Strengthening the Links between Programs of Technology Transfer and Indigenous Knowledge Systems

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Abstract

Many programs of technology development and technology transfer have failed – and continue to fail – because change agents do not fully understand and embrace the fundamental role that Indigenous Knowledge Systems play in the lives of people and their environment. Some of the most critical factors affecting this process are: 1) change agents' (creative) struggle to successfully link Indigenous Knowledge Systems with science, technology, economic, communication, organizational, political, and infrastructure considerations, 2) the complexity and dynamic nature of Indigenous Knowledge and the lack of systematic records, and 3) ethical concerns and intellectual property rights issues. The paper presents examples and discusses several strategies to help change agents better analyze the realities and dynamics of the change process, and better achieve complementarity, synergy, interdependence, interaction, and collaboration among various stakeholders in the development process. Some of the key strategies include: Moving from a transfer of knowledge framework to a co-creation of knowledge framework; facilitating social and experiential learning; building interdisciplinary teams that include social scientists; giving farmers a central role in agricultural innovation processes; enhancing trust relationships; using participatory methods; recognizing appropriate criteria to judge the truth value, applicability, consistency, and neutrality of both naturalistic and quantitative processes (Lincoln and Guba, 1985); and engaging in sound program development (including analysis of situation, priority setting, design and implementation, and evaluation).

Keywords: Indigenous knowledge, diffusion, innovations, consequences, change

Introduction

Indigenous knowledge is defined as local knowledge, beliefs, and values unique to a group of people, culture, or society (Warren & Rajasekaran, 1993). It is an immensely valuable resource from the past, and relevant to the present and future of societies, for it "is the basis for local decision-making [and communication] in agriculture, health, natural-resource management, [education,] and other activities" (World Bank, 1998, p. i).

Many past agricultural development programs have had less than optimal results because their agents (scientists, engineers, educators, etc.) have failed to fully understand and embrace the Indigenous Knowledge Systems (IKS) of the intended beneficiaries of the development effort. In 1995, Flavier stated that indigenous knowledge was grossly under-utilized in development. Today, although it is not questioned that consideration of the Indigenous Knowledge Systems of the intended beneficiaries will help reduce both rejection of innovations and negative consequences of development programs, it is still often the case that technological innovations do not demonstrate sound intersection between innovation research and transfer efforts and Indigenous Knowledge Systems.

Rogers' diffusion of innovations model (Rogers, 1995) is widely used by agricultural and extension educators to frame the process of technology transfer and plays "a major role in informing the design and implementation of agricultural extension" programs (Reece & Sumberg, 2003, p. 411). For many agricultural scientists, Rogers' book (five editions, from 1962 to 2003), may be the only text employed at a professional level that links the scientific perspectives of technology development with the communication, human, cultural, and societal components of the change and diffusion of innovation process. Although Rogers addressed the need to link Indigenous Knowledge Systems, the people, and the innovation development and diffusion processes, "some critics have blamed the theory for the characteristics of formal research and extension, which they see as being inefficient, technology-driven, centralised, top–down, dominated by elites, overly directive, out-of-touch and so forth" (Reece & Sumberg, 2003, p. 411).

Many factors make it difficult to appropriately connect programs of technology development and transfer with Indigenous Knowledge Systems. Some of the most critical factors are: 1) change agents' (creative) struggle to successfully connect Indigenous Knowledge Systems with science, technology, economic, communication, organizational, political, and infrastructure considerations, 2) the complexity and dynamic nature of Indigenous Knowledge and the lack of systematic records, and 4) ethical and intellectual property rights concerns.

A better understanding of the change and technology development process by agricultural and extension educators is necessary for successful and sustainable development efforts.

Purpose of the Paper

The purpose of the paper is to help change agents working in agricultural development and technology transfer programs to better address the needs and realities of the people and environments they are working with, to link Indigenous Knowledge Systems with their innovation-development and innovation-decision programs, and to better understand the dynamics of the change process that they are engaged in.

Philosophical Themes

Moving from a transfer of knowledge framework to a co-creation of knowledge framework

In a 2000 article, Christiansen reviewed the lessons learned (and not learned) through years of analysis of agricultural development projects. One of his most important premises was: "Underlying all successful development programs is the thread of seeking out, paying attention to, involving, working with, collaborating with, and obtaining feedback from the intended beneficiaries of development programs, projects, and activities" (Christiansen, 2000, p. 1).

In analyzing "technology transfer" experiences, numerous case studies show how development programs have failed simply because they have not started with the people. Rhoades (1984), for example, showed how a project to improve conservation of potatoes in Peru was not successful with highland small potato producers because the scientists failed to understand the dynamics and relationship between the farmers and their potatoes: The scientist-created a well-engineered structure to conserve the potatoes that the farmers did not use because it did not solve the farmer-perceived needs for post-harvest systems of potatoes.

For many, regardless of the degree to which technology transfer efforts strive to develop by the people, with the people, and for the people, they will always still be "linear," meaning that "an expert . . . seeks acceptance of, or compliance with, his way of looking at the world or of solving a problem" (Rölling, 2004, p. 10), as opposed to a co-creation of knowledge, in which "a group of stakeholders with different and often complementary experiences or knowledge agree on ways forward to improve their shared problem" (Rölling, 2004, p. 10)

Rölling (2004) proposes several principles that development practitioners should take into account when working with farmers:

> [1.] Farmers have veto power, better listen to them! . . . The challenge is to create social spaces for learning . . . in which farmers can be listened to . . . . [2.] Farmers have no negotiating power [no collective voice]; better find ways of giving it to them! [3.] Innovation is not the end-of-pipe result of a linear process but the emergent property of interaction among multiple stakeholders in an AKIS [Agricultural Knowledge and Information System, and 4.] One must involve those who have the power to determine the framework for the agriculture and rural development sector [. . . for] it is impossible to achieve goals without involving these 'higher' levels. (p. 16-19)

Building interdisciplinary teams that include social scientists

In 1984 research teams working in agricultural development in the CGIAR centers (Consultative Group for International Agricultural Research), were mostly composed of specialists in agricultural and life sciences, and focused primarily on improving productivity of crops. It was then when Robert Rhoades demonstrated, in a book entitled *Breaking new ground: Agricultural Anthropology* (1984), the need to include social scientists in agricultural and technology development research teams. Rhoades (1984) showed how projects based on sound science and well engineered technological innovations could fail if knowledge, culture, beliefs, and needs of farmers were not included in the research process. Thanks to Rhoades and many that followed, composition, dynamics, and processes of many development teams have changed: The research community has increasingly acknowledged the need for multiple and interdisciplinary foci in technological improvement, and has included social scientists in their teams who have helped improved the soundness of cultural and social foundations in development efforts. In fact, many granting agencies today require that all funded projects – even "basic" biological science projects - include interdisciplinary perspectives and analysis that include social scientists.

Addressing the pro-innovation bias

Breaking the empty vessel fallacy. One of the most important considerations in technology transfer is that potential adopters have existing ideas and beliefs, classified by many as Indigenous Knowledge Systems. Although surprising, many agricultural development projects have failed because agricultural and extension agents have not started by investigating what the potential adopters know and believe, and have not taken into account the compatibility of the innovation with the values and beliefs of the people ("empty vessel fallacy") (Rogers, 1995, p. 240). A migration away from the "empty vessel fallacy" will require emphasis on the study of prior practice, knowledge, resources, problems, challenges, perceived gaps, and perceived needs of people affected by change. In addition, change agent's must internalize the need to look for synergy, interdependence, and complementarity between "traditional research," "farmers' research," and indigenous knowledge.

Overcoming the "technology push." Another common problem of the pro-innovation bias is that researchers do not address the needs of the people, and assume that "innovations" are better and should be adopted by their intended beneficiaries, a bias that is often dubbed a "technology push" (Tielens, 2003). Rhoades (1984) discusses how change agents are perplexed after scientifically sound innovations are rejected. For example, in an effort to offer a faster drying system for the Andean chuño (dehydrated potato), CIP scientists developed "the black box," a well-engineered and simple tool that efficiently sped-up the dehydration process. However, the black box was not adopted by the farmers: although it dried potatoes faster, the black box did not offer any advantage over what was available through traditional methods. Rhoades (1984) then explains that if CIP scientists had engaged in appropriate needs assessment, they would have realized that time taken to dry the potatoes was not a concern of the farmers. After appropriate needs assessment with social scientists, the CIP potato team discovered that what farmers wanted were more efficient methods to cut and peel the potatoes.

Including more flexibility in the diffusion process. Failing to realize the value of user "re-invention" of innovations is another flaw brought about by the "pro-innovation" bias. "This view does not admit the possibility that the idea may be transformed by the creativity of those who use it . . . [who may] modify the recommended practices to fit their own circumstances or the particular conditions on specific fields" (Reece & Sumberg, 2003, p. 411-412). Re-invention helps adapt innovations to local environments and enhances perception of ownership, and should be encouraged and studied rather than discouraged, especially in marginal areas with specific and particular circumstances not studied by the innovation-development teams (Reece & Sumberg, 2003).

Preventing negative and unexpected consequences of development. Probably the most important danger of the pro-innovation bias is to assume "that adoption of a given innovation will produce only beneficial results for adopters" (Rogers, 1995, p. 405), and therefore fail to recognize possible negative consequences of an innovation: "Change agents should recognize their responsibility for the consequences of innovations that they introduce. They should be able to predict the advantages and disadvantages of an innovation before introducing it to their clients, but this is seldom done" (Rogers, 1995, p. 405). Christiansen (2000) proposed to "ask questions to minimize the unanticipated and unintended consequences resulting from our development efforts, or to get people to consider those consequences before deciding to go ahead with development activities." Important questions to ask are questions regarding equity of the change process (who gains, who loses), sustainability of change, environmental concerns, and cultural and societal compatibility of the innovation.

Further analyzing the characteristics of an innovation. Moving from transfer of knowledge to co-creation of knowledge adds new meaning to "characteristics of innovations." The traditional list, relative advantage (is it better?), compatibility (does it fit?), complexity (can it be understood?), trialability (can it be tried), and observability (can the operations and results be seen?), are concentrated in characteristics affecting the rate of adoption of an innovation (Rogers, 1995, p. 207). With rate of adoption losing importance in a new paradigm, different characteristics need to be studied, especially those that could help elucidate possible short-term, medium-term, and long-term consequences and changes brought about by specific development efforts (risk and uncertainty, required commitment and investment, opportunity cost, access, equity, gender/age/class focus, educational needs and availability, horizontality and verticality, re-invention, reversibility, time requirement for change).

Understanding development. One explanation why some agricultural and extension educators focus so much on the innovations is because they conceptualize development from a "production" and industrialized-country perspective. The starting point for them to reflect on their pro-innovation bias is to analyze the meaning of development, and focus development from a human development perspective instead of an economic growth perspective. An appropriate definition for development that would help these agents in this process is the one given by the United Nations Development Program (1999):

> Human development is the process of enlarging people's choices . . . choices that are created by expanding human capabilities and functionings – what people do and can do in their lives. At all levels of development a few capabilities are essential for human development, without which many choices in life would not be available. These capabilities are to lead long and health lives, to be knowledgeable and to have access to the resources needed for a decent standard of living… [other] additional choices . . . include political, social, economic and cultural freedom, a sense of community, opportunities for being creative and productive, and self-respect and human rights. Yet human development is more than just achieving these capabilities; it is also the process of pursuing them in a way that is equitable, participatory, productive and sustainable. (p. 16)

Engaging in sound program development

It is important for anyone engaged in extension education to appropriately present what are the specific objectives by which the overall goal will be met, how will these objectives will be met, and how will success or failure be assessed. There are many different models of program development used to help extension agents organize their actions throughout the process. The model used traditionally in extension education is based on the three interrelated phases of program development: Planning; design and implementation; and evaluation; and on the influences exerted upon these by the needs of community and society, the organizational context, and the agent herself/himself (Seevers, Graham, Gamon, & Conklin, 1997). Another useful model is the one used by the University of Wisconsin Cooperative Extension (UW-E) (2003), which includes analysis of situation (needs assessment, analyzing stakeholder engagement, and differentiating between problems/causes and symptoms/effects), priority setting (establishing priorities and intended outcomes), program action (inputs, outputs, and outcomes) and evaluation. The model also includes assumptions made regarding the program and the people involved, and the external factors influencing the program. Important contributions of this model are that: 1) It proposes evaluation as a process that starts at the very beginning of the program development, with the analysis of situation, and continues throughout the program, including both formative

and summative evaluations, and 2) It differentiates between inputs (what we invest, including personnel, time, resources, partnerships), outputs (what we do and who we reach), and outcomes/results (short term impacts such as learning results, medium term impacts such as change in actions such as practices and policies, and long term impacts such as change in social, economic, civic, and environmental conditions) (UW-E, 2003).

Understanding struggles between naturalistic and quantitative paradigms. Regardless of the model used, sound program development processes will require appropriate data collection in order to complete needs assessments and evaluations. Agricultural and extension education educators are not surprised to hear the word *versus.* in sentences including the words qualitative and quantitative. These words are often compared, contrasted, and confronted, by students, teachers, and researchers. Regardless of their "preferred" paradigm, educators need to be prepared to address many of the misconceptions involved in the collision of these terms when discussing program development, needs assessment, and evaluation, and avoid comparisons of their value and worth based on identical scales. The measuring scale needs to be different for each of them, allowing for both good and bad programs in each. According to Lincoln and Guba (1985), research should be judged using four criteria: truth value, applicability, consistency, and neutrality. In the conventional paradigm (quantitative research), these will measured using the "internal validity, external validity, reliability, and objectivity" (Lincoln and Guba, 1985, p. 300) measuring scales, while in the naturalistic paradigm the scales will refer to "credibility, transferability, dependability, and confirmability" (Lincoln and Guba, 1985, p. 300).

Using participatory methods

Regardless of the research paradigm embraced by an agricultural development agent, or by the stage at which s/he is in the migration from the transfer of knowledge paradigm to co-creation of knowledge paradigm, the use of participatory methods will be invaluable in needs assessment, implementation, and evaluation of any development project. Learning to use participatory methods is not easy, and the first step is to develop key skills and attitudes. According to Harvey and Appleton (nd.), to create an enabling environment, one not only needs to adopt new habits and "unlearn a whole range of habits" (p. 4), such as: Facilitating vs. telling, listening vs. talking, guiding vs. directing, relinquishing control, probing, and stimulating (Harvey and Appleton, p. 4-8). Some conventional methods that are also used in participatory processes are focus group, community and spontaneous group meetings, semi-structured interviews, direct observation, and triangulation (Harvey and Appleton, p. 11-16). Some additional methods used in participatory processes can be found in most participatory methods manuals. The most common are: community mapping (most used as a tool to identify problems and to establish a common vision of the community), gender analysis, three-pile sorting (good, bad, and in-between), problem trees (to analyze causes and effects of specific problems), solution trees, pocket charts or matrix scoring (to analyze and evaluate situations and solutions to a problem), and option ladders (Harvey and Appleton, p. 21-33).

Asking the right questions of the right people, and interpreting the answers well. Analysis of past agricultural development programs have shown that common mistakes of development agents and scholars have been to ask the wrong questions, misinterpret the responses, and make assumptions about different stakeholders in the development program.

Misinterpretation of results is often caused by contrasting understanding between farmers, scientists, and other stakeholders. Rhoades (1984) explained how "potato postharvest losses" meant one thing to farmers and something totally different to scientists. The scientists' losses,

mostly pathological (fungi, bacterial) problems, were not considered losses by farmers, for all potatoes – diseased or not – were used in some form. To the farmers, the loss was in the form of spoiled sprouts that had to be cut at the time of planting. Similarly, a "water" problem can be interpreted in different ways within a social system, with adult males analyzing availability and quantity for animal rearing, females and children considering time needed to walk to the nearest water source, and health workers worrying about quality and safety of drinking water.

Some of the assumptions about stakeholders are based on class, gender, social status, ethnicity, and identity of the stakeholders. These assumptions have "influenced the problems selected for study and the methods used in the research, and . . . shaped the characteristics of the proposed . . . [development] strategies (Ferguson, 1994, p. 545). In the case of Ferguson (1994), these assumptions were gendered assumptions and resulted in male land owners being the only ones surveyed regarding a bean variety improvement project, while women were the only ones with knowledge of bean agricultural systems, and thus, in essence, were the prospective users and beneficiaries of the bean improvement program. Participatory development strategies and tools can help development professionals to better identify the different sectors of the population and their roles in the co-creation of knowledge.

Participatory development methods also help to assess the types of decision making unit(s) (individuals or groups), and styles (holding responsibility vs. delegation, majority rule vs. consensus), interpersonal relationships and communication behaviors among intended beneficiaries (including frankness vs. reticence, attitudes towards disclosure and information sharing, level of directness, attitudes towards conflict, different degrees of assertiveness, group dynamics), and different ways of knowing, learning, and doing (e.g., deductive vs. inductive modes of reasoning) so that appropriate questions can be asked of the right people.

Building trust. Trust "is crucial for obtaining insight into sensitive information and tacit knowledge . . . which is necessary for identifying and using the room for manoeuvring, as well as enhancing mutual learning between, and risk-taking behaviour by, different actors involved in the [development] process" (Swaans, Broerse, & Bunders, 2005, p. 3). "At the beginning of a process the level of trust is generally low" (Swaans, Broerse, & Bunders, 2005, p. 3), but can be increased by participatory methods. However, it may take time and many failures to achieve trust. Below are two case studies from the Carter Center (2007a; 2007b) illustrating how similar development projects can have contrasting results due to different level of trust among the stakeholders.

Guinea worm is a parasitic disease contracted by drinking contaminated water. It is not only extremely painful for the affected people, but its effect on people's capacity for agricultural work and children's school attendance also debilitates entire communities. A disease of the poor, its prevention has been one of the foci of the Carter Center for two decades through awareness campaigns, education, and low-technology strategies (filtering, boreholes, deep wells, human-safe larvicides) (Carter Center, 2007a). When using chemical strategies, the idea is break the life cycle of the worm by treating all shallow waters and drinking sources with a mild larvicide that kills the fleas that carry the worms. This task has proved to be very difficult for the Carter Center agents, with both disguised and open opposition to the efforts, mostly based on lack of trust among different stakeholders. In the Sacred Pond of Ogi (Nigeria), after having secured permission from local leaders to treat the pond (which gave Carter Center agents a false sense of security and trust), the Carter Center volunteers found that many of the women in the village were blocking their access to the pond to prevent them from treating it. The women did not believe the disease had anything to do with the water, but was a curse from their ancestors… and

treating the waters would make the problem even worse. In Ogi and many other locations in Africa, the eradication process of Guinea worm is taking at least ten years longer than expected, mostly because of unanticipated opposition based on local beliefs (McNeil, 2006) and the lack of trust among stakeholders.

In the same way that some projects do not work because of lack of trust and local dynamics, other projects advance better and faster than imagined precisely because of successful trust-building efforts, and compatibility with local beliefs and dynamics. A case study exemplifying this thesis is the work of many organizations with another disease of the poor, trachoma, endemic in many areas where water sanitation is not easily available. Among strategies to fight trachoma, personal (e.g., facial cleaning) and environmental hygiene (e.g., water sanitation) are key. The Carter Center and many other organizations have seen their latrine construction and improvement projects greatly surpass initial expectations after being very well received, supported, and expanded by women. Trust built up in latrine construction projects because it proved to be not only a tool for sanitation and disease prevention – as initially designed – but also as a tool for empowerment, development of women-based community organizations, time saving, security, privacy, dignity, independence, self-sufficiency, as well as access to education for girls, and income generation (Gender and Water Alliance and United Nations Development Programme, 2006; Carter Center, 2007b).

Without trust co-creation of knowledge is practically impossible, collaboration among stakeholders very difficult, and integration of Indigenous Knowledge Systems in the development of innovations very complex. In addition to being a key component in successful innovation-development projects, trust also empowers and provides numerous learning opportunities to all involved. For example, in the report of a clinical trial for HIV prevention, International Partnership for Microbicides (2006) reports that "enrolment in trials often *decreases* a woman's risk of HIV infection due to the extensive outreach services offered to study participants including safe sex education, treatment of sexually transmitted infections and the provision of condoms" (p. 1)

Finally, the use of participatory methods will also help prepare a more in-depth analysis of the factors influencing cultural environment (norms of the social system, religion, education, economics, politics, power and reach of civil society, natural resources/geography, family, class/age/gender structure, language, and history) that had been possible when simply using quantitative methods rooted in the conventional paradigm. In the case of the trachoma control programs of the Carter Center, participatory methods helped to reveal that the process was highly dependent on local indigenous knowledge systems. For example, while in some countries public latrines seem to be working (Ethiopia and Ghana), in other countries (e.g., Mali), different wives or families under the same roof required separate latrines. Also, technology has had to be adapted in all cases for local environment and available resources to make the latrines affordable and sustainable: In areas with loose and moist soils traditional latrines tend to collapse, and in hot areas the lids would get too hot, requiring in both cases special design and materials (Carter Center, 2004).

Participatory methods will also help to better understand personal characteristics of individuals (personality, opinion leadership, innovativeness, communication style), to study the verbal and non-verbal communication patterns (meaning of symbols, space, touch, face expression, gestures, eye contact, time, tone) and the changes in communication behavior depending on communication channel, environment, and partners.

Understanding the dynamic nature of IKS and the lack of systematic records

Two of the most important factors that make it difficult for agricultural and extension education agents to appropriately connect programs of technology development and transfer with Indigenous Knowledge Systems is the complexity and dynamic nature of Indigenous Knowledge Systems, and the lack of systematic records of Indigenous Knowledge Systems that are accessible by change agents during the innovation-development process (Center for International Earth Science Information Network [CIESIN], 2003).

According to Williams and Muchena (1991), indigenous knowledge "is generated in response to the natural and human conditions of a particular environment and context. It is dynamic and creative in that experimentation and evaluation are continually stimulated by both adaptation requirements and external influences" (p. 53) (see also Flavier, 1995). In West Africa, for example, many argue that small scale farmers are stagnant. According to Rölling (2004), however, these same small scale farmers are adaptive, innovative, and dynamic, having been able to deal well with unfavorable and rapidly changing situations (e.g., changing climate, lack of access to resources, declining fertility, wars, epidemics, and taxes, and still feed a growing population). In fact, "the only thing that 'works' in rural West Africa is 'rural dynamics', the continuous struggle of rural people to improve their lives" (Rölling, 2004).

> The question then is: Why has it not been possible for agricultural research to link into this rich lode of innovativeness? We believe it is too easy here to place all the blame on the disciplinary myopia of some researchers and the linear transfer of technology paradigms that international and national science & technology have been following. However serious an impediment this is . . . we explore three factors: (1) farmers' lack of countervailing power, (2) the lack of markets and service delivery institutions at the middle level, and (3) the systematic creaming off of the wealth generated by West African agriculture by pre- and post-independence governments. (Rölling, 2004, p. 12-13)

Understanding the dynamic nature of IKS and adapting to the limitations presented by the lack of records is a challenge that can be best addressed through social learning among the different stakeholders in the co-creation of knowledge, as they "partner and collaborate in local experimentation, monitoring and assessing innovations in specific contexts" (Kroma, 2004). In the last two decades, due to this synergy and collaboration between scientists and farmers (and other stakeholders) and better use of Indigenous Knowledge Systems, a considerable percentage of research for agricultural development projects has been switching from a production-oriented focus to a sustainable resource management focus, and there has been a significant shift in research attention toward marginal areas

Conclusions

The role of agricultural development agents in innovation-development efforts is very complex. To strengthen the synergy between their work and that of farmers, they must move from the idea that agricultural extension is "an instrument for disseminating technologies from researchers to farmers" (Pijnenburg, 2004, p. 7) toward an interactive and integrative model of co-creation of knowledge. Some strategies that will help them in their efforts are as follows: 1) Using interactive and integrative approaches that involve multiple stakeholders and recognize the "central role of farmers" (Swaans, Broerse, & Bunders, 2005, p. 3); 2) Building interdisciplinary teams that include social scientists; 3) Using participatory methods and recognizing appropriate criteria to judge the truth value, applicability, consistency, and neutrality of both naturalistic and quantitative processes (Lincoln and Guba, 1985); 4) Building trust relationships and facilitating

social and experiential learning (Swaans, Broerse, & Bunders, 2005); and 5) Engaging in sound program development (including analysis of situation, priority setting, design and implementation, and evaluation).

Educational Importance, Implications, and Application

A growing concern in agricultural development efforts is how to effectively adapt to changes in climate and population pressures. Effective solutions to these problems will be different from place to place and will depend on local knowledge and participation. This does not mean that innovation-development efforts should be exclusively local. "Adaptation is a combination of *implementation*, which is largely undertaken at the local level, and *facilitation*, which involves roles for actors from local to national to international level" (Kartha, Bhandari, van Schaik, Cornland, & Kjellén, 2006, p. 3). To be able to facilitate adaptation of agriculture to changes in our environment, agricultural and extension educators need to be prepared to create "an enabling environment in which the local implementation of adaptation is feasible" (Kartha, Bhandari, van Schaik, Cornland, & Kjellén, 2006, p. 3). This paper will help agricultural development agents better address the needs and realities of the people and environments they are working with, to integrate Indigenous Knowledge Systems with their innovation-development and innovation-decision programs, and to better understand the dynamics of the change process that they are engaged in.

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