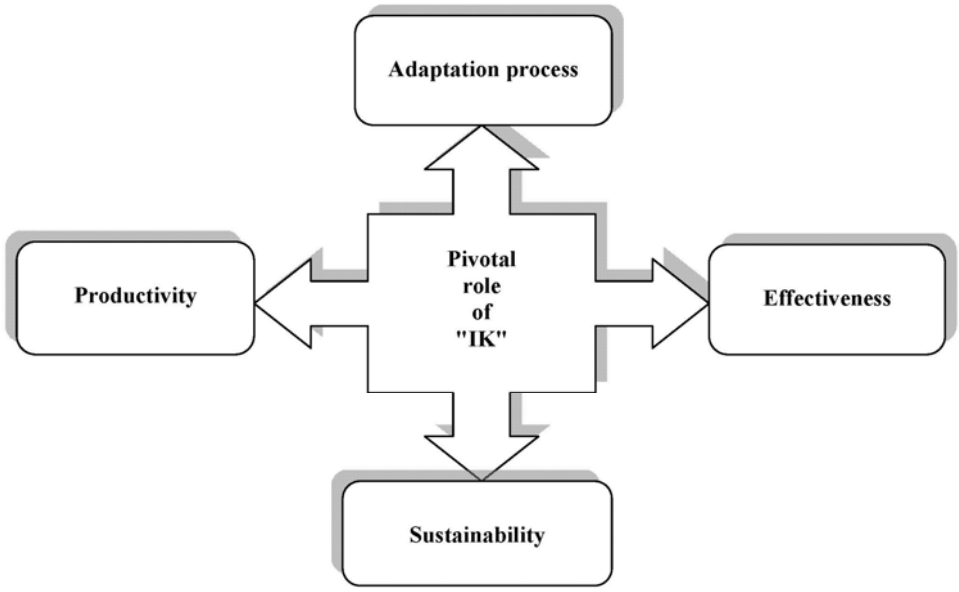

Figure 2 - Pivotal role of "IK" (Indigenous Knowledge)

CONCLUSIONS AND RECOMMENDATIONS

Indigenous knowledge (tacit knowledge) is the basis of farmer communities, coping practices that have helped vibrant communities to adapt different practices socially, economically and environmentally, with their conditions. Since the 1980s, indigenous knowledge (IK) has been a topic of important discussion among scholars of anthropology, geography and disciplines related to development studies. Today, there is broadening interest from a variety of fields: ecology, soil science, health, medicine, botany, water resource management and many more. The interest is driven by research into sustainable development practices in developing countries and the scientific community's concern over loss of species and ecosystems (Nakata, 2002).

Incorporating local knowledge into project activities such as, sustainable agriculture development projects can reduce the risks associated with relying on non relevant technology and with adopting alternative resources of indigenous knowledge, use techniques and practices that have adapted and tailored over exists resources and structures. Indigenous knowledge can help promote biodiversity and environmentally conservation by characterizing applying sound environmentally practices that are appropriate for the particular local landscape. In fact, incorporating indigenous knowledge subsystem into conservation and development activities of sustainable agriculture is believed to be an important mechanism for ensuring the most efficient and productive use of natural resources in the short term without jeopardizing the long-term and effectiveness capacity of nature to continue producing these resources. Yet, indigenous knowledge is often neglected as a key source of policy-relevant information because it is often undervalued relative to scientific knowledge, both by non-local project managers and local communities themselves. Learning about and making use of local knowledge helps confirm the value and importance of such knowledge and facilitates its integration into sustainable agricultural development policies and practices. For example, the NATURAMA project at Kaboré Tambi National Park in Burkina Faso used traditional communication channels (stories told by griots), in combination with the knowledge of the villagers on the Nazinon river, to develop and implement a fishing management plan for the area.

Although indigenous knowledge was often well adjusted to the prevailing biological, economic, and social conditions, but different studies indicated that local knowledge (IK) alone is unlikely to provide all the necessary solutions, given the rapidly changing economic, ecological, and social circumstances of farming systems. Therefore, integration and co-management of indigenous and non-indigenous subsystems toward sustainability is necessarily needed.

In this paper, three case studies was addressed, to represent indigenous knowledge effects on the effectiveness of different projects and extracting solutions for integrating "indigenous knowledge" in current agricultural knowledge and information systems toward sustainability. Four case studies indicated that:

- IK (Indigenous Knowledge) can help adaptation process (involvement of farmers who possess indigenous knowledge) of modern cultivation techniques (Case study 1).
- Using locally adaptable standards and means of transport, facilitates transportation of staples at the local level (Case study 2).
- Public based opinions can help to converting discriminatory practices (Case study 3). In this regard, land reform measures in order to aggregating farming lands can be effective.

Overall, according to findings of this study, indigenous knowledge provides problem-solving strategies for local communities and helps shape local solutions to revitalizing farming system and environment. Finally, a number of recommendations for integrating indigenous knowledge in the current agricultural knowledge and information systems toward sustainability have been proposed:

- Other indigenous knowledge systems to be understandable to farmers.
- Implementable (socially, economically and environmentally).
- Emanated within communities, based on local needs, and specific to culture and context (environment and economy).
- Provides core knowledge with flexibility for local adaptation (For example, participatory on farm experiments) for implementation.
- Uses local knowledge and skills, and experiences based on rural ecology.
- Has been proven to be time tested and useful in complex, diverse and risk prone (CDR; third agriculture) conditions.
- Understand and establish the value of indigenous knowledge in present context, and build a foundation for its integration with other knowledge and operational subsystems toward sustainability.
- Systematically document the indigenous knowledge on sustainability of farmer's organizations.
- Test the value of indigenous knowledge and identify appropriate practices for integration in the context of "agriculture sustainability".
- Demonstrate through national and regional pilot programs, the applicability of indigenous knowledge with appropriate adaptation, as a subsystem to awareness and support programs of sustainable agriculture development.

- Institutionalization of indigenous knowledge systems (IKSs) through international and regional efforts.
- Advocacy with national and local governments for inclusion of their local indigenous knowledge as well as adapted indigenous knowledge from other relevant communities in their agriculture management plans.
- And its integration in the policy frameworks and agendas of sustainable agriculture knowledge and information system (SAKIS).

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