

# AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEM IN THE CONTEXT OF SUSTAINABLE AGRICULTURE : SUSTAINABLE AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEM FRAMEWORK AND EFFECTIVE FACTORS

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**ABSTRACT.** Promotion of sustainable agricultural practices (SAPs) is indispensable, either the need of increasing productivity, or more sustainable agriculture. A precondition for ensuring and buttressing the 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 and regional level. An Agricultural Knowledge and Information system for Rural Development (AKIS for RD), links people and institutions to promote mutual learning and generate, share, and utilize agriculture-related technology, knowledge, and information. Most AKIS projects support agricultural research, extension, or education activities, which are increasingly viewed as components of an inter-related system. An AKIS should incorporate current and potential elements and resources

economically, socially and environmentally in the context of Sustainable Agricultural Knowledge and Information System (SAKIS). Therefore, the goal of this study, was the investigation of different agricultural knowledge and information systems based on comparative concepts, structures, and functions for extracting and delineating appropriate framework for SAKIS. AKIS in Kenya, Hagaz (Eritrea), Israel and Netherlands has been addressed. AKIS in Kenya, because of links between external institutions and organizations, for both government organizations and NGOs, were generally weak and poorly coordinated (Low Networking), as a developing country has been selected. The AKIS in Hagaz (Eritrea), because of one study supported by Food and Agriculture Organization (FAO) and DANIDA, to addressing AKIS, has been selected. And at last, AKIS in Israel and Netherlands, because of structural and functional comparisons, has been selected. Results indicated that, much of the success

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of the AKIS in the Netherlands and Israel stems from the well-functioning interfaces between the knowledge subsystems, i.e. (Synergistically sound relationships and networks among different subsystems and suitable networking processes). In this paper, main emphasis is on the networking and synergy processes as factors affecting SAKIS effectiveness. Finally, fourteen recommendations for buttressing current AKIS toward sustainability, has been rendered.

**Key words:** Inter-related system; Networking and Synergy Processes; Sustainable Agricultural Knowledge and Information System (SAKIS).

## INTRODUCTION

An agricultural knowledge and information system for rural development and sustainable agriculture links people and institutions to promote mutual learning and generate, share, and utilize agriculture-related technology, knowledge, and information (FAO/World Bank, 2000). The system incorporates farmers, agricultural educators, researchers, and extension workers to harness knowledge and information from various sources, especially from farmer's "indigenous knowledge systems" (IKSs) for better farming and improved livelihoods. This integration is suggested by the "knowledge triangle". Also, it should be added to the "knowledge triangle", as the policy subsystem to achieve Sustainable Agricultural Knowledge and Information System (SAKIS). Policy subsystem as supra system component is effective on the function and structure of all components of one

agricultural knowledge and information system, so that with excluding that, one agricultural knowledge and information system will be very low effectiveness toward achieving sustainability indicators and goals.

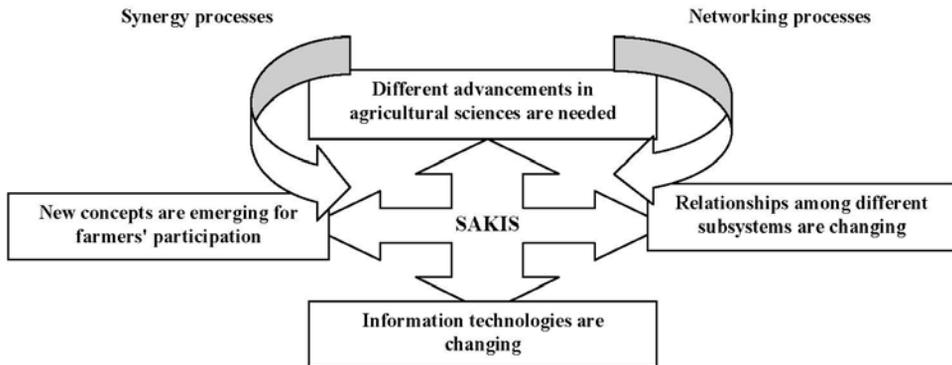
Rural people, especially farmer organizations, are at the heart of the knowledge triangle. Education, research and extension and policy subsystems are services - public or private - designed to respond to their needs for knowledge with which to improve their productivity, incomes and welfare and manage the natural resources on which they depend in a sustainable way. A shared responsiveness to rural people and an orientation towards their goals ensures synergies in the activities of agricultural educators, researchers and extensionists. Farmers and other rural people are partners within SAKIS, not simply recipients.

The SAKIS strategy is intended as a conceptual and structural framework for sharing ideas and principles with the various stakeholders addressing the causes, and for seeking solutions for more sustainable agriculture and rural development. Therefore, a "shared responsiveness" to farmer organizations and an orientation towards their goals ensures synergies in the activities of different subsystems in the SAKIS. Farmers and other rural people are partners within the knowledge system, and as the main subsystems for achieving a more flexible, productive and

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sustainable agriculture. For upgrading the effectiveness of current agricultural knowledge and information systems toward sustainability (SAKIS), new opportunities are emerging. These opportunities are as follow: 1) Advances in the agricultural sciences are crucial, but other advances are also needed (such as precision farming); 2) Relationships are changing between different subsystems (accurately and synergistically relationships of

subsystems); 3) Communication and information technologies are advancing rapidly (Integrating Indigenous Knowledge Systems (IKSs), in the SAKIS); 4) New concepts are emerging for farmers' participation in the learning, problem solving and problem posing processes (such as Participatory Action and Learning Method (PALM)). Therefore, "networking" and "synergy" processes among different subsystems increase the effectiveness of total SAKIS (Figure 1).



**Figure 1 - Necessity of visualizing the networking and synergy processes, in the current agricultural knowledge and information systems toward sustainability**

Figure 1 explains the necessity of considering and articulating the accurately and synergistically relationships of different subsystems in the current agricultural knowledge and information systems that affect the farmers participation, information technologies and other related technologies in the agriculture to achieve more socially, economically and environmentally sustainable agriculture. Networking processes among different subsystems are

crucial for increasing the effectiveness of total SAKIS. Alders *et al.* (1993) explains the preconditions and advantages of investment in networking knowledge for development (sustainable agriculture): 1) Networking is a tool for boosting development performance (AKIS effectiveness); 2) Networking takes time; 3) Adaptive management and flexibility are of primary importance to the governance of learning-oriented networks (such as AKIS); 4)

Traditional approaches for M&E and supervision won't necessarily fit the bill of sponsoring a network. Based

on Biggs (1995), there are contending coalitions in agricultural research and technology promotion.

**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	Description
AEA	Agro-ecosystems Analysis
BA	Beneficiary Assessment
DELTA	Development Education Leadership Team
DPR	Diagnóstico 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

In order to bridge the gap between the planning and management literature and the practice of R&E, we suggest that research and technology promotion activities be seen as taking place in

arenas occupied by various contending science and technology (S&T) coalitions in which all components especially farmer organizations as the pivotal subsystem, interacts with each other

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systemically. However, in practice these coalitions may be competitive, complementary, or coexistent. Generally, for achieving sustainable agriculture, we need 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 SAKIS.

Therefore, the goal of this study was the study of different agricultural knowledge and information systems based on comparative structures, concepts and functions and extracting and delineating appropriate framework for SAKIS.

## MATERIALS AND METHODS

For delineating appropriate framework for SAKIS, agricultural knowledge and information system (AKIS) in Kenya, Hagaz (Eritrea), Israel and Netherlands has been addressed. AKIS in Kenya, because of links between external institutions and organizations, for both government organizations and NGOs, were generally weak and poorly coordinated (low networking), as a developing country has been selected. The AKIS in Hagaz, Eritrea, because of one study supported by Food and Agriculture Organization (FAO) and DANIDA, to addressing AKIS, has been selected. And at last, AKIS in Israel and Netherlands, because of structural and functional comparisons, has been selected.

**Agricultural knowledge and information systems in Kenya.** The AKIS of Kenya's smallholder farmers are diverse and complex, varying with

agricultural enterprise, agro-ecology, and from district to district. Agribusiness plays a major role in the AKIS of Kiambu district near to Nairobi, whilst government and non-government agencies are the major "external" actors in the pastoral areas of West Pokot. NGOs and church organisations are particularly active in Homa Bay, but their coverage is limited (Rees *et al.* 2000). Links between external institutions and organizations, for both government organizations and NGOs, are generally weak and poorly coordinated. The major sources of knowledge for smallholders are local (neighbors, family, markets and community based organizations). In KENYA, the importance of participatory learning approaches recently has emphasized in the AKIS and government research institutes have captured a pivotal roles in the AKIS of the future through increased emphasis on strategic alliances with other development agencies, the production of teaching materials designed for facilitating participatory learning, and the production of 'basket-of-options' information materials for farmers and extensionists. Therefore the role of synergistically relationships and networking processes among interrelated subsystems in the AKIS of Kenya as a developing country for increase the overall effectiveness of AKIS, have been emphasized.

### **Agricultural knowledge and information systems in Hagaz, Eritrea.**

The Ministry of Agriculture of the Government of Eritrea, with support from FAO and DANIDA, carried out a study of the AKIS in a sub-zoba (an administrative area similar in extent to a District in other countries in the region) (Garforth, 2001). The purpose of the study was to contribute to the development of demand-led extension and advisory services in Eritrea, through a better understanding of

the information needs of farmers and of the sources and channels through which they access information. The specific objectives were as follow: 1) Develop a methodology for analyzing an AKIS at sub-zoba level and build capacity in using the methodology among zoba and sub-zoba staff; 2) Identify the most pressing information and technology needs of different categories of farmers; 3) Describe and assess, from farmers' perspectives, the functioning of the AKIS; 4) Identify constraints in the efficient functioning of the AKIS and make suggestions for improving its performance. The study was carried out in March 2001 with the SDRE Communication for Development Group and DANIDA/Eritrea. The study set out to develop methods for analysis that can be used by advisors in dialogue with farming communities. Findings highlighted local variations in AKIS, the key role played by farmers in introducing and adapting new agricultural technology, and the importance of market opportunities in driving successful innovation. Opportunities for improving the functioning of the AKIS included: 1) Training to meet specific farmers' needs; 2) Participatory adaptive research; 3) Improving the reliability of information exchanged through farmer-to-farmer interaction and 4) Planned use of existing informal channels for enhancing the two-way flow of information between advisors and farmers. As the purpose, objectives and results of this study carried out by FAO and DANIDA about AKIS in Hagaz, Eritrea, shows the effect of farmers' participation in all stages of establishing demand-led extension have been highlighted.

**Agricultural knowledge and information systems in Israel and Netherlands.** After analysis of the U.S. extension system, Rogers *et al.* (1976)

have found eight elements which made it successful, and which can be used to analyze other research utilization systems. These are: 1) A critical mass of new technology; 2) A research subsystem orientated to utilization; 3) A high degree of user control over the research utilization process; 4) Structural linkages (networking processes) among the research utilization system's components; 5) A high degree of client contact by the linking subsystem; 6) A spannable social distance across each interface between components of the system; 7) Evolution as a complete system; 8) A high degree of control by the system over its environment. In the analysis of the Dutch and Israeli knowledge systems all eight elements were found to be conspicuous, thus reinforcing the conclusions of Rogers and his colleagues (Blum, A., 1991). However, eight further elements exists which explain the success of the Dutch and the Israeli AKISs and which probably can also be found in the U.S. and in other successful AKISs. These additional points are the following: 1) Knowledge policy (policy subsystem), is an important component of the AKIS. It complements the "classical" knowledge generation, knowledge exchange and knowledge utilization subsystems. The importance of formulating and following a knowledge policy has been noted, e.g. by Arnon (1987). However, it is often neglected when knowledge systems are investigated. Both AKISs of the Netherlands and Israel have special bodies for the formulation of agricultural knowledge policy, and farmers have a distinct input and joint responsibility for bearing the costs. The relatively strong influence of farmers in these countries have over research planning is one of the main reasons for the overall effectiveness of the whole AKIS. 2) Different stages of knowledge generation and exchange are

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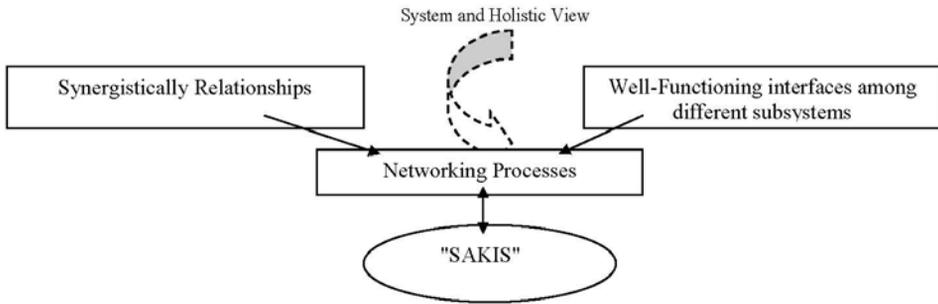
coordinated in an interlocked knowledge management system. The knowledge system, like other man-made systems, needs careful management for optimalization. This task requires an agreed division of labor and coordination among institutions, whose staff engage in the generation, transformation and transmission of agricultural knowledge. 3) Knowledge exchange subsystems include more than extension (research, education, and other inter related subsystems). The media and all farmers play an important role in the exchange of agricultural knowledge. Farmers, too, act as important knowledge exchange agents, especially for peers who do not accept the direct advice of extension workers, but do so indirectly when the same message comes through an experienced farmer. Also the media, in Western countries mainly the press, play an important role in the transmission of agricultural knowledge. 4) A good educational level of the users enhances the effectiveness of agricultural knowledge exchange. The comparative review has shown the importance of basic and of vocational-agricultural education as important components of the agricultural knowledge exchange subsystem. Evenson and Kislev (1975), Evenson (1986) found that education and extension can be substitutes for each other, at least in industrialized countries. In our case, a synergistic effect seems to exist. Farmers' good reading standards and basic agricultural knowledge enables them to make full use of a well-established agricultural press. In developing countries, probably other mass media like radio and television could play a similar role. 5) Informal linkages are as important as the formal ones. Much of the success of the AKISs in the Netherlands and Israel stems from the well-functioning interfaces between the

knowledge subsystems. In Israel, advisors and even farmers are involved in adaptive research, often through informal cooperation. In both countries farmers are involved in field trials and observations, usually through quite informal arrangements. Thus, knowledge exchange through the whole knowledge system becomes smoother. 6) Linkages are especially effective when the AKIS is small or when regionalization is well organized. In relatively small systems, as in The Netherlands and Israel, most researchers and advisors have studied at the same place or at a small number of institutions. They often know each other personally or have at least common experiences. They have a similar cultural background. All this helps to encourage and strengthen informal linkages. The small distances for travel enable them to meet more often and more easily than in large systems. Probably, also larger systems can be made more efficient by regionalization and decentralization. 7) Advisors should be professionals. The more functional (formal and informal) linkages that exist between the knowledge subsystems, the better are the chances that the system as a whole functions well. At the same time, the "actors" in the system must be professionally independent. Researchers, advisors, farmers, educators, the farm press etc. should not be unduly directed by government or other partners in the system. They should be able to act on their best professional judgment. When advisors have an independent and professional status, their credibility among farmers grows. 8) Cooperation is an important facilitating factor which enables the user subsystem to have more influence over the system. Farmers' active role in influencing the whole AKIS is helped by their having strong representative bodies and a high degree of cooperation at all levels. Based on the

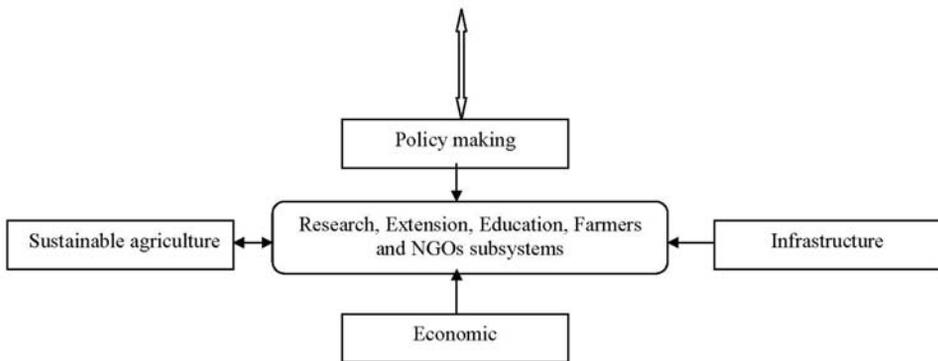
main discussed characteristics of AKIS in this study, the *Figures 2 and 3*, has been delineated.

As *Figure 2* shows, synergistically relationships of interrelated subsystems of one agricultural knowledge and information system and well-functioning interfaces among these subsystems with system and holistic view as factor and perspective that surrounds all function and structure of different subsystems when the relationships of different subsystems consider in one system, affect

the networking processes, and finally affect the SAKIS effectiveness. *Figure 3* shows the relationships of factors affecting the effectiveness of sustainable agriculture. The link of factors affecting sustainable agriculture and effective factors on SAKIS lies in the inextricable role of networking processes as the processes integrate all subsystems economically, socially and environmentally toward achieving more sustainable agriculture.



**Figure 2 – Factors affecting sustainable agricultural information system toward sustainability**



**Figure 3- Conceptual relationships about factors affecting the effectiveness of sustainable agriculture**

## CONCLUSION AND RECOMMENDATIONS

A good number of communication approaches are available for agricultural development. Farming System Research (FSR) and Training and Visit (T & V), as approaches of agricultural extension are unable to achieve synergy as they are centralized with top down approach of managing different subsystems, do not build farmers' capacity and ignore informal demands and networking processes. Hence, systematically and holistically management of all subsystems in the SAKIS will be required to hold all formal and informal elements together, and ensuring coordinated interaction among inter related subsystems to increase synergy and effectiveness indicators. However, earlier farming system, extension, agricultural technology development, research and policy making subsystems were considered as separate entities each with its own set of issues, managed by only groups of researchers and professionals. There is conceptual progression from looking at various institutions and practices such as farming system development, extension and research in isolation to considering the linkages between pairs of these elements and now to looking at all the elements as an AKIS for sustainable agriculture (SAKIS). If the sustainable agricultural knowledge and information strategy is to make the maximum contribution to

sustainability needs a shift from "imposed technologies" to "demand driven" one. Main focus of this paper, lies in the importance of adopting a systems perspective and emphasizes the synergistically relationships among different subsystems toward AKIS for sustainable agriculture. This calls for a holistic, interactive and integrated system of research, extension, education and farming community and policy-makers subsystems. It is usually necessary to integrate the information from researchers, extensionists and farmers and policy-subsystems to be able to develop strategies which work well in the context of AKIS for sustainable agriculture. This process of integration (networking processes) often receives insufficient attention. Development of "network" processes (as explained by Alders *et al*,1993), to exchange information among all relevant actors is an important aspect here. The combined contribution of these actors is more than the sum of the individual contributions. The AKIS respond to technology, knowledge and information needs of farmers helping them in decision making and management of their farms. The basic assumption of this system is that information relevant for decision-making is generated by different actors and reaches farmers in many different ways (Therefore, establishing "networking processes" among different subsystems is a leading factor).

The dual concept of AKIS and synergy can fill this analytical gap.

Briefly, current AKIS have not been responsive enough in addressing the problems and opportunities facing farmers (such as AKIS in Kenya in this study). This, together with related shortcomings in the existing AKIS institutions, has become increasingly clear in light of the considerations described above. For example:

- Farmers' needs do not sufficiently drive the orientation and function of research and extension subsystem and labor, market requirements are not adequately translated into curriculum design in agricultural training institutions.

- The know-how and technologies that are produced by different subsystems, even when relevant, are not widely taken up by farmers, suggesting a lack of effective transfer. Concerns over cost effectiveness mean that public research and extension services have trouble ensuring their financial sustainability.

- Public decision-makers as supra system in the agricultural knowledge and information system are often unaware of the actual results achieved and the long-term resource allocations needed. Many public decision-makers are frustrated by the disappointing levels of coverage, of actual face-to-face contacts, between farmers and extensionists and researchers. However, the same decision-makers often constrain outreach programs through budget cuts that further limit coverage.

- In many settings, the quality of human capital in AKIS is low,

suggesting that investments in human capital formation are inadequate and that the training and educational institutions themselves are insufficiently responsive to changing demands.

- A lack of systematic collaboration among educators, researchers, extension staff and farmers has limited the effectiveness and relevance of support services to the rural sector and sustainable agriculture development. In this paper, the AKIS in Kenya, Hagaz (Eritrea), Israel and Netherlands was addressed. AKIS in Kenya, because of Links between external institutions and organizations, for both government organizations and NGOs, were generally weak and poorly coordinated ("low networking" ), as a developing country was selected. The AKIS in Hagaz, Eritrea, because of one study supported by FAO and DANIDA, to addressing AKIS, was selected. And at last, AKIS in Israel and Netherlands, because of structural and functional comparisons, has been selected. In the AKIS in Israel and Netherlands, the key factors that increase effectiveness of total system, were as follow: knowledge policy (suitable policy-setting framework and formulating national extension policy); coordinated knowledge generation and exchange subsystem among different subsystems and briefly; synergistically sound relationships and networks processes among interrelated subsystems.

Finally, the following recommendations are integration from

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emanated results by this study and other related studies about upgrading the overall effectiveness of current AKIS toward sustainability:

1. Identification of the current formal and informal mechanisms that link various subsystems for the purpose of joint planning and integrated functions within the context of SAKIS and assessment of their suitability and effectiveness.

2. Collection of information on the human, physical and, especially, financial resources of various subsystems and the technical and geographical scope of their individual functions, and identification of any current or planned modalities for sharing resources, especially aimed at cost-sharing.

3. Assessment of the importance that the government attaches to each subsystem in terms of budgetary allocations, staff benefits (incentives), promotion and career development opportunities (enabling environment) and provide facilitator environment for function of interrelated subsystems.

4. Identification of the main constraints such as institutional, physical, political, financial, human resources, etc. that discourage various subsystems from planning and operating jointly.

5. Collection of the views and suggestions of various subsystems for facilitating joint planning and function.

6. Assessment of the extent of decentralization, delegation of power and authority for financial control of

income and expenditure to lower administrative levels, such as the district level, in the cases of the various subsystems.

7. Identification of cases where the farmers use in their field operations client oriented and participatory approaches to planning, programming and implementation, involving several subsystems.

8. Assessment of the importance attached by interrelated subsystems to human resources development, such as through development of problem solving skills, participatory learning and empowerment, as compared with a mainly technology and production focus.

9. Critical assessment of any appropriate mechanisms for monitoring, evaluation and impact assessment of their respective programs used by various subsystems (as leading pre-requisite of “networking process”).

10. Making the whole current AKISs financially, socially and environmentally more sustainable.

11. Improving the relevance as well as the effectiveness of the processes of knowledge and technology generation, sharing and uptake among interrelated subsystems.

12. Making AKIS/RD more demand-driven through empowerment of farmers, particularly those who are marginalized and disadvantaged, so that they might participate more meaningfully in AKIS decisions and priority setting in order that AKIS for sustainable agriculture development

programs would be more responsive to their needs.

13. Increasing the interface linkages among the various education, research, extension and farming activities.

14. Building accountability to assure that each stakeholder assumes his/her respective responsibilities, that performance failures are identified and that appropriate responses are made.

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