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Options for Developing Capacity to Generate, Disseminate, Access, Adopt and Improve Agricultural Knowledge, Science and Technology for Development

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Key messages

Critical challenges for the future include the development of national programs to conserve indigenous agrobiodiversity and the implementation of the Global Plan of Action for Food and Agriculture (GPA) for the conservation and sustainable utilization of plant and genetic resources for food and agriclture (PGRFA). Limitations to conserving plant genetic resources for food and agriculture (PGRFA) in developing countries include financial constraints, lack of interactive dialogue between farmers and *ex situ* custodians of genetic resources, increasing homogenization of farming practice, and lack of awareness by policy makers of the importance of PGRFA.

The protection and nurturing of local and traditional knowledge can help to preserve agrobiodiversity and encourage and support technological innovation. Through a process of informal experimentation, observation and experience,, women and men farmers have developed a wide range of farming systems that are often compatible with their ecological niches. Yet their knowledge, and women's traditional knowledge in particular, is only now being valued, and understood as in continual evolution. This is important because such farmers help to ensure the conservation of the diverse genetic pool of landraces needed for modern plant breeding, for ecological fit and for genetic resistance. Through agrodiversity, the risk of significant agricultural loss is minimized, thereby enhancing food security and income generation potential. Recognition and protection of local and traditional knowledge and its utilization will help to encourage pro-poor people technological innovation.

National decision makers will increasingly need access to science advice as well as capacity development in science-based decision making, regulation and monitoring. Given the complexity of the science and technology issues related to agriculture and the development of an innovative AKST-based agricultural system, these countries often face challenges in terms of handling some of the scientific and political demands that are inevitable in their implementation.

Educational facilities need to be better equipped to play a major role in human capacity development, research and technological innovation. AKST orientated education needs to start in primary school, continue through secondary school, and into university. Some measures that can further this goal include experiential, problem-solving approaches, enhanced outreach, and linkages, and stakeholder participation in curriculum design and research. Innovative approaches to teacher training and exchanges need to be developed.

Future development policies and programs will need to be informed by an understanding of the increasing concentration and power of supermarkets in developed and developing countries. Extension workers can play a role by assisting small-

scale farmers and entrepreneurs to make the investments in equipment, management, technology, commercial practices, and in the development of strong and efficient organizations, to meet the requirements of the changes in procurement systems.

Encourage women to study agriculture. Encouraging the increased enrolment of female students in science, technology and agriculture courses will increase national capacity in these areas by allowing countries to benefit from the contributions and expertise of an under-used human resource. Encouraging the involvement of women in the design of technologies can lead to more gender-sensitive products and research agendas and increasing the number of female extension agents will help to expand outreach to women farmers. Men too should be trained in the skills of gender analysis.

Shift the focus of education from content to process. Improving employment opportunities for graduates requires that curricula focus less on specific technical knowledge that will quickly become obsolete, and more on processes. Enhancing the abilities of students to think and solve problems that are relevant to societal needs is important. Students need to learn skills and abilities that are transferable to a wide range of occupations. Placing the study of agriculture within the wider context of development, knowledge, science and environmental management will increase its attractiveness to young people.

Government policy makers need to prioritize where in their country, and with which farm groups, agricultural extension workers should work. Funding should be greatly increased, or government agencies should re-examine the size of their extension job force, develop new, more reasonable sets of priorities, and adopt a delivery mechanism that they can afford. The use of innovative ICT and knowledge generation and dissemination strategies will need to be examined to ensure synergy between the various sectors - public, private and NGOs/CSOs - working on extension and the need to bring farmers actively into AKST generation and dissemination systems. Given that extension services are becoming increasingly privatized and fragmented, a cadre of extension workers advising on public goods needs to be maintained to advise farmers on public health, sustainability and sustainability issues.

Better ICT, training, and other workplace incentives are needed to help attract and retain good researchers and extension personnel in remote locations. Staff need to be connected to colleagues and offered career incentives. Research increasingly points to the need to decentralise work addressing low-input farming in stressed areas to ensure that locally-relevant technologies are developed.

There is an urgent need to retain under-utilized and disenfranchised human resources in farming. The roles and responsibilities of women and men in agriculture need to be better

supported by AKST if farming is to be seen as a viable and attractive livelihood option. Similarly, if youth are to be involved more effectively in agricultural development, it is essential to have a fuller understanding of why they feel disenfranchised and choose not to enter farming.

Establishing and promoting fair trade models for agriculture can act as a vehicle for capacity development of farmers and open up new value-added markets. Participation in fair trade commodity chains involves developing local markets as well as international ones, assisting women entrepreneurs to enter the sector, balancing consumer requirements with sustainable environmental management practices, and increasing the relevance of fair trade standards to farmers.

HIV/AIDs and other health issues are placing significant physical and psychological burdens on farming families and threatening the erosion of agricultural knowledge. Addressing food security, promoting the development and use of labor-saving technologies, shifting to less labor-intensive crops, promoting income-generation based on local agrobiodiversity, and sharing and documenting local and traditional knowledge are useful strategies to mitigate the effects of disease and ill-health on family well-being and income.

Various actors -- national, community and local -- must be equipped to manage situations that have the potential to result in conflict. Conflict over natural resources -- primarily land and water -- may occur among people within community, or between communities or between countries. These conflicts are can disrupt AKST systems and adversely affect rural livelihoods.

When end users participate in the design and implementation, rather than in just the final testing of new technologies can better serve the rural communities, particularly those members of the community who have traditionally been at a disadvantage, such as rural women. Furthermore, participatory research leads to the empowerment of rural communities through the recognition of their local and traditional knowledge and the awareness that they can contribute to their own development. Participatory approaches are also useful tools in conflict management.

7.1 Knowledge Domains and Management Strategies

The concept of capacity development considers that development is reliant on collective rather than individual action. A country's capacity, therefore, is measured by its ability to carry out collective, coordinated action efficiently and effectively, as opposed to its success in training individual development actors. An enabling environment that facilitates collective actions is important to the efficacy of capacity development.

While capacity development involves working with individuals, informal groups, structured organizations and at national, regional and international levels, it is only effective if it can work on several levels simultaneously. It is likewise necessary to take into account direct and indirect forces, such as governance, that might have a bearing on how capacity development interventions can be devised and implemented. According to Kühl (2004), sustainable capacity development is not possible without simultaneously ensuring human resource development, organizational strengthening and establishing supportive environmental conditions.

7.1.1 Plant genetic resources for food and agriculture

Historically, farmers have been the principal generators and stewards of plant genetic resources for food and agriculture (PGRFA). Although much adaptation seen in landraces is a natural evolutionary process that occurs when a population with a broad genetic base responds to its environment, local farmer breeding systems have also provided small farmers, often on marginal land and in variable environments, with highly adapted local varieties. Farmers have also maintained diversity in the management and knowledge processes to which these crops were subjected. They have continually innovated through hybridization, regulation of cross-pollination, and directional selection. Over time, wild plants occurring in crops as weeds have also introgressed with cultivars, leading to a rare – but over time – significant transfer of alleles. Frequently, women's specific understanding of germplasm, its uses, and its specific cultivation requirements for cultivation have been paramount in selecting and shaping PGRFA. Need references

Today, there is significant genetic erosion as landraces are being replaced by modern varieties. Consequently, there is concern that undermining diversity will impact negatively on yield stability, particularly in marginal and variable environments. *In-situ* conservation is increasingly regarded as an important strategy to tackle genetic erosion (reference).

Challenges include better linking of *ex-situ* custodians of genetic resources and their users, encouraging the re-introduction of landraces, promoting public awareness of PGRFA, promoting agricultural practice that is place-specific, and developing national capacity to conserve indigenous biodiversity.

Challenge: To promote enhanced linkages between ex-situ custodians of genetic resources and the users. There are over 6,300,000 accessions held world wide in a network of some 1 500 genebanks world wide, which represents a massive investment of resources in perpetuity (reference). However, there are questions about how effectively these resources are being used. Greater utilization of PGRFA will promote ongoing conservation strategies. One of the limitations often cited as a constraint to greater utilization is a lack of knowledge about the accessions and the transfer of this knowledge to the user community – plant breeders and the scientific community in particular. Another limitation is a general conservatism among plant breeders to use unimproved genetic backgrounds in their breeding programs because of the uncertainty about unwanted traits that would be transferred along with the desirable traits.

Strategies/Options.

- Reconsidering funding strategies for PGRFA. Many genebanks are underfunded and cannot fully characterize or screen their materials adequately. Some of the massive funding being channeled to *in-situ* conservation could be diverted to characterizing and evaluating exactly what is being held in *ex-situ* collections.
- Committing more resources to pre-breeding efforts in which useful traits from wild and landrace species are introgressed into improved genetic backgrounds. This makes it easier for breeders to utilize the genetic resource material.
- Improving the flow of information back to genebanks from users who evaluate the material. This could be done by making the provision of PGR from genebanks dependent upon the information being provided in return for the germplasm. This information could then be used to build a more comprehensive picture of the accession and its particular traits.
- Promote the web-enablement of genebank databases so that all information about accessions is easily available to all users.
- Promotion and out-scaling of the methodologies and knowledge developed by those breeding programs that regularly incorporate exotic and landrace material into their breeding cycles.
- Promotion of the focused identification of germplasm strategy by using GIS information to link landraces and wild materials to their environment of origin; thus enabling the prediction of the selection pressures that the genotype developed under. This is an effective method of developing small subsets of best-bet material for specific adaptive traits that users tend to seek when approaching genetic resource collections. The subsets can be provided to users, thus improving the efficiency with which material is screened and utilized.

Challenge: To promote public awareness of the importance of PGRFA. Public awareness of the importance of PGRFA at all levels needs to be raised. Loss of agrobiodiversity is not only the result of inappropriate policies, but also occurs at a farmer level whereby the need to secure a subsistence income outweighs considerations of the importance of agrobiodiversity

(reference). Thus farmers themselves can be led to take decisions that have a negative impact on the agrobiodiversity under their custodianship.

Strategies/Options.

- The importance of biodiversity could be integrated into curricula at all levels in education systems.
- Linking public awareness programs, and developing synergies to ensure that resources are used more effectively at a global level.
- Channeling more resources into public awareness at a CGIAR and NGO system level.
- Facilitating national programs to conduct discussions with farmers about the long-term consequences of losing their agrobiodiversity.
- Studying and facilitating the out-scaling of indigenous agroecosystems that still feature a high degree of agrobiodiversity awareness.
- Involving farmers in a fully participatory manner in research focused on agrobiodiversity conservation.

Challenge: To promote the re-introduction of landraces into farmer's fields, and to direct flows of knowledge about a particular landrace back into genebank information systems. Many farmers, after having lost their landraces to modern varieties, complain about the loss of these landraces because they have specific quality traits that the modern variety does not have. Many of these landraces are kept in genebanks and could easily be repatriated.

Strategies/Options.

- Undertaking surveys of farmers and of genebanks to establish which communities want their landraces back - and to find out if the landrace is still being maintained in a genebank.
- Developing a sustainable reintroduction campaign.
- Genebanks could develop a system where landraces are regenerated and maintained in farmers' fields: a hybrid *in-situ* and *ex-situ* conservation system.
- Capturing farmer knowledge about the specific traits of their landraces into genebank databases on a more rigorous basis. Such knowledge often highlights quality and specific traits adaptive traits
- Involving farmers in the characterization process of landraces. This is similar to participatory plant breeding but focuses on the characterization of the material. Doing this will increase exposure and possible utilization of the material at a farm level.
- Promoting the development of registration facilities that will recognize a given landrace as the indigenous property of a particular area or village. This will enhance the perception of the importance of the landrace as an entity that is a part of the local heritage.
- Developing and promoting viable and sustainable incentive schemes for communities who maintain local material in their agroecosystem. This should be a multi-stakeholder process that involves international organizations, NGOs, policy makers and farmers.

Challenge: To promote agricultural practice that is place-specific, and reliant on local ecological specificity in order to help maintain PGRFA.

Strategies/Options.

- The development and funding of a Global Program for Ecoagriculture Research and Development in selected biodiversity hotspots.
- International and national policy research and innovation to develop cost-effective market, legislative and institutional interventions to support diversification of agricultural systems. This will help to ensure that they are robust. Modern practices can be integrated with indigenous and site-specific practices
- Developing networks of farmers, technical specialists and scientists working in similar agroecological zones. Mechanisms include mobile phone networks, mutual tours, and the internet. Involving farmers in participatory plant breeding programmes is an important additional measure.
- Funding basic research in biodiversity hotspots on interactions between agricultural systems and wildlife habitat and species, particularly in landscape ecology, agricultural ecology, and wildlife behavior.
- The development of programs to educate and involve farmers, agricultural researchers and policymakers in ecosystem management, and to educate wildlife biologists, ecologists and conservation policymakers in agricultural resource management. Such programs must be strongly aware and supportive of how PGR actually supports farmer livelihoods if farmer involvement and take-up is to be assured.

*Challenge: To develop national programs to conserve indigenous agrobiodiversity.*The implementation of the Global Plan of Action for Food and Agriculture (GPA) adopted by 150 governments at the International Technical Conference in Leipzig, June 1996, is critical. National programs have begun implementing the GPA. The International Treaty for Plant Genetic Resources for Food and Agriculture (IT-PGRFA) encompasses all PGRFA and thus represents a further landmark. The treaty makes governments responsible for the realization of farmers' rights, including the protection of relevant local and traditional knowledge, provision for farmers to participate equitably in sharing benefits; and farmers' participation in national policy decision-making (Esquinas-Alcázar, 2005).

Limitations to conserving plant genetic resources in developing countries include financial constraints and a lack of awareness at the policy maker level of its importance. This results in inadequate financial and policy commitment to PGRFA conservation.

Strategies/Options.

- Integrated approaches at the national level are essential. Capacity to explore, collect, characterize, evaluate, conserve and document PGRFA needs to be developed. National surveys and inventories should be conducted.
- National programs need to develop and maintain appropriate policies and legal measures. Such measures should be directed at promoting the sustainable use of PRGFA, including on-farm management, strengthening research, promoting plant-breeding efforts, broadening the genetic bases of crops, and promoting the use of locally-adapted crops and varieties and under-used species.
- Awareness building programs are essential. The awareness of policy-makers vis-a-vis PGRFA needs to be strengthened and sharpened.
- National programs need to be advised on how they can hook into international undertakings. Advice needs to be provided on how policies can be specifically improved.

Case study: improving national PGR capacity in Ghana, and the lessons learned

A study conducted in Ghana indicated that the capacity of Ghana's PGR Center (PGRC) could be improved in the following ways (Bennett-Lartey et al., 2003):

- Better identification, and targeting of, the PGRC's needs in order to ensure alignment with the strategic goals of the center. A necessary step in this process is for the PGRC to identify and prioritize its own capacity needs. A holistic definition of capacity development was developed to include more than technical training. Improved capacity in management and strategic planning, fund-raising, public awareness and policy was seen as critical. Suggested capacity delivery mechanisms included publications, training and workshops, personalized technical assistance, equipment and facilitated collaborative research.
- Monitoring and evaluation of capacity development. M&E of the capacity development initiatives undertaken was seen as important in avoiding the risks of overemphasizing some capacity areas and underemphasizing others. While M&E is important to enable external agencies to understand the needs of individual countries and thereby focus on assisting with capacity development that meets these needs, ultimate responsibility for the M&E of capacity development was considered to rest with the national center. This will ensure that all capacity development efforts are directed towards institutional priorities.
- A participatory approach to capacity development evaluation helped to ensure that results were widely understood, thus increasing the likelihood that necessary changes will be embraced and implemented.

7.1.2 Biotechnology

Genomics, and more broadly, biotechnology, can potentially contribute to the development of productive, environmentally safe and profitable food and farming systems (James, 2006). Yet

concerns remain around food safety, adverse environmental effects, the industrialization of farming processes, and the exclusiveness of related intellectual property rights.

Biotechnology can provide a more precise and faster way than conventional breeding to modify plants to specific requirements (reference). It can also achieve results not achievable by conventional means, for example by allowing the introgression of two varieties that could never breed conventionally.

Public sector finance for biotechnology research has been reduced in the wake of public concern, and consequently the private sector provides most of the funding for research and development of new genetically engineered crops. Increasingly driven by the need to cover high regulatory costs, this funding is usually, for economic reasons, directed toward major row crops that offer a profitable return on research investment. China and India appear to be moving forward on developing public sector projects to develop locally important crops, yet this remains an exception. Generally, crops that might be important to local economies, but lack profitability (so-called orphan crops) are deprived of adequate research funding, fail to attract sufficient research personnel, and fail to negotiate the costly regulatory burdens.

The question is whether biotechnology, especially transgenics, can provide products that are economic, environmentally safe, have no adverse human health consequences, and are consistent with a pro-poor people agenda?

Biotechnology regulation was introduced to ensure that the results of modification of plant genomes could be properly monitored and evaluated and to provide confidence to the public that the risks and benefits of GM products had been fully evaluated (reference). Despite the initial intent, biotechnology regulation has not in general reassured the general public. Therefore, it may be useful to assess the value of the current regulations and modify if needed, recognizing the products, rather the processes used to make them, require regulation.

Developing countries are fomulating national biosafety regulatory systems. Given the complexity of the issues, these countries often face a challenge in terms of handling some of the scientific and political difficulties that are inevitable in their implementation.

Challenges and capacity development options. If governments consider GMO products are potentially consistent with achieving national development and sustainability goals, then it will be important to ensure that countries have the capacity to:

- develop public sector biotechnology research capacity, both with respect to staple and orphan crops – this will require sufficient funding for public laboratories and the employment of relevant scientists;

- assess the economic, environmental, social and human health risks and benefits of new products;
- address regulatory issues;
- ensure the benefits are offered to a wide range of beneficiaries; and
- develop public relations programs to educate the public about the risks and potential benefits of biotechnology products.

7.1.3 Local and traditional knowledge

Increasing professional specialisation in the management of knowledge processes over the past few decades marginalized an appreciation of local and traditional knowledge, and of farmer-driven AKST processes (reference). The dominant AKST model, Transfer of Technology, assumed a linear flow of technological products and information. The underlying assumption was that farmers are relatively passive cognitive agents whose own knowledge is to be replaced and improved. The role of women farmers in local and traditional knowledge processes was even less valued and largely unexamined. However, as multi-stakeholder approaches to agroecosystem management started to become more common, and as policy-making started to favour evidence-based procedures, place-based, user knowledge began to regain value in science governance.

Local and traditional knowledge generally refers to locally bounded knowledge that is site-specific and embedded in the culture, activities and cosmology of particular peoples (reference). Interestingly though, there are examples of local and traditional knowledge shared by communities in geographically distant areas – for example, some medicinal properties of barley are known to farmers in Nepal, Egypt, and the Andes (references). Local and traditional knowledges can be seen as systematic bodies of knowledge that are tested through experience, through precise observation, and through informal experimentation. Indeed, like scientists, farmers belonging to an epistemological community engage in various forms of observation, measurement, experimentation, data collection and peer review. An important aspect of local and traditional knowledge is its evolving nature, yet the processes by which it evolves is rarely studied and documented.

Challenges to be addressed include ensuring that local and traditional knowledge is protected and developing innovative approaches to intellectual property rights.

Challenge: To ensure the protection and nurturing of local and traditional knowledge in the interests of preserving agrobiodiversity and encouraging pro-poor people technological innovation. Through a process of informal learning and adaptations, farmers, especially smallholders in the tropics, home to the world's greatest reserves of biodiversity, have developed a wide range of farming systems that are compatible with their ecological niches. The bio-diverse character of many such farming systems facilitates environmental

sustainability through the provisioning of diverse ecological services (Di Falco and J.P. Chavas, 2006). They help to ensure the conservation of the diverse genetic pool of landraces needed for modern plant breeding (Brush, 2000). Through agrodiversity, risks of complete agricultural failure are minimized and food security enhanced. In terms of international public goods the principle is that without recognition of local and traditional knowledge and its utilization there is little chance that technological innovations that are targeted, relevant and appropriate to poor people will be developed (Bellon, 2006).

Strategies/Options.

Options for conserving, improving and contributing to the evolution of local and traditional knowledge at a range of scales include:

- Participatory research approaches involving collaboration among scientists, farmers and policy makers in order to document, nurture and up-scale good smallholder farmer resource management practices. Those that bear positive results with respect to environmental sustainability, biodiversity conservation, crop improvement, and food security should receive particular research attention. A systems approach to research is needed in order to locate such positive benefits in context.
- Participatory research provides opportunities for local and traditional knowledge to evolve as a result of the interaction with a continuous contact with scientific knowledge. This evolution could be different from what might have happened in absence of the interaction with scientists. Is this good or bad? One challenge is to include in participatory research work a component to evaluate the effect of participatory research approaches on the evolution of local and traditional knowledge.
- Formal education curricula should include, as an important focus, locally-adapted indigenous resource management knowledge (Gyasi et al. 2004a,b).
- The cultural/ethnic/geographical origin of extension workers should be considered when preparing programs to work with farmers. There are issues around dialect, terminology, gender and local cultural understanding to consider.
- It is important to consider the full range of local and traditional knowledge related to agriculture, from production planning, cultivation and harvest practices, postharvest handling, to storage and food processing methods.
- The capacity of national and regional local and traditional knowledge networks needs be developed. Supporting local and regional networks of traditional practitioners and community exchanges can help to disseminate useful and relevant local and traditional knowledge, and to enable communities to participate more actively in the development process. Establishing ‘Local and Traditional Knowledge Centres’ to provide detailed case study information for use in extension, in agricultural teaching – nationally and regionally – and for open access, would be a further useful step.

Challenge: To create innovative approaches to intellectual property rights (IPR) in order to protect local and traditional knowledge. Innovative approaches are necessary because existing arrangements are not always applicable to the specifics of local and traditional knowledge. The normal criteria for patenting a process do not exist with local and traditional knowledge. This is because local and traditional knowledge is generally preserved through oral tradition and demonstration rather than written documentation; more often than not it emerges gradually rather than in distinct increments. Only in rare cases is an industrial process concerned; and even then an individual inventor is unlikely to be identified. For these reasons it is important that addressing IPR with respect to local and traditional knowledge does not hinder the development and implementation of local and traditional knowledge initiatives that are beneficial for communities and the development process as a whole.

Strategies/Options.

- Encouraging local communities to register traditional practices. Practical, cost-effective and 'indigenous' examples of documentation already exist.
- Evolving forms of protection for local and traditional knowledge include Material Transfer Agreements (MTA) involving the provision of material (resources or information) in exchange for monetary or non-monetary benefits. Examples of fair and equitable benefit sharing between users and custodians of traditional knowledge can be found in several countries today. As a minimum registered local and traditional knowledge practices should be referenced and cited when referred to by others in books or training programs.
- Regional agreements can also lead to cost-effective forms of protection for local communities. For example, the 1996 Andean Pact - adopted by Bolivia, Colombia, Ecuador, Peru and Venezuela - empowers the national authority and indigenous communities in each country, who are defined as the holders of traditional knowledge and resources, to grant prior informed consent to the application of their knowledge in exchange for equitable returns.
- Documenting examples of successful technologies developed with the contribution of local communities through their knowledge.

7.2 Improving Human Capacity

7.2.1. Achieving an educational continuum in agricultural education

A focus on life-long learning, and on post-secondary models which focus on education and training systems, will help generate capacity along agricultural value chains. Capacity needs include improved management systems, enhanced research output, and strengthened national, regional and international networks.

There are three levels of formal education: primary, secondary, and post-secondary, which may include intermediate level and tertiary. The promotion of a sustainable and more comprehensive approach to agriculture in school, which combines educational, socio-political and economic objectives can, however, easily be achieved. For example, primary and

secondary schools can manage allotments. The involvement of school children in the Australian Landcare movement was a great success (reference). In this, children were involved in monitoring the environment, initially by examining salting levels in the water and soil. In Thailand, primary school children under the Ministry of Education are taking science classes built around IPM Farmer Field School principles, and in association with FFS graduates.

Challenge: To ensure that primary school curricula provide the building blocks of AKST capacity. Currently, agricultural awareness, training and education are generally not adequately addressed in primary school curricula. This inadequacy, along with inadequacies in science and mathematics, diminishes at a very early age these students' opportunities for acceptance into tertiary agricultural programmes. Ideally, if capacity in AKST is to be developed, it should start at the primary level. Primary school curricula should include basic agriculture to prepare and encourage students to continue with agriculture at secondary and tertiary levels (Ministry of Agriculture, 2004).

Strategies /Options.

- The integration of vocational skills, including the reintroduction of a broad, well-packaged agriculture component, into the primary schools curriculum would provide the building blocks of AKST.
- Developing and enhancing outreach and linkages, including AKST-oriented educational material, and the adoption of experiential approaches – demonstrations, school farms and farm visits - for enabling problem-solving and enhancing pupil enjoyment, and implementing teacher-training systems - will enable more effective teaching of agriculture

Challenge: To tackle the negative image of agricultural science as an option at secondary school. Although most secondary and vocational school curricula contain an agriculture component, it tends to be offered as a minor subject to those students not taking physical science subjects. As a result most students have a negative attitude towards agriculture and perceive it to be inferior to other disciplines.

Strategies/Options.

- Negative perceptions can be changed through changes to secondary school curricula to incorporate agriculture into sciences. School plots can be used to learn about basic ecology, the life cycles of plants and animals, and competition for water, light and nutrients. In addition, children can learn about the impact of hand management of living organisms through weeding, watering, protection, and influencing nutrient supply. This happened frequently in many places in the past, but modern school curricula does not allow enough time to do these things, for agricultural sciences are not valued as academic subjects. The aim of innovative approaches to agricultural science at this level would be to help students to qualify for

enrolment into agriculture programmes at tertiary level, while making students aware of the many career options that agriculture offers (Ministry of Agriculture, 2004).

Challenge: To meet the multi-faceted demands that society places on tertiary institutions for meeting human resource and knowledge needs. Universities play a major role in human capacity development, research and technological innovation. All over the world investment in university education is a critical component of national development effort (Bankolè Oni, 2004). Nations depend increasingly on the knowledge and skills that are achieved in universities. Consequently, society expects universities to produce highly competent personnel with practical skills in technology, engineering, management and other professions. Universities are also expected to develop solutions that are technically, environmentally, financially and socially suited to the complex and varied agriculture in developing countries (Lenihan, 2005). Universities also produce teachers, administrators and managers for other levels of human resources development institutions (Oni, 2004).

Challenges faced by universities in many regions include low staff levels, the erosion of talent due to the brain drain - exacerbated by HIV/AIDS, and the presence of just a few young scientists and teaching staff spread too thinly across too many activities. Curricula in most universities are too theoretical, outdated, and do not address the current needs of the agricultural sector. In addition, there are inadequate research opportunities and linkages and the stakeholder participation in the design of research or education programmes is weak (Lenihan, 2005).

Modern graduates require complex skills to engage in various areas of the agricultural sector – training, academic institutes, civil servants as well as extension workers, farm managers, and those involved in manufacture, marketing and agroprocessing. As such the curriculum must contain theory and practical application, as well as agri-business skills and management. Unless agriculture is seen within a wider context it will not remain attractive to students. For example, Wageningen Agricultural University in Holland suffered a constant decline in student numbers over a 15-year period, but after dropping 'agriculture' from its title, and developing more societally relevant courses, the number of students applying has risen (reference). The Earth University in Costa Rica combines hands-on fieldwork experience with theoretical work on not only the agricultural sciences, but also business administration, entrepeneurship, ecology, resource management, forestry, anthropology and sociology (Earth University, 2007)

Strategies /Options.

- A multidisciplinary curricula review could integrate all the disciplines that have a bearing on advances in modern agriculture (biotechnology, social sciences, etc).

- Wherever possible, training facilities should be established in the region or country itself. Sending students to universities abroad carries significant risks that a high proportion of the students will not return to utilise their training in their country of origin. This is especially the case if the individuals feel that the necessary infrastructure, including but not limited to like-minded, trained graduates, for effective and rewarding work do not exist in the country of origin. Short-term placements might be useful.
- Consideration should be given to opening an Agricultural Faculty at an existing university. Teaching at both undergraduate and postgraduate levels should be put in place, as well as research. Partnership programmes with overseas universities with agricultural faculties should be sought, particularly if the opportunity could be created for routine student exchange programmes, including at undergraduate level. Much agricultural technology is common to all agricultural systems. Where is can be adapted it can be used. Local research, with local crops, cropping systems, soil and climate considerations should also be promoted. In all cases, connections should be established with local farming communities and short and longer, practical, courses established consistent with their needs.
- Essential elements in any agricultural and rural development training are: continuous practical learning; the history and philosophy of science (natural and social); understanding hard and soft systems thinking; the meaning of disciplines - interdisciplinarity, multidisciplinarity and transdisciplinarity; participatory methods theory and practice; from farming systems to sustainable livelihoods, and finally - groups, networks, social learning and facilitation skills. For example, at the University of East Anglia 'Dev Farm' was created to counteract the decline in practical, experiential learning as part of an academic degree in natural resources in Development Studies. It was anticipated that many students would work overseas in projects requiring a basic understanding of farming with low external inputs (NGO projects). Students therefore gained experience with animal draught, wind power, biogas, hand weeding and with management of crop /livestock interactions.
- Creating local job opportunities for agricultural graduates in the ministries of agriculture, agricultural input companies, and as staff to international agencies is an obvious step to take. Continuing in agricultural technology research in their own university, or in international public or private sector research are alternative options for the most academic. Involving potential employers in the design of curricula to ensure the development of relevant knowledge and skills is helpful as is annual training and relearning.

Challenge: To improve the training of teachers and lecturers, and to improve educational infrastructure. Teachers and lecturers need to have effective pedagogical skills and a firmer grasp of the subject matter to enhance the ability of students to learn.

Strategies /Options.

- Strengthening of formal and vocational education by ensuring teachers can obtain the necessary skills to enable them to teach adequately, both in terms of content and approach.

- Providing teachers with assistance in curriculum development and educational resources development.
- Increasing staff levels to meet the demands of multidisciplinary approaches, and to ensure a high student-staff ratio.
- Reduce class sizes. In sub Saharan Africa, for example, the challenges faced by most universities include low staff levels, the erosion of talent due to the brain drain - exacerbated by HIV/AIDS, and overstretched young scientists and teaching staff (Eicher 2005).

7.2.2. Capacity development in the extension services

Agriculture needs to produce and distribute enough food for a growing, increasingly urbanized population. This would seem to warrant ever-higher production and ever-increasing intensification of farming activity, as well as the increased utilization of improved post-harvest handling and processing practices aimed at reducing food losses. At the same time, agriculture, as a consequence of its systemic interactions with supporting ecosystems at a variety of scales, and its nature as a place-based activity, needs to develop the capacity to deliver public goods such as rich biodiversity, and viable rural and peri-urban livelihoods. Agricultural curricula need to acknowledge these new societal demands and develop a flexibility and responsiveness to these broadening linkages.

Yet due to inherited institutional structures dating back some 50 years, many national agricultural research and extension systems in developing countries are under-productive and top-heavy with large numbers of non-research staff and poorly paid unmotivated scientists. They are operating in poorly resourced contexts that cannot support implementation requirements. Traditionally, researchers have been considered academic high fliers, with general scientists being posted to the extension services. These divisions, both in the structure of education institutions and in people's minds, persist.

In many countries, agricultural extension systems are financially supported by governments or donors. Frequently, different institutions are funded by different funders, creating rivalry, conflict and duplication rather than synergies in service delivery. These factors lead to weak stakeholder oversight. The dominant teaching paradigm remains Transfer of Technology, though this is increasingly considered to be overly linear, to fail to understand knowledge processes, and to insufficiently acknowledge the multi-functional nature of agriculture and its contradictions. New learning institutions are needed.

The examination of challenges in the extension services opens with a discussion on the types of knowledge required, considers how learning institutions can be created and concludes with an examination of how cross-sectorial capacity in extension can be developed.

Challenge: To expand the remit of extension work. Most developing country extension efforts concentrate on capacity development for crop production, with very little emphasis on post-harvest handling, marketing, and agroprocessing. A farming systems approach is generally lacking completely. While capacity development in crop production methodology (like increasing yield, pest managements etc) is important, marketing of the produce remains a challenge for most farmers. Postharvest losses in developing countries for perishables such as fruits and vegetables - as well as staple foods like grains and dry beans - can be considerable due to insects, fungal attack, rodents, and birds. The lack of the cold chain in most cases, and inadequate storage conditions further leads to spoilage and loss of quality and market value.

Marketing food at times other than directly after harvest allows the farmer to receive higher prices, avoids the price depressing effects of a glut, and allows the cash flow delay and costs of storage to be recouped. At the same time the environmental costs of some storage options (for example citrus or potato cold stores) need to be examined carefully.

Strategies/Options.

- Support the development of farm system analyses. Incorporating management and trade-related training among training institutes and agriculture universities would prepare a better force of extension workers capable of acting as catalysts and facilitators with farmers across the farming system. An integrated approach to better crop production, as well as marketing, will assist farmer profitability.
- Ensure the sustainability of the system. Greater sophistication in marketing options enables farmers to sell produce at an agreed price and quality, in return for advice on postharvest, transport and storage arrangements and/or production inputs to a specific market contractor at a future date. Training in postharvest handling, storage techniques and crop marketing will contributes towards ensuring the sustainability of the systems developed.
- Build producer groups. Bringing farmers together to form a marketing board or community group can help to tackle postharvest management and selling issues to optimise cash flow. Low resource farmers can compete more effectively with larger growers when they join together in groups and share the costs of inputs and marketing expenses.
- Update knowledge and skills to handle globalisation. Developing in-service training for extension workers on topics of current interest such as globalisation, market liberalisation, quality standards, and biotechnology issues will enable extension workers to assist farmers to relate their farming practices/systems to these developments. The advent of hypermarket chains in developing countries means that extension workers must to be able to guide farmers on how to produce to hypermarket standards regarding produce handling, packaging, cold chain management and refrigerated transport.

- Develop alternative marketing systems. Training extension agents to work with farmers on the development of alternative local marketing systems may be important if participation in global commodity chains, or selling to local supermakets, is not considered feasible.

Challenge: To maintain a sufficient number of public good advisors so that farmers receive independent advice and regulatory counselling. Increasingly, public extension has become fragmented. Hierarchically organized public extension systems delivered by Ministry of Agriculture staff are declining (reference). This situation allows a greater role to be played by advisers employed by supermarkets and commercial input suppliers, as well as by chambers of commerce, community-based groups, NGOs, and farmers' organizations. In some countries, university-based extension remains strong or is expanding. As environmental, public health and sustainability issues come to the fore, advisors employed by drinking water companies, nature and park managers, urban authorities, animal health authorities and fair trade and organic staff can potentially fill needed gaps as information providers.

In China for example there are approximately 10 million extension workers. Many are now selling vetinerary products and agrochemicals, without supervision, in order to make money. County officials cannot afford to pay them properly. On-going policy research is seeking ways to cut this extension body in half. The remainder will probably be employed with enhanced capacity to address value-adding along food chains, environmental and natural resource issues, and regulatory matters (including animal-human health risk management).

Strategies /Options.

- Undertake an examination of the current extension service to see how well it is addressing public goods issues. On this basis, develop policies to redeploy and retrain extension staff.

Challenge: To assist smallholders to survive, and profit, in the face of the exponential growth of supermarkets. The exponential growth in supermarkets, and their increasing prominence at the head of buyer-driven chains, warrants careful scrutiny. Supermarkets may yet undo the promising entry of smallholders into global commodity chains. At the same time, under certain conditions smallholder producers may hold their own and even thrive (Reardon and Timmer, 2005; Raynolds, 2002).

Supermarket expansion and growing market power is accelerating in much of Asia, Africa, and Latin America (Coe, 2004; Tallontire and Vorley, 2005). In Latin America for example supermarkets are rapidly taking over food retailing. Currently they hold approximately 60 percent of the national retail sectors in South America and Mexico. Supermarkets have shifted decisively out of their early niches (upper income cities in the richest countries) in less than a decade. Today they are present in middle and working class areas, and in poorer

countries, thus directly affecting rural zones on both the supply and demand-side. Supermarkets and large processors are, or fast becoming, the main retail buyers in the supply chains of processed foods (Reardon and Timmer, 2005; Reardon and Berdegué, 2002).

All of this means that smallholders will be forced to engage directly and indirectly with a retail sector in the North and increasingly in the South that holds substantial power over all aspects of agricultural commodity chains. With respect to fair and organic production, producers and importing organizations must be prepared to work to the requirements of supermarkets as they continue to expand existing fair and organic trade lines, bring on new products, and, importantly, expand their own-label brands of good such as coffee and chocolate.

Are smallholders able to meet the supermarket challenge? The evidence is mixed. On the negative side, it would seem that it can be dauntingly difficult for smallholders to cope with the procurement practices of supermarkets and large processors. These include quality and safety standards, packing and packaging, cost, volumes, consistency, and payment practices (Reardon and Berdegué, 2002; Boselie et al*.,* 2003).

Why is this? Smallholders tend to have a weak understanding of supermarket standards and consumers, in contrast to their knowledge of local markets, and in contrast to the knowledge base of large commercial farmers. This has implications for their bargaining position, and their ability to fully understand supermarket requirements. Furthermore, it can be difficult for smallholders to deliver desired quantities at short notice, or to manage the labor instability involved. As a consequence, evidence is mounting that supermarket buyers in both industrialized and developing countries are increasingly sourcing from large commercial growers (Boselie et al., 2003).

Strategies /Options.

- Future development policies and programs must understand and engage successfully with the increasing concentration and power of supermarkets in developed and developing countries. Extension workers can assist small-scale farmers and entrepreneurs to make the investments in equipment, management, technology, commercial practices, and in the development of strong and efficient organizations, to meet the requirements of the changes in procurement systems (Reardon and Berdegué, 2002; Bosalie et al., 2003).
- Supermarkets or their suppliers can benefit from work closely with small producers and extension workers to clearly communicate changes in their requirements. It is important to note that even if the information infrastructure exists, this does not guarantee information flow and the correct interpretation of information.
- Given that many farmers have never been inside a supermarket to see how products are presented and how consumers make choices novel ways of enabling them to understand requirements can be helpful. For example, cupping labs for coffee enable coffee producers to

monitor quality and identify, promote and brand regional flavors that are able to capture market premiums, and at the same time they provide produces with a sense of how coffee quality can be improved through different production and management techniques.

- Dairy products and fresh fruit and vegetables tend not to have important economies of scale in production and so the growth of the supermarkets could represent, if carefully handled, an important avenue of poverty alleviation (Reardon and Berdegué, 2002).
- Smallholders excel in supplying *particular* crops that require labor-intensive production techniques. Many techniques, for example pruning and trellising, cannot be mechanized, so there are limited economies of scale in their production. For these reasons smallholders dominate the production of beverage crops such as coffee, tea and cacao in some regions (Tallontire and Vorley, 2005). Gender issues are also important to address: women are often heavily involved in labor-intensive techniques, enabling supermarkets to benefit from their frequently-low priced work (for a critique see Rammohan and Sundaresan, 2003).
- Organic agriculture is an important type of value-added agriculture and is particularly accessible to small farmers who cannot afford to purchase off-farm synthetic inputs such as fertilizers and pesticides. Cultural practices and cropping systems are utilized to generate nutrients and pest control. Extension agents can oftentimes be trained by organic farmers themselves because universities and ministries of agriculture have traditionally been focused on conventional agriculture systems. Organic farmer associations help to support this sharing of information from farmers to extension agents and to other farmers. National organic certification processes can also provide value.

Challenge: To capture gendered knowledge and build it into research and extension. Women frequently play important roles in farming, increasingly so indeed due to the phenomenon of 'feminization of agriculture', as men increasingly seek non-farm jobs. Women *de facto* control much smallholder production and development worldwide, sometimes making all major decisions about land use, crop and livestock choice, and marketing. Women control many markets, in West Africa for example. Yet, peculiarly, the present extension system is quite 'men-oriented' and lacks the ability to consider some unique aspects of capacity development among women. The participation of women in formalised AKST systems is lower than that of men almost everywhere (European Commission, UIS Bulletin, 2006; IAC 2004).

Strategies/Options.

- Encourage women to study agriculture. Encouraging the increased enrolment of female students in science, technology and agriculture courses will increase national capacity in these areas by allowing countries to benefit from the contributions and expertise of an under-used human resource. Encouraging the involvement of women in the design of technologies *may* lead to more gender-sensitive products and research agendas. Amplified involvement of trained women agriculturalists in policy and planning is needed to cater for those women who do not opt for a career in extension.

- Develop gender-sensitive methodologies and methods. The training of men and women extension workers in participatory approaches and gender analysis will encourage the identification, retention and use of women's knowledge and expertise around farming and natural resources, as well as help to ensure that their activities and enterprises are appropriately supported.
- Building on women's knowledge and expertise. Marketing, food processing and postharvest sciences are well suited as areas of specialization for women who desire a career in extension work, since these fields are often dominated by women farmers, small-scale food processors and retail vendors in developing countries. Demonstrations of improved postharvest handling practices, for example, could be held at minimal cost in a local marketplace, where women gather to sell their goods or to shop for food. In Bangladesh the explosion of women's/village-based small enterprise development has been headed by women, although only a few years ago women were considered by extension workers to be 'unreachable'.
- Demolish the old boy network. Potential steps include ensuring that women extension agents can travel safely away from home; and that travel and work schedules will be flexible enough to permit them to manage their domestic responsibilities. To achieve this, old-fashioned institutional cultures will require change, e.g. promotion can no longer depend on 'old boy' networks.

Challenge: To update curricula in agricultural education institutions in order to incorporate new subject areas, and to promote the development of new skills. Traditionally extension workers have formed the link between farmers on one side, and agricultural administrators and agricultural researchers on the other. Today this role is shifting, with extension workers playing a facilitation role in teams containing researchers and farmers. Playing a facilitation role requires a good understanding of how group processes work, as well as an understanding of the environmental and social context of natural resource management. In addition, an ability to understand and evaluate new technologies emerging from agricultural research institutes and universities is critical for extension workers. Other useful facotors include the ability to provide support services and logistics that are needed by farmers for agricultural production.

Subject areas include food processing and post-harvest technologies, biotechnology, agri-business management and farming systems development. Studying how the private sector has achieved vertical integration from production to markets to consumption is essential. Combining health and well-being with agriculture and food science and technology is already being addressed in some institutions.

Strategies/Options.

- Identify key stakeholders and assess their needs. In order to generate new curricula, and update existing courses, assessments of the needs of key stakeholder groups in the local, regional or national agricultural communities should be conducted.
- Develop learning networks. Curriculum sharing, joint curriculum development and peer review processes should be encouraged in order to create learning networks between farmers, students, lecturers and other stakeholders. Education institutions need to update and improve their information infrastructure to enable students and faculty to access and contribute to on-going research. Interdisciplinary interaction and information sharing can be promoted through the use of mobile phones and the internet.
- Shift the focus of education from content to process. Improving employment opportunities for graduates requires that curricula focus less on specific technical knowledge that will quickly become obsolete, and more on processes. Enhancing the abilities of students to think and solve problems that are relevant to societal needs is important. Students need to learn skills and abilities that are transferable to a wide range of occupations. Teaching with practical, reality-based cases is a good example of how teachers can change pedagogical approaches to meet student needs and those of the larger society (Boeher and Linsky, 1990).

Challenge: To tackle the charge that extension workers in the field lack credibility with the farming community. Too often the primary claim to agricultural knowledge that extension workers possess comes from classroom lectures. Farmers require practical information and technologies that are appropriate to their homes and communities. It is the extension worker's responsibility to bridge the gap between the farming community and the researchers, and assist communication between the two groups. However, although extension workers often share the very same background as the communities they wish to serve, they frequently find it easier to relate to the academic community due to the way they have been trained.

Strategy/Options.

- Reinstate experiential learning approaches to extension. Experiential learning has to be an integral part of university education at all levels and on a continuous basis. Up to thirty years ago, extension workers in many institutions were required to spend a year of their studies working on a farm, and to visit a farm weekly during the remainder of their studies. This approach to extension studies needs to be reinstated.
- Ensure service continuity. Often extension service providers are transferred from one area to another. There is a need for reduction in transfers as this often happens when the extension officer has developed rapport with the community. This often has negative implications for continuity as the in-coming officer needs time to likewise develop rapport with the community.
- Involve extension workers in stakeholder needs analyses. Conducting local needs assessments of farmer and marketers to identify and discuss key problems and concerns

would help extension agents gain direct experience with their clientele and their current concerns.

- Ensure practical focus. The heart of the agricultural extension program should be demonstrations and applied research, based on the understanding that farmers themselves are researchers. A learning process in which farmers, researchers and extension workers are involved is of much use and when properly conducted, farmer field schools provide a model approach.
- Link the introduction of new practices to cost-benefit analysis. The dissemination of information and adoption of new practices can be improved when potential users have access to pertinent information regarding costs and expected benefits. Useful tools include training in how to conduct cost/benefit analyses for agricultural extension workers should receive, and in how to assist their clientele to make decisions regarding choices and options.
- Develop M&E capacity. To develop systems to measure the activity and effectiveness of the extension work, training in participatory monitoring and evaluation is needed, along with the capacity for critical learning.
- Support the extension worker's own learning strategies. A continual training system among extension workers should be developed to assist them to stay abreast with new developments in agriculture. Any professional needs the drive to 'do better', and therefore needs training in how to reflect and learn something new from their experience. New communication methods as well as new technologies are invariably adapted – rather than adopted – and this requires an inquiring mind in extensionists and farmers.

Challenge: To streamline the extension services and make them more productive. Agricultural extension systems are often bloated with too many - sometimes unproductive - workers and most of these employees are greatly underpaid. In general, agricultural extension systems suffer from too many employees with too little job focus, who are paid salaries that are too low and who lack operating money. Lack of operational funds makes it difficult for them to accomplish their stated goals, and is often the driving factor behind the criticism that 'we never see our extension agent', not the worker's disinclination to leave the office.

Strategies/Options.

- Governments must prioritise. Government policy makers need to prioritize where in their country, and with which farm groups, agricultural extension workers should work. Either funding should be greatly increased, or government agencies need to re-examine the size of their extension job force, develop a new, more reasonable set of priorities, and adopt a delivery mechanism that they can afford.

or

- Government policy makers need to prioritize where in their country, and with which farm groups, agricultural extension workers should work. They then need to privatize the extension system. Public dollars (not farmer payments) will still drive the programs. The best

extension workers will join together and bid as consultants on projects in which reimbursement is based on desired outcomes (a Public Funding/Private Delivery system). To do this requires reconceptualising the role of the extensionist, and the nature of their work.

- Provide operational funds. Funds must be provided for transportation as well as teaching aids, equipment and other supplies. Extension workers should not be expected to use their own vehicles and fuel.
- Provide in-service training. Current staff may be rejuvenated by in-service training aimed at making them more relevant and useful. If extension workers feel interested in the information they have to offer to farmers and marketers, and have confidence in their ability to play a positive role in helping their clientele to improve their livelihoods - and if they have the funds to provide programs to their community groups, it becomes more likely that they will make the effort to be more productive.

Challenge: To develop appropriate agricultural and rural development learning institutions capable of producing effective facilitators of sustainable agricultural and rural change.

Society's willingness to pay for university-based research as a public good can only survive so long as it is apparent that the public good is being served. The foregoing discussion makes it evident that a continued production focus in agriculture does not serve the public good (Jiggins and Gibbon, 1997). Agricultural and rural development institutions need to be become learning institutions that produce facilitators rather than drivers of change.

Strategies/Options

- Develop student to student learning. Institutions should seek international graduate students, at Masters and PhD level, to share courses, field work and research programmes with 'home grown' students.
- Encourage staff interaction with peers. The interaction of staff with foreign researchers and overseas institutions allows staff to develop and gather new ideas and energy. Ideally, interactive opportunities should be built into staff time planning so that this experience can be budgeted for in well in advance. Staff could spend one third of their time in outside applied work - which could be research, consultancy or secondments.
- Involve staff in international debates. Encouraging the participation of staff in networking and key debates - gender, resource management theories, IPM, biodiversity and bioscience for example - with international institutions, through evaluation and consultancy work, and through professional exchanges and secondments to other institutions will aid the internationalisation of their thinking. Permitting staff to participate in short courses for professionals, modelled on masters modules, in foreign countries will provide them with valuable opportunities for exchange. These approaches will infuse and enrich the academic community with the concerns of practitioners trying to put science to work in real problem situations.

- Work with other stakeholders. Develop close links with the programmes of international aid agencies with whom valuable placements could be negotiated in different countries.
- Encourage institutional collaboration. Visiting professionals, attached to the institution for periods of a few weeks to several months, can deploy new skills and experience, thus enriching the learning experience for students and staff. They can also help with the writing of research proposals to foster further institutional collaboration.
- Encourage interdisciplinarity. Joint publications with colleagues from international institutions and journal and book projects enhance interdisciplinary thinking and learning .
- Ensure critical learning. Develop a critical self-learning approach by all staff with regular monitoring and review by peer groups.

Challenge: To tackle the lack of synergy between the various sectors - public, private and NGOs/ CSOs - working on extension. This frequently leads to an isolated way of working, which is compounded by a widespread tendency to see 'extension' as a task somehow separate from the research process, or farmer decision-making.

Strategies /Options.

- Develop national associations of capacity building agencies. Efforts should be made to encourage partnerships and synergies between the various extension efforts of public, private and CSO sectors. Individual governments could initiate a national association of capacity building agencies, representing all sectors - public and private - to promote partnerships. To ensure farmer representation, such national associations of capacity building agencies could have one or two farmer representatives participate in their meetings, or alternatively the association should consider farmers' knowledge in designing strategies for facilitating synergies among the various stakeholders. A combined approach would strengthen capacity development efforts through augmenting the sharing of resources, and reducing repetition of effort.
- Provision of resources. Seeds, fertilisers, pesticides, irrigation and mechanisation products and technologies are vital if extension workers are to be enabled to implement what they have learned, and so they must be made available. Education without access to the necessary tools of increased productivity is contradictory.
- Develop new understandings. Increased productivity is not just about more 'product', but also about challenging people's mindsets and working to create new visions. It is necessary to develop, and work with, new approaches to resource management, and to consider new roles for stakeholders.
- Ensure sufficient manpower. Manpower plans should be developed at the national level in order to adjust training programmes to bring them in line with national requirements for extension personnel.

- Improve access to new technologies. To improve access to new technologies, intra-regional research centers and partnerships could be developed. Partnerships with private companies could be explored. For example, it is sometimes possible to coordinate efforts with commercial suppliers of inputs, so they can participate by providing training in their optimal use, at the supplier's design and cost.
- Ensure regulation of pluralistic extension schemes. In areas where pluralistic extension schemes exist - where NGOs, commercial agriculture companies, fruit and vegetable cooperatives, and pesticide companies are involved in delivering extension advice to farmers - governments have to ensure that these extension services are not biased in an attempt to increase business for the suppliers, and that the terms of trade are 'fair' to farmers who are contracted to grow and supply their produce to the marketing companies. Some of the regulation and control that is required can be performed by the farmers themselves.

7.3 Mobilising and Supporting Under-Used Human Resources for AKST

7.3.1 The brain drain and brain circulation

The 'drain drain' may be defined as the movement of human capital in the form of skilled, knowledgeable personnel from a less favourable geographical area to a more favourable one on a more or less permanent basis (Beine et al., 2003; Answers Corporation, 2006). It constitutes part of a wider emigration of such labour, including the movement from place to place on a temporary basis in what is described as 'brain circulation' (Lowell et al., 2004; Parthasarathi, 2006).

Both processes occur at various geographical scales within and between countries. Movements from the rural, mainly agricultural sector, to the urban sector, and from developing countries to developed ones are the most pronounced. The drain is estimated at 15% for Central America, 6% for Africa, 5% for Asia and 3% for South America (Carrington and Detragiache, 1998). Owing mainly to globalization, urbanization, spatial inequalities in levels of economic development, and 'quality-selective' immigration policies, the brain drain together with brain circulation has accelerated in recent years, with far reaching socio-economic implications for the development of AKST (Rapoport, 2002; Beine et al., 2003).

While it has some negative consequences, including the outward flow of young people, and the unwillingness of researchers and extension workers to be located in remote areas, the brain drain can also stimulate agricultural development. Migrants remit money, and they can introduce important innovations upon their return, as in the case of retrenched civil servants in East Africa (Sumberg and Okali, 1997). A 'drain' from one perspective is simply demographic and economic change for another; 'de-agrarianisation' may be a long-running trend (Bryceson, 1996, 1999, 2002).

Challenges include enticing researchers and extension workers to work in remote areas, encouraging young people to remain in farming, considering the gender dimensions of the brain drain, and enabling migrants to maintain links with rural areas.

Challenge: To ensure the development of locally relevant technologies through the provision and retention of expertise in rural areas. As agricultural research is pushed to decentralise its approach, the brain drain is becoming a major hurdle. It is becoming increasingly difficult to get skilled personnel to work - and possibly be based - in more marginal and highly-stressed farming environments, or indeed in any research setting far removed from major cities.

Strategies/ Options.

- Better ICT, training, and other workplace incentives are needed to help attract and retain good researchers and extension personnel in remote locations. They need to be connected to colleagues and offered career incentives, and provided with guarantees that they will not be stranded there. Although such incentives are currently low on the reform agenda of agricultural R&D institutions, research increasingly points to the need to decentralise work addressing low-input farming in stressed areas, if locally-relevant technologies are to be developed.
- Ways of linking the diaspora back into national networks of dialogue, advice and technology transfer need to be explored.

Challenge: To retain sufficient young people in farming. The enterprise and energy of young people is important to sustain farming. The loss of potential taxable income of those who move out can undermine agriculture by depriving it of investment funds. Foreign food dependency and balance of payments may worsen as agricultural production stagnates or even retrogresses in the wake of flight of labour and the skills and capital associated with it. These negative implications are likely to be severest under conditions of brain drain involving permanent outward flight of human capital.

Retaining youth in the countryside means ensuring that young people see farming as dynamic enough to be interesting and relevant. In many cases, it is not, or youth leave because they are unwilling to take up the subordinate roles that are available to young, starting farmers under existing social systems. For example, the coastal rice farming systems in Guinea Bissau depended upon young farmers being mobilised for considerable toil in land preparation. This system declined following the civil wars of the mid-70s, because young men were no longer willing to be organised by older men into work crews. Social changes wrought by conflict meant that older male authority was being questioned (Richards *et al.*, 1997). Often, youth have legitimate concerns of not being masters of their own destiny - if their energy and enterprise mainly benefit someone else, who can blame them for leaving?

Strategies/Options.

- If youth are to be involved more effectively in development, it is essential to have a fuller understanding of why they feel disenfranchised. Research needs to be commissioned to find this out (e.g. Richards, 1996).
- Innovative ways to engage youth in agriculture include more relevant, problem-oriented and vocational education curricula which engage students' interest in the natural world, including farming. Attention also needs to be directed to supporting new dynamic farming activities that engage the interest and skills of young farmers. In places like Sierra Leone, where ex-fighters need to be resettled, the challenge is to find them activities which fit well with farming communities, for example as black-smiths. Youth can also be supported in the farming of land that nobody else wants. Crucial to such endeavours, though, is social change to give youth a greater stake – and say - in their societies. Otherwise they will continue to want to leave.

Challenge: To ensure that migrants retain links with, and an interest in, farming. Rural-urban migration plays a role in making agriculture viable. For instance, average farm sizes in highland Ethiopia are probably already too small to sustain many families, and out-migration of some youth to the cities may be preferable to sub-dividing land still further. According to some researchers (e.g. Ellis and Woldehanna, 2005) a certain level of out-migration is the only way to ensure food security in rural areas, and economic growth in non-farm sectors. In the case of Ethiopia, which restricts migration more than most SSA countries, policies to 'stem' the brain drain from rural areas actually help perpetuate rural poverty.

Strategies/Options.

- Incentives can be provided to encourage for migrants to return home for good after some reasonable period of sojourn elsewhere. Access to land and agricultural support is important, as is the promotion of a democratic environment that discourages the flight of skilled human capital (Lowell et al., 2004). For this to succeed, young people must feel enfranchised.
- The 'diaspora policy option' involves arrangements that induce a source area's émigrés or expatriate community to contribute their experiences and financial, technical and other resources to the development of their original home area, while they still remain resident abroad (Rapoport, 2002; Mutume, 2003; Lowell, 2004; Sriskandarajah, 2005; Kuznetsov, 2006). The provision of effective ICT and money transfer systems to enable the efficient repatriation of remittances is important.
- Inter-governmental, bilateral and multilateral arrangements that seek to regulate exchange of skilled human-power on a mutually acceptable basis can be developed (Lowell et al., 2004).

7.3.2 Recognising the changing roles and responsibilities of women and men

As off-farm and urban employment opportunities increase, men are increasingly moving out of rural areas and into non-farm employment in some regions (particularly Africa and South Asia (UNIFEM, 2000), making the role of women in agriculture more important in these areas.

Conversely, in other regions, particularly Latin America and Southeast Asia, there is an increasing tendency for women to move from rural to urban areas. While migration is changing the traditional patterns of gender-based roles in rural areas, women's access to essential resources and services remains problematic. In many countries, rural-urban migration has contributed to both the 'feminization of agriculture' and the 'feminization of poverty' (FAO, 2003).

Although considerable funds have been directed towards mainstreaming, the gender-blindness of national R&D institutions persists. Tackling the consequences of the brain drain means that the capacities of people remaining in the rural areas needs to be directed into domains of AKST formerly reserved for one gender or the other. In general, the roles and responsibilities of women and men in agriculture need to be better supported by AKST if farming is to be seen as a viable and attractive livelihood option.

Strategies/Options.

- Accurate assessment of farm-level resource needs and labour allocation will reveal important clues about women's resource, training, and support needs; as well as the areas of farm production where capacity development will produce the greatest results. For example, participatory rural appraisal in a community in India found that poultry production - which is controlled by women and is less labour-intensive in view of the size of the animals and size of the flocks than caring for other livestock - was increased, both household nutrition levels and cash savings improved. Yet if goat herds were increased, girls were pulled out of school to tend the herds (FAO, YEAR).
- Innovative training approaches can reap dividends at household and community level. For example, community learning centres in three provinces in China provided vocational courses in field crops, livestock and poultry, agroprocessing technology and gardening in four formats: specialized training; short-term training; TV and radio-based training; and on-site visits and exchanges. Women had additional opportunity to participate in on-site science and technology training at high-yield vegetable gardens, fruit orchards, demonstration rice fields, pigpens and fishponds. Those were who trained were responsible for passing on the practical knowledge and skills they gained to others; women were also provided with access to credit by local governments and credit cooperatives. It was found that the skills and technological knowledge gained by women was applied to improve farming practices, so that women's social position and role in economic development increased in the communities (UNESCO, 2003).

- Training women in new skills and areas of knowledge is not enough. Gender relations reflect the outcome of economic/ political / social relationships at the micro-level, and so it is also necessary to find ways of increasing women's room for manœuvre, that is, strengthening their agency (the ability to make plans and to act upon them). Education and literacy may be important assets for human capital, but women also need to be able to put these assets to use.

7.3.3. The potential of fair trade as a capacity development tool

Fair trade is designed to support two basic processes. It offers explicit on-the-ground development support to some of the most marginalized and poor actors in international agricultural commodity chains – small-holder farmers and plantation workers; and it aims to make visible the relations sustaining international commodity chains to consumers.

Created by 'alternative trade organizations' in recognition of the deteriorating livelihoods of small-scale and primary commodity producers in the South, today fair trade has launched itself into the mainstream of many developed economies. This market growth has allowed the fair trade model to spread to many communities in developing countries, and into the provision of an ever-increasing palette of raw and processed agricultural products. FLO (Fair Trade Labelling Organisations International) estimates that the capacity of producers worldwide who could meet certification standards is roughly seven times the current volume exported via fair trade channels (Murray, 2006).

An emerging concern is that space so slowly won by fair trade practitioners for transforming the international commodity chain may be captured by agrofood corporations able to transform this progressive initiative into a niche marketing scheme for products re-packaged under 'green' and/ or 'ethical' symbols. In some cases conventional companies have adopted a fair trade label for only one product line. This leads to the situation where consumers may believe a company to be a fair trade practitioner (labeling used to brand), whereas in reality a small percentage of its product lines are actually bought under the terms of fair trade labeling. The challenge for the fair trade is to maintain stringent fair trade standards while competing against the entry of transnational companies using weaker fair trade standards.

In the classic fair trade situation, premiums that farmers receive under fair trade terms of engagement remain with them to build community, grower, and worker livelihood capacities, through, for example, providing access to clean water and the purchase of household implements, supporting transportation and community infrastructure, and educating farmers' children.

And yet participation in fair trade commodity chains demands significant capacity on the part of farmers. There are many challenges and just a few can be examined here. They include

developing local markets, assisting women entrepreneurs to enter the sector, balancing consumer requirements with sustainable management practices and increasing the relevance of fair trade standards to farmers.

Challenge: To develop local markets for fair trade goods in developing countries. Europe has the strongest retail market for fair trade agricultural goods worldwide, running at 60-70% of the global market. Markets are set to launch, or experience significant expansion in the Czech Republic, Spain, Portugal, Latvia, Hungary, Greece, Malta, Poland, Slovakia, and Slovenia. Canada, New Zealand and the United States have significant and expanding fair trade markets (Krier, 2005).

However, in less developed countries the picture is different. There are no consumer markets for certified fair trade goods on the African continent, for example, though observers argue that mastery of the local market would provide a first step to true fair trade in Africa (http://www.fair-trade.africa.com/cont.php. (accessed 30 November 2006). Exploring the potential for fair trade in developing countries may be a way of taking up some of the excess capacity of smallholders.

Strategies /Options.

- Local markets with low standards are disappearing, as is the distinction between the global/ export market and the local/ domestic market. Fair trade support networks need to consider urgently how to enable small farmers and entrepreneurs to gear up quickly to compete in both international *and* domestic markets as they open up for conventional and fair trade/ethical products.
- The fair trade movement needs to explore, and support the development of, complementary circuits: national fair trade, regional fair trade, and South-South fair trade. Beyond this, it would seem necessary to think more holistically to consider how fair trade can link to other motors for sustainable development. Such motors include networks of farmer organizations, regional integration processes, and ensuring that stakeholders in the South play a role in influencing multi-lateral trade negotiations (Fair Trade Africa, YEAR). In Africa, local fair trade markets could build on the tradition of large women's cooperatives, like the Gouro women's market in Abidjan, Ivory Coast, or try to implant itself into significant sub-regional markets, such as the Diaobé at the border of Senegal, Mali, Guinea, Guinea Bissau and Gambia.
- Local producers could supply ecotourist hotels and restaurants.

Challenge: To assist women entrepreneurs to enter the fair trade sector. Although fair trade organisations encourage producers to develop projects aimed at securing gender equality, the effectiveness of these projects is unclear. Impact studies indicate some successes, but indicate also that greater strides need to be made. Women's involvement in fair trade

agricultural production can be a mixed blessing because it can increase their workload. Furthermore, despite women's contributions, fair trade cash crops and the income generated from them are generally controlled by male household members (Redfern and Snedker, 2002; Farnworth and Goodman, 2006).

In many countries women are self-evidently the main traders in informal markets and have substantial interests in processing crops for formal market sale. Yet the ability of women to respond to market incentives can be constrained, despite the efforts of many governments to restructure the agricultural economy towards expanded production of tradable crops through liberalizing markets and relative price changes. Women are generally excluded from a process of feedback between price incentives, increased production, increased revenue and yield enhancing measures. A Bolivian fair trade study (Charlier et al., 2000) noted that women farmers were less informed by the fair trade partner than men farmers were with respect to product pricing, agricultural techniques, running organizations, and how to access credit. In other words, fair trade partners often assume men pass information on to their wives. However, in practice knowledge transfer is inadequate. Furthermore, targeting men can be counter-productive, since women and men tend to have gender specific knowledge on particular crops and their associated ecosystems (Farnworth and Jiggins, 2006; Charlier et al., 2000).

The problem of mutedness (Ardener, 1975) also arises. A high percentage of female membership in a fair trade cooperative does not mean women are participating actively. A study of women members of Coocafé's affiliated cooperatives (average 20%) revealed that many women are members on paper only in order to enable the family, as a unit, to access more credit from the cooperative or to increase voting rights. Female participation in coffee cultivation is significant, but their role in decision-making is low. Sporadic attempts by the cooperatives to increase women empowerment has had limited success, due to the unfocused nature of the projects (Ronchi, 2002). In contrast, La Asociación Maya de Pequeños Agricultores in Santa Anita la Unión, a Guatemalan coffee cooperative formed by ex-combatants, reserves 50% of their elected board positions for female members (Lyons, 2006).

Strategies /Options.

- Considerably more gender analysis should be conducted in the fair trade sector in order to obtain a richer understanding of the costs and benefits of fair trade for both women and men producers.
- The findings of gendered impact analyses will assist in the design of criteria and processes for the identification and selection of whom to work with. Such decisions are consequential for the empowerment effects of fair trade. In some cases practical constraints

to women's participation may need to be removed or women extensionists may need to be hired in specifically to work with women producers.

Challenge: To balance consumer requirements with sustainable resource management practices. The single-commodity focus of many fair trade interventions does not necessarily encourage sustainable natural resource management practices. Since supermarkets generally demand high cosmetic quality standards, much produce is rejected by buyers, resulting in a large financial loss to the growers. This practice is environmentally wasteful and acts as a disincentive to continue production for export (NRET, 2003).

A Bolivian study showed that the demands of fair trade consumers in the North for 'quality' products undermined local preferences for particular colors and shapes – and by implication the survival of landraces (Charlier et al., 2000). The need for homogenous products, to enable mixing into larger batches, is problematic when small producers farm widely varying plots of land.

Even in cases where environmental standards are devised, meeting them can be problematic. For example, for many of the elderly members of a fair trade cooperative in the Caribbean Windward islands the physical labor required of them to comply with standards issued by FLO (Fair Trade Labelling Organisations International) consisted of time-consuming and back-breaking manual clearing of weeds and other laborious tasks. This work was physically debilitating and arduous (Bacon, 2004; Moberg, 2005).

Strategies/ Options.

- Diverse ecological production systems need to be supported by fair trade partners. This is already occurring. However, meeting environmental standards can be onerous. It is therefore necessary to contextualise standards and certification procedures in accordance with local labour and social conditions.
- Avenues for marketing innovations, for example with vintage varieties of pineapple, in both local and international markets need to be explored (van Walsum and Guijt, 2006).
- Farmers should be encouraged to spread livelihood risk, and to contribute to agrobiodiversity, by investing in a diverse activity and crop portfolio (Nelson and Galvez, 2000).

Challenge: To increase the relevance of fair trade standards and labelling to producers in developing countries. Fair trade labeling organizations such as FLO stipulates certain minimum criteria that the trading process must fulfill in order for a product to be labeled and sold as 'fair trade'. Fair trade labels are issued to a limited range of commodities for which an international fair trade standard has been developed. The fair trade label can be used by buyers registered with one of the FLO National Initiatives to show that the product has been

produced and traded according to pre-defined social, contractual, and – sometimes - environmental standards (Tallontire, 2001). For example, in the case of fair trade coffee they work with coffee importers, roasters/wholesalers, and retailers. Coffee distributors may buy a license to display a fair trade label on specific packages of coffee if they purchase from groups on the FLO coffee register and uphold FLO standards and procedures (Raynolds, 2002).

A concern shared by many developing countries is the fact that fair trade standards are generally decided unilaterally in bodies with no formal voting power on the part of developing countries. The intended beneficiaries - smallholders and workers - sometimes see them as exclusionary, unrealistic and imposed by stronger stakeholders. A further difficulty arises due to the fact that organisations based in developed countries also largely control certification and accreditation processes in fair trade.

Furthermore, producers in developing countries are concerned that the development of new labels may form yet another barrier to entry into the European market, along with technical and health protection barriers (African Fair Trade Symposium, 2006). Producers must often comply with more than one standard.

Strategies/Options.

- It is essential for fair trade organizations to understand themselves as evolving, learning institutions. Part of this awareness involves developing the capacity of producer partner organization to negotiate, communicate and to become fully involved in discussions around standard-setting, certification and accreditation.
- Building trust between partners is important if a fuller understanding of processes in fair trade is to be obtained. Trust-building in commodity chains, including fair trade, is particularly problematic due to the volatile prices associated with commodity markets, the isolation of farmers from markets, and size imbalances between different actors. However, trust building must be prioritised.
- Communication between local stakeholders would require strengthening in order to encourage the sharing of locally relevant learning experiences. Current communication structures tend to privilege North-South interactions.
- The development of national certification initiatives should assist producers in the development of their domestic markets, through reducing the costs of certification and by enhancing local relevance of fair trade standards. In Latin America, for example, Mexico has just started its own national certification initiative known as *Comercio Justo*.
- New policy frameworks that are bringing in new stakeholders are being formulated in the developed and in many developing countries. These imply, and require, rapid transitions to new forms of agriculture that meet intensified standards of pollution control and pest and

disease management throughout the agrofood chain. Fair trade should expand its interactions with stakeholders in these areas in order to keep pace with change.

7.4 Farming and Human Health

Health interactions in farming are both positive and negative. Positive impacts that agriculture can have upon farmers include the production of, and access to, sufficient and nutritious food, as well as to medicinal products. The physical, mental and emotional health benefits of farming to farmers can be significant. Studies of organic and sustainable farming, and of horticultural therapy programmes, show that these approaches can be particularly fulfilling for both women and men farmers, particularly those for whom entering the sector is a matter of conviction (Howard and Jansen, 2003; Chiappe and Flora, 1998; Meares, 1997).

Conversely, producing a commodity monocrop may provide an income but not necessarily household access to a balanced and nutritious diet. The increased use of farm machinery is stimulating rising levels of obesity in the South (FAO, YEAR). Long term studies in some European countries indicate that vitamin and mineral contents of crops have declined with the advent of industrialised agriculture, which has focused on feeding the plant with a small range of nutrients (NPK) – as opposed to feeding the soil (Mayer, 1997). Pesticide intoxication, drinking water pollution, and high rates of agriculturally-related suicides and social isolation also constitute negative health impacts (Hazell, 1995). Farm labourers and farmers may have limited access to health facilities in sparsely populated areas. Capacity development issues include access to health education for women and men, education around protection from health risks, and training in the appropriate and safe use of pesticides, dealing with other occupational hazards related to farming – such as the safe use of machinery, and ensuring support for social and learning ventures such as Young Farmers' Clubs in order to ameliorate isolation.

Challenge: To reduce the physical and psychological burden of HIV/AIDs on farming families, and to tackle the erosion of agricultural knowledge. Agrobiodiversity and local and traditional knowledge count among the most important resources in materially poor rural societies. In fact, these resources are a *requirement* in such communities as a substitute for material inputs. As households and communities affected by HIV/AIDS become increasingly impoverished, they are stripped of many of their assets. They may be left with 'just' their land, some extended family and social networks, their knowledge and experience of farming, and locally available plant and animal resources. At the same time, the changing needs and circumstances of HIV/AIDS-affected households and communities demand a change in farming systems.

HIV/AIDS deepens existing poverty. Impacts experienced by People Living With AIDS (PLWA) include health constraints, labour shortages and weakened labour force, social

isolation, monetary shortages, and household impacts - such task redistribution, and the care requirements of the sufferer. PLWA provide less labour, have less capital and are more in need of risk management. As they struggle to pay increased medical and other bills - while at the same time suffering diminished earning capacity, their financial wealth decreases and assets may be sold, such as livestock, tools or seed reserves. Cash crop production is often abandoned due to its now excessive financial and labour requirements. All of these aspects contribute to a decline in production in rural communities, and to farm degradation in terms of a decrease in the use and conservation of agrobiodiversity, to a decrease in the food quality and quantity available to farming households, and to an abandonment and disinvestment in land. The poorest people are hardest hit, since people who experience food insecurity are more likely to die when infected with HIV than healthy people (Kebede and Retta, 2004).

The death of women and men in their economic prime is accompanied by the loss of their skills and knowledge. Many die before they have had time to share their livelihood skills with their children, thereby reducing the range of livelihood options for the next generation. Further disruptions occur when the increased need for medicine and treatment forces productive family members to leave their farms in search of paid employment elsewhere. Children are often taken out of school because their labour is needed on the farms and because there is no longer money to pay for education. With the loss of adult lives, child-headed farming households are on the increase, and therefore the agricultural labour force is weaker overall. The stress of HIV/AIDS on the social capital within communities erodes the transmission of knowledge between households and communities, and contributes to the demise of local seed exchange systems (reference).

In areas where cultural practices limit women's participation in formal organizations outside the home, the death of the husband/father can result in limited access to community resources. In some areas, women are deprived of their access to land and their husband's resources by his extended family when their husbands die (Stokes, 2003).

Strategies/Options.

- Food Security. The first essential for communities with PLWA is to ensure a more constant supply of locally accessible food, both in quantity and nutritional value. This enables them to remain as healthy as possible for as long as possible, building physical resilience to the range of minor infections and diseases which can prove fatal to PLWA. In the sub-Saharan African situation, communities grow, or gather, most of their food themselves. Appropriate local varieties which are yield secure and resistant to local stress conditions should be promoted.
- Labour-saving technologies. The weakened workforce of PLWA is less able to provide enough, strong, timely labour. Therefore, labour intensive production and post-harvest practices are now inappropriate : production becomes less a measure of ‘yield per hectare’,

than‘ yield per hour’. Shifting to other less labour-intensive varieties or species and practices increases harvest security. Promoting low-labour high-income crop production, particularly tree crops such as cashew and avocado, will enable crop management by weaker/child labour due to the low investment and maintanence required. At the same time, labour-saving technologies, such as grinding mills, improved tilling, processing and transport technologies as well as lighter ploughs and tools that can be used by older children, women and the elderly will ease the increasing onerousness of the workload. Other priority technology needs include small-farm mechanization, low-input agriculture, intercropping, zero or minimum tillage, access to potable water and fuel-efficient stoves (Topouzis, 2001).

- The provision of potable water and local renewable energy sources close to homesteads will decrease the time expended, particularly by women and girls, on accessing water and on cooking food.
- Income-generating activities. In the case of HIV/AIDS affected households, the need for income increases due to the rise in medicinal and funeral costs, yet at the same time the capacity for income generation decreases. Useful income-generating activities based around local agrobiodiversity are those requiring little capital investment and labour, those that bring dividends throughout the year, and those that require local resources, knowledge and skills to be accessed. Developing women's income-generating and economic activities will assist them to support their families when their husbands or other breadwinners in the family fall ill. Reducing food losses by utilizing low cost post-harvest and food processing practices can enhance profitability and improve nutritional outputs of existing farming operations.
- Sharing and documenting knowledge. Knowledge sharing between elderly farmers, traditional healers and young people can be encouraged through schools and through promoting informal knowledge-sharing activities Locally relevant local and traditional knowledge needs to be documented and made available.

Challenge: To build government capacity to act cross-sectorally. For a long time, HIV/AIDS was seen as purely a health issue, and most financial resources have passed through Ministries of Health towards reducing infection rates, buying anti-retro viral (ARV) drugs, educating and awareness-raising, and, more recently, on increasing home-based care. It is now understood that HIV/AIDS requires a cross-sectoral response, including the ministries of education and health as well as agriculture.

Strategies/Options.

- Government coordination and facilitation of the development of action plans among different ministries and agencies to address the increase of HIV/AIDS in rural areas and its effect on agricultural production. Cross-ministeral cooperation will be essential for action plans to succeed.
- Retraining the agricultural support sector, for example the Ministry of Agriculture, will enable them to better facilitate local, appropriate, natural-resource based solutions.

- Involving the agricultural sector also needs to occur at the policy and decision-making levels: with regard to land rights, food aid, seed legislation and so on. It is important to involve community level stakeholders in the policy circle as well as in providing good channels for feedback to influence change at such levels.

7.5 Systemic Management of AKST

7.5.1 Feedback systems

Agriculture, as a consequence of its place-specificity, is embedded in systemic relations. Its diversity generates flows of products and services that situate agriculture in a web of institutional arrangements and relationships, at varying scales, such as farmers' organisations, commodity chains, production areas, natural resource management areas, and ethnic territories. Farmers are therefore members of multiple arrangements and relationships.

Due to this complexity, much AKST that has been developed over the past few decades have not been successful at the farmer level. Adoption rates of technologies have often been poor. Factors include a lack of dissemination, access, and/or the inappropriateness of the technologies offered. These factors can be related to the supply-drive 'transfer-of-technology' (ToT) approach that has dominated the AKST paradigm. A significant conceptual shift in the approach to AKST, and more generally economic, environmental and social sustainability is required. Crucially, feedback mechanisms in the AKST knowledge generation cycle need to identified and implemented.

Challenge: To transform AKST from a supply-driven to a demand-driven paradigm, feedback mechanisms need to be developed that incorporate the knowledge of farmers – the core of the AKST system – and other stakeholders. The AKST systems framework should be defined and implemented as a knowledge generation cycle for identifying stakeholders and their institutional relationships. This involves assessing their capacities, and identifying gaps and weaknesses in generating and using knowledge. Feedback, as a project goes through the various stages of the knowledge generation cycle, to the research organization working to identify capacity development needs in AKST is essential.

Strategies/ Options.

- Capacity development should be monitored and evaluated across the cycle to ensure it is innovating appropriately. Monitoring and evaluating appropriateness includes considering relevance to public, private and community sector organizations. In many developing countries such a public-private concept has made little headway, and farmer feedback loops have rarely been achieved. Joined-up thinking is required.
- In order to work with smallholders to enhance their productivity of small-holders it is necessary to shift the research paradigm firmly towards a 'demand-driven' model. The ToT model in its purest form claims that the role of researchers is to apply scientific methods to

understand, structure and model 'reality' to develop technologies for farmers. In contrast, the demand-driven 'follow-the-technology' (FtT) approach uses technologies as an entry point into a complex situation to determine what is important and where all stakeholders, including farmers, are perceived as equal partners.

- The shift from a ToT approach towards a FtT approach requires a major change in perception of roles. In the ToT model, the task of extension is reduced to a transfer of scientists' knowledge to farmers, whose role is conceptualised as that of passive recipients. They are not expected to adapt the messages brought to them. In the FtT approach, technologies are presented as options, not as final solutions, to farmers who are expected to modify and fine tune them jointly with researchers and extension staff.
- Farmers and farmer organizations need to be actively involved in the research-development continuum, from the setting of research priorities to technology dissemination and adoption, including monitoring and evaluation and impact assessment.
- Demand-driven approaches demand flexibility in planning. Perceiving research as a joint learning process implies implementing adjustments after gaining additional insights through monitoring and evaluation. This ensures that the research continually focuses only on questions which remain relevant following this sifting process. This approach is also economical in that it reduces research redundancy.
- There is also a need for increased investment in research that is simultaneously site-specific and yet capable of generating knowledge that can be up-scaled (generation, dissemination, access and adoption and improvement as global/international public goods).
- In many developing countries access to AKST - research, technology and extension has become more rather than less difficult - with state organizations often no longer providing such services, while the private sector has not adequately filled the vacuum. These gaps need to be bridged, via means such as developing training programs for private sector based FtT consultants.

Challenge: To develop capacity to monitor and evaluate national AKST systems. Many countries lack M&E functions in the form of a physical unit or a system. However, it is essential to establish such units or systems to permit the assessment and monitoring of natural and farm resources, and of the processes of change at local, national and regional levels. This information may be used to evaluate how effectively farm resources are managed, and if they are maintained in good health. Concerns about biodiversity in agricultural strategies and production processes need to be operationalized.

Strategies/Options.

- Establishing and/or strengthening M&E systems allows information for the measurement and assessment of progress and change over time in achieving national AKST goals to be produced.

- Without developing the capacity of stakeholders to monitor and evaluate natural and farm resources, the potential to improve them remains largely unknown and unmanageable. Therefore the development of the capacity of farmers and other stakeholders to contribute to M&E through ensuring their participation in the generation, dissemination, access and adoption/use of AKST and technologies will help to produce high-quality and timely information.
- Assessing progress and incorporating feedback loops to permit a country to act on information and knowledge generated, disseminated, accessed, adopted and improved through M&E will ensure future action is more effective. This process, through drawing in a range of stakeholders, will also build commitment at various levels to implement corrective action.

Challenge: To integrate environmental and social sustainability into AKST.

Strategies/Options.

- Develop a shared understanding of the nature of social and environmental sustainability among the key actors in the web of institutional arrangements involved in agriculture.
- Seek to ensure that there is widespread appreciation of the value of this shared understanding of social and environmental sustainability distributed throughout the institutional web. Doing this will require a proportion of investment to be made in programmes that educate and promote the sharing of experience and good practice relating to this issue. Both environmental and social sustainability often crucially depend on contextual dimensions. Particular sensitivity is needed to capture and propagate an awareness of this dimension.
- Establish feedback mechanisms to assess all investments and proposals for projects to consider how well they deliver social and environmental sustainability. Such assessment is essential in improving the social and environmental dimensions of project proposals and in ensuring that initiatives that are detrimental to social and/or environmental sustainability are not adopted.

Challenge: To address the lack of reliable M&E information, including indicators, on natural and farm resources. In many countries, baseline data and indicators to measure the status and quality of natural resources (especially water and soil) have large gaps, and are often of poor quality. Successful capacity development M&E programs are holistic. They recognize the strengths and weaknesses of the past, and the opportunities and threats facing AKST. However, there are insufficient indicators and metrics for monitoring and evaluating progress. M&E units and/or systems are needed to monitor progress and suggest necessary corrections in mid-course.

Strategies/Options.

- The establishment and/or strengthening of M&E databases to permit the generation of indicators to measure the efficiency and efficacy of the stakeholders, including farmers and farmer associations, in farm and natural resource management.

Case study: generating feedback: capacity development to handle H5NI Avian Influenza Virus in Egypt

The recent response to bird flu in Egypt of the government and other actors in the AKST system is an example of how upcoming challenges to national agricultural innovation and production systems prompt a correspondening need for capacity development, interaction and collaboration among various actors in the agricultural innovation and knowledge cycle.

In 2005, several UN organizations; The International Finance Corporation (IFC), the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) sent messages to Middle Eastern countries warning them of an expected attack by the deadly H5N1 Avian Influenza Virus (AIV). FAO officials suggest the potential spread of avian influenza could be carried along the pathways of migratory birds to northern and eastern Africa. Egypt, the area's most populous country with more than 70 million people, was on high alert. However, it was not prepared.

AIV is an infectious bird disease caused by type A strains of the influenza virus which occurs worldwide. While all birds are thought to be susceptible to infection with AIV, many wild bird species carry these viruses with no apparent signs of infection. Other bird species, including domestic poultry, develop disease upon infection. Well over 200 million birds have died worldwide from either the H5N1 flu virus or preventive culling.

The Egyptian authorities had already banned poultry imports and bird hunting, such as for quail, for months. In addition, the Egyptian authorities banned almost all small-scale poultry producers' farms and backyard production, which represents about 80% of the total poultry industry production. However Egypt's poultry industry is worth about $3 billion and employs approximately 1.5 million people. So it was imperative for Egypt to seek new ways of handling Avian Influenza. The ban on imported poultry and its by-products was expected to raise the price of already expensive white meat products. The government did permit poultry imports during the Ramadan (the Muslim Holy Month observed by fasting during daylight and eating at sunset during which large quantities of poultry are consumed.)

Analysis of the Egyptian government's response to H5NI Avian Influenza Virus. The response to the bird flu threat involved several dimensions: the organizational capacity of the national government to respond quickly and effectively; the ability to monitor the situation and bridge the knowledge gap between the government and all key players in the poultry industry; the

capacity to take action to deal with the current threat and to protect human health; and prevention and preparedness against future outbreaks.

Organizational Capacity: By bringing together all stakeholders, IFC created a platform to share valuable operational and commercial lessons, views on private-public sector partnerships, and implications for the public at large. The Egyptian Government recognized that one way to widen the work already started with all partners was to provide even more focus on communication and co-operation between all stakeholders.

Knowledge of how to maintain and control poultry production to prevent AIV is lacking in Egypt, especially for small-scale producers who cannot use conventional methods to protect their birds. Governmental, research, and extension agencies are lacking the proper strategies for AIV research development that could minimize the risk to the poultry industry. As a result, they reverted to cultural practices for controlling AIV in order to preserve this affordable protein supply for poor people. In this respect capacity of researchers and extension educators needs to be developed as well as the producers, in learning how to protect birds from this risk.

*Human Health Capacities***:** Since the responsibility of maintaining Egypt's human health and the protection of the poultry industry does not belong to the government alone, protecting human health means meeting with all stakeholders to share collective experience. In Egypt, some level of success has been seen with the actions taken to date, particularly with regards to active surveillance of poultry at its source. There is hope that with the support of development agencies and the private sector, Egypt can develop an even more integrated response to Avian Influenza.

Preparedness Policy: Current policy and options to mitigate the human and economic costs of an avian flu pandemic continue to evolve in three critical areas: Strengthening communication and knowledge delivery services to people in the rural sector; capacity development regarding vaccine information and vaccine production, and deepening knowledge on how to treat using antiviral drugs and other medications to reduce the impact of any pandemic, developing M&E systems to track the impacts of such a pandemic, and preparing state, local government and public health responses to the problems that would be presented by an outbreak

One of the results of this capacity development process was the proposal to establish a US $10 million two-part programme: a short term component to bring outbreaks under control (vaccine research and development) and a long term initiative to help protect against future outbreaks and accelerate recovery, including capacity development of stakeholders, for the next 5 years.

7.5.2 Encouraging stakeholder communication through information and communication technologies

In implementing ICT systems for knowledge generation and dissemination in agriculture, strategies have tended to focus on the technology (hardware) as an end in itself. Technological entrancement has resulted in an overlooking of the user. Knowledge has been disseminated in forms that are not useful, understandable or applicable to farmers and other users. Media have been selected that are inappropriate or not accessible in local conditions.

Agricultural research and knowledge tends to be generated and disseminated according to the "pipeline" model, that is, researchers and scientists develop research that is then transmitted to the farmer. A knowledge system or innovation cycle approach, however, takes into account the knowledge generation and adaptation practices of farmers and the roles of other stakeholders in the generation, adaptation, use and dissemination of agricultural knowledge. ICTs can fit into this cycle in several ways: by providing different media for dissemination of information; by promoting the generation of different forms of knowledge by different groups in a cost-effective manner; and by encouraging the interactive co-creation of AKST among researchers, farmers, NGOs, the private sector and the public sector.

Currently, however, inequity exists in access to, and the ability to use agricultural information. There is a need to coordinate and streamline existing agriculture information sources, internationally and nationally. The disconnect between the information needs of farmers, and the actual information provided by agencies, has to be addressed. The latter tends not to be relevant to local conditions, to be couched in overly scientific terminology, and to be presented in a format that is not easily accessible to farmers. At the national level, information is often available in hardcopy only or stand-alone computer databases, while information on local knowledge and good practices is difficult to find (GFAR, 2006).

Due to cost and time constraints, women and girls usually have fewer opportunities than men to access information, and to learn how to use new technologies. As a result, they are at a disadvantage in making informed choices around crop selection, food production and marketing, including what price to set. Lack of information also limits their influence in their communities and their ability to participate in decision-making. However, access to ICTS allows women and girls to benefit from increased educational opportunities and to gain information and knowledge to improve their lives. Considering that women's knowledge in production methods, plant selection and biodiversity is an important resource for sustainable agricultural development and natural resources management, supporting women to retain, document and disseminate their knowledge is an important challenge for AKST (FAO, 2002a; Huyer et al., 2005; Howard, 2004).

Researchers in developing countries also face challenges in gaining access to the latest scientific information and have difficulties keeping up with their fields at international and regional levels, including developments and advances in other developing countries.

National governments will increasingly be challenged to understand and define rural development and information strategies and policies. Their ability to collect, analyse and disseminate data; to understand and address the information and knowledge needs of their rural population; and to establish appropriate legal and regulatory frameworks need to be improved. To tackle these problems an understanding of the role of governments in information, establishment of appropriate policies and institutional structures, as well as skills for proper information management and decision-making, is required (Wesselar and Brinkman, 2002 ; IICD, 2006).

Challenge: To ensure that national systems of agricultural information are compatible, and that usable information is better disseminated. National systems of agricultural information are not always compatible, nor is there an international standardised approach to using and developing data and databases for comparison and analysis across and even within countries. In addition, the information that is collected can be difficult to use and not easily translatable to non-scientists. A coordinated approach that addresses the challenges of accessibility; relevance and compatibility with other systems and stakeholders is needed.

Strategies /Options.

- Integrated content can be achieved by promoting coordination among information systems at local, national and international levels. The Global Fund for Agricultural Research (GFAR) and its members are collaborating in the development of a Global Partnership Programme (GPP) for ICM in ARD. The focus in this program will be on social appropriation rather than technology as the driving force for improving information systems. The GPP will focus on three main areas: 1) advocacy for sensitization, awareness and resources mobilization, 2) capacity development and 3) integration of ICT enabled information systems and services at national and international levels. (Maru, 2005).
- At the national level, there is a need to coordinate information exchange and knowledge development among among civil society, the private sector and government departments. In 2002 the Ministry of Agriculture in Bolivia developed an ICT strategy for the agriculture sector in consultation with a range of stakeholder groups. Resulting strategies included bringing Ministry staff online and setting up knowledge exchange networks among producer organisations, NGOs and the private sector at the regional level (IICD, 2006).
- Providing internet-based information services to farmers can be very productive, particularly if the service responds to feedback or allows farmers to reach out to new markets or suppliers. One example is the CTA web-based QandA service to policy makers, researchers, lecturers, students and farmers. The centres collect information and respond to

user requests in the form of verbal or written answers, bibliographic references or full-text documents, as well as advise on sources of finance and training opportunities. This service is both paper-based and available via the Internet.

- The use of small portable technologies is a promising trend in terms of affordability as well as the ability to access and input data from farmer fields and markets. In Jamaica, the Agricultural Business Information System and Jamaica Export Initiative set up by the Ministry of Agriculture and the Export Promotion office collects information on prices and product availability with hand-held PDAs. The information is centralised in a nationl database and is made available through a web portal and customised hard-copy reports.
- The mobile phone is an example of an information technology which is increasing exponentially because it is appropriate to the circumstances of people in many developing regions. A phone costs less up-front and payment plans are flexible, so that lower-income people can "pay as you go"; and it can be an income-generating strategy. The Grameen Phone project in Bangladesh provides loans to buy cell phones to "phone ladies" who sell time on a call-by-call basis. Cell phones are also a portable market research tool in allowing producers to find and compare current market prices for their products, eliminating the middle-man, and ensuring greater profits for their product. The Kenya Agricultural Commodity Exchange (Kace) has set up a cell-based service where farmers can access daily fruit and vegetable prices from a dozen markets via text message (SMS). In this way the farmers have access to information that will enable them to either negotiate fair prices with traders, or choose where and when to market their own products (England, 2004).

Challenge : To ensure that ICTS are effectively utilised to share and integrate the different kinds of knowledge produced by different actors, and to enable farmers to use ICTs to gain information and knowledge. This will help them increase their market share and make informed choices in crop selection and production. Issues for farmers include poor communication networks (deficient or non-existent infrastructure) and an overall lack of training and knowledge in the use of ICTs. Appropriate training approaches which are embedded in community and socio-economic context will promote increased use of ICTs by farmers and communities and application of knowledge to farming practices.

A second key issue is to ensure that this knowledge is disseminated via appropriate technologies: technologies that are affordable, able to provide farmers with content that is practical and available in local formats and languages; able to be updated as information changes, and appropriate to local infrastructure. A range of technologies and technology mixes can be used to collect reliable market data on a regular basis, to process it into information that is relevant to farmers, and to deliver it via an accessible, affordable and effective medium for the local context.

Strategies / Options.

Developing local and customised content is one important factor towards ensuring that information systems are accessible to farmers. Collaborations among researchers, extension workers, and farmers will ensure that relevant, accurate and usable knowledge is generated and disseminated.

Case studies: the provision of localised, customised content:

- *A* web-based multistakeholder workshop organized by the European Tropical Forest Research Network involving all stakeholders in a participatory (particularly indigenous and local communities) in national assessment, monitoring and reporting processes. This was undertaken on the grounds that working with non-scientists in biodiversity assessment can speed up the scientific assessment process, provide data which is useful to local resource managers, link in to scientific information which is relevant to local needs, and increase participation and inclusivity in decision making. Participation was via email or through posting message on the web site. Participants from 55 countries included international donors, NGOs, universities, and grassroots organizations.
- Encouraging multi-stakeholder networking to capture and disseminate innovation: the Honey Bee Network bring together innovators, farmers, scholars, academicians, policy makers, entrepreneurs and non-governmental organizations (NGOs). The network collects, documents, promotes and acknowledges the knowledge and innovations of communities and individual at the grassroots level, and helps the owners of this knowledge (both women and men) protect and benefit from their IPRs. Media for this include a newsletter in six Indian languages and an online database of traditional knowledge and grassroots innovations (www.sriti.org).
- Integrating ICT access centres in local communities, providing training to local users for not only access but also development of content, can contribute to improved knowledge management in a range of community issues. In India, the National Institute of Agricultural Extension Management, MANAGE, Hyderabad, has established a series of information kiosks established at local levels which provide access to regional Web sites, and information is collected, digitized and put up on a local web site. In one pilot, Mutually Aided Co-operative Thrift and Credit Societies (MACTCS) were provided with a multimedia computer system, printer and Internet connectivity. Members were trained in basic computer operations and Internet browsing. These groups (with a high participation rate of women) are now using the Internet for information on government programmes, technical agricultural information, weather forecasts, market prices, job opportunities, and news. They have also started to charge for some of these services selectively to generate income and maintain the sustainability of the kiosk (www.manage.gov.in/cyberextension/cyberext.htm).
- Considering that computers are expensive and difficult to maintain, placing a computer in a local community group or NGO which then disseminates information locally via a range of formats and media is an effective strategy. The World Association of Community Broadcasters (AMARC) and the Developing Countries Farm Radio Network (DCFRN) work with the FAO rural radio programme to establish community radio stations, connecting these

stations to the Internet and training local broadcasters to source information online. In addition a dedicated web portal within FAO's World Agricultural Information Center (WAICENT) provides specialized content including a warning service on food security to AMARC's news agency Simbani Africa (www.fao.org/sd/ruralradio/en/index.html).

Challenge: To overcome the 'the last mile' problem. How do we use appropriate ICTs out in the rural areas, particularly in remote areas?

Strategies /Options.

- Some innovative groups, for example Green Wi-Fi in San Francisco, have really worked hard to produce viable solutions. They have re-engineered computers to run cooler without expensive components. The computers are based in the community centers in order to give local residents access to computers. Locals can gain new skills and access to the innternet gives then new opportunities such as exchanging farming techniques or buying and selling products over the internet.
- Satellite systems are now custom-made for remote communities and are not expensive to setup. They can be configured to upload or down email messages or allow low bandwidth Internet browsing. Wi-Fi technology for example can link remote communities together, augmented with Satellite access to provide a viable system, again at a low setup cost and without technical knowledge. This opens up the possibility of cheap Voice Over IP telephony. It is simple for children, also, to gain an understanding of such technologies.

7.5.3 Managing conflict over natural resources

As the world's natural resources dwindle we are headed for a crisis in supply of essential life supporting and life giving resources. Two key resources that could result in conflict are land and water. Land availability for competing interests such as agricultural and conservation can, if not properly handled, lead to conflicts that have severe consequences for societal cohesion. Water is already in short supply in some parts of the world and is headed for a crisis in availability in most countries of the world. Conflict over these issues can be localized among people within a community, between communities, or between countries. Conflicts over scarce resources are liable to reverse improvements in AKST and livelihoods, and hence undermine development goals.

Agriculture has the potential to spark conflict because it is a place-based activity. It relies on natural resources that either occur in a shared space, or are interconnected through systemic feedback loops, such that actions by one individual or group may cause effects far off-site. Furthermore, since agriculture takes place in a shared social setting, established relationships among a wide range of social actors are often complex and unequal. For example fishers, fish traders, boat owners and government agencies, have differing powers in the fishing industry.

The use of natural resources is configured by socio-cultural and religious dimensions. For example, aquatic species and coral reefs are not just material resources that people compete over, but are also part of a particular way of life, an ethnic identity and a set of gender and age roles. These non-economic values of natural resources tend to give rise to ideological, social and political struggles that have significance for the process of conflict management. Natural resources conflicts therefore often have multiple causes and its management requires a recognition of the multiple perspectives of stakeholders (Buckles and Rusnak, 1999).

Conflicts over natural resources vary in the degree of intensity, They may be non-violent in nature, ranging from confusion and frustration over the direction fisheries management is taking, to violent clashes between pastoralists and crop producers over resource ownership rights and responsibilities. Conflict frequently results from power differences between individuals or groups, or through actions that threaten livelihoods (Buckles and Rusnak, 1999).

Challenge: To ensure that at the national, community and local levels people are equipped with the capacity to manage situations that have the potential of degenerating into conflict.
Conflict management processes to handle personal conflicts exist in every society, yet processes to manage conflict between local groups over natural resources are less well developed, and are often lacking. This is despite the fact that there have been various attempts at the meta-level by UN organizations, The World Bank, NGOs and CSOs to develop the institutional capacity of countries to manage conflict (Economic and Social Council, 2000; Hoguane, 2005; Carius et.al., 2004; Baranyi and Weitner, 2006).

Conflict is a dynamic process, and so, therefore, is conflict management. The process involves different activities which require capacity development of institutions or individuals to yield effective and satisfactory results. Depending on the nature of the conflict and the capacities already extant, it may be necessary to develop capacity across the following domains of conflict management.

Strategies/ Options.
There are two parts to conflict management. First, an assessment of factors/situations causing the conflict is needed. Second, a process to mitigate those factors/situations in order to bring about a settlement satisfactory to all stakeholders needs to be set in train.

Conflict assessment involves determination of the nature, scope and stage of the conflict. Capacity development in the correct identification of the problem of conflict helps to separate out the multiple causes of a conflict, and thus enables the use of appropriate interventions, so avoiding protracted conflict.

It is important, during the conflict management process, to focus on the problem rather than on personalities or attitudes. Capacity development to enable mediators to identify all the stakeholders in a particular conflict, and enabling stakeholders to properly articulate their concerns is necessary. Multi-stakeholder assessment demands addressing the complex interactions between stakeholders and the natural resources at different levels. It brings a wealth of knowledge to bear in the identification and development of solutions. To arrive at a successful conclusion, all stakeholders should be engaged in the management of the conflict. Capacity for shuttle mediation, raising public awareness about the effort for conflict management, sharing preliminary conflict analysis with stakeholders and the ability for negotiation - if not already present – should be developed.

Conflict management involves capacity development in various conflict management options to assist stakeholders in deciding upon the appropriate method of management. Options include conflict prevention, consensus-building and conflict resolution.

- Conflict prevention may involve the co-management of natural resources. The development of capacity to develop a partnership among the stakeholders in which there is sharing and negotiation undertaken in an efficient and equitable manner is needed (Borrini-Feyerabend et al., 2000; Wilson, 2005). The capacity of stakeholders to prioritize issues, define and implement policies, and to make better-informed decisions for the sustainable use and management of natural resources should be developed. Policies may be implemented by a representative group of all the stakeholders. The enforcement of bylaws and rules governing access involves the use of various sanctions including fines, a ban from access to and use of resources, and the entire community watching out for violators of bylaws and rules - and reporting them to the right authority for sanctioning.

Case studies on conflict prevention

Examples of the development of representative groups include the case of the ‘Services Committee’ of Cahuita National Park, Costa Rica, which is composed of two government officials and three community representatives (Weitzner and Fonseca Borras, 1999). Another example is the 15 member elected representatives of the Community Forest User Group in Dhungeshori village in Dolakha district of Nepal, which is responsible for daily management of the forest (FAO, 2002b).

An interesting model for conflict prevention is illustrated by the procedure for land allocation in the village of Long Korn in Phukood District of Xieng Khouang Province, Lao PDR. The village is fairly remote and therefore not subject to outside pressures for land distribution. Most villagers returned after the war and have now begun re-establishing their livelihoods. Individual households were allocated land based on the labour supply in that household. The process of allocation involved community consultation and the community’s perception of

fairness. The small size of the village and the strong leadership of the village committee enabled the community achieve a consensus relatively easily. The fairness of the process of land allocation to households has enabled the community to prevent conflicts that are found in other communities (Hirsch et al., 1999).

- Consensus-building approaches require stakeholders to agree and develop innovative solutions. These should respect their social and economic needs, and their beliefs and attitudes in ways that everyone will be happy with. The development of negotiation capability and the capacity to recognize the importance of the common good of all stakeholders is required.
- Conflict resolution /Alternative Dispute Resolution (ADR) are collaborative approaches. They were developed in North America and involve conciliation, negotiation and mediation (Pendzich *et al.,* 1994; Moore, 1996). Through ADR, multi-stakeholder 'win–win' options are sought by focusing on the problem (not the persons or groups) and by the demonstration of interdependence among stakeholders (Buckles and Rusnak, 1999).

Conciliation or arbitration often involve a neutral third party communicating separately with disputing parties to reduce tensions and reach agreement on a process for addressing a dispute. The third party has legal authority to impose a solution. Capacity of institutions or individuals for communicating concerns of stakeholders to each other and reducing tensions among stakeholders is needed.

Negotiation is a voluntary process in which stakeholders meet 'face-to-face', in the presence or absence of a facilitator, to reach a mutually acceptable resolution of the issues in a conflict. It is necessary to develop the capacity of stakeholders to ‘let go’ of some entrenched positions on different issues to enable a mutually agreeable position to be adopted.

Negotiation Case Study

An example of successful negotiation can be found in Tanzania. When the Chumbe Island Coral Park was established in the early 1990’s fishermen were not happy about it becoming a protected area because of restrictions to their fishing activities. As they increased the pressure to fish in the area the management team engaged them in a series of discussions and dialogue to educate them about the benefits of protection for the area. In the process the villagers negotiated for, and obtained, preferential employment over people coming from urban certers. Villagers were trained as rangers by Chumbe Island Coral Park Their competence and dedication has brought infringement from users of the reef to a minimum (Riedmiller, 2000; Hoguane, 2005).

Mediation is another voluntary process which involves a neutral third party, a mediator, who helps the stakeholders in conflict jointly reach agreement by negotiation process. The third party however has no power to either give directions to stakeholders or enforce a solution in

the conflict. The capacity development requirements are the same as for negotiated settlement.

Case study: Mediation

During the decentralization period in Nepal (1989), most communities were given the forests in their communities to manage through community forest user groups (CFUG). In Dhungeshori village in Dolakha district, located 160 km east of Kathmandu some villagers began to encroach on community forest. A dispute ensued with the farmers and the CFUG decided to plant trees to demarcate the boundary of the lands they were supposed to manage. Further conflict with the farmers ensued. Hoping to reach an equitable settlement the CFUG general assembly decide to enter into negotiation with the farmers - but some farmers were not in favour, thus leading to a collapse in this method of resolving conflict. The CFUG then proposed the mediation of the conflict by a neutral representative. Both parties agreed that the district forest authority be asked to resolve the issues of the conflict. The forest authority called a meeting of representatives of the CFUG and farmers and presented them with a proposal for sharing the land under conflict. Both parties then agreed that the district forest authority mark the boundary between private and community forest. This resolved the conflict (FAO, 2002b).

While ADR may work in many western societies, it may not be the best approach in other societies. In some societies, openly discussing conflict can involve 'losing face'. ADR may also be counterproductive if the process only manages to mediate the differences among certain groups when the causes of conflict and obstacles to resolution are beyond their control. ADR may also result in a dependence on mediators for conflict resolution, to the neglect of building local capacity to do so. On the other hand in situations where structures for conflict management are non-existent ADR may well fill a much needed gap.

Challenge: To tackle lack of information flow and poor coordination amongst various public institutions sharing responsibility for oversight of natural resources. This may result in conflicting laws and regulations which are ignored by communities. In this situation administrative systems need to be improved. They should adopt an use an integrated approach so that laws and regulations of different institutions complement rather than conflict with each other. In addition there might be local/traditional/customary laws and regulations that also lack conformity with each other, thus causing users a dilemma on which laws and regulations to obey. These laws are often based on the cultures and property rights regimes of communities and therefore are complex and diverse.

Strategies /Options.

- Participatory approaches, including decentralization of decision-making and the engagement of the community at all levels of decision-making, could help resolve such

issues. However, it is important to appreciate the cultural norms of communities and to tailor the intervention to suit the circumstances (Baranyi and Weitzner, 2006).

Challenge: To work appropriately with relative differences in power among stakeholders in a conflict.

Strategies /Options.

- Less powerful actors could be trained to analyse problems and to formulate strategies for their resolution. However, engaging the most powerful actors in the exercise is often a challenge and sometimes requires violence by the weaker groups. Another challenging issue is how to enhance the capacity of weaker groups to effectively engage the more powerful actors in meaningful and constructive negotiation (Buckles and Rusnak, 1999).

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