Stakeholder Empowerment Through Knowledge-Based Sustainable Agriculture and Natural Resource Management

(SANREM CRSP)

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The Office of International Research, Education, and Development

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Stakeholder Empowerment Through Knowledge-Based Sustainable Agriculture and Natural Resource Management Systems

A. Technical Approach

Introduction

Virginia Tech is pleased to lead a strong consortium of U.S. universities, IARCs, NGOs, and private sector organizations in partnership with USAID to help achieve the targeted Strategic Objective (SO) and related Intermediate Results (IR). The Virginia Tech Consortium (VT Consortium) will support the EGAT/NRM/LRM's objective of increasing USAID and its partners' capacity to advance land management practices that provide long-term social, economic and environmental benefits for countries around the world. We will contribute to the achievement of all related Intermediate Results by strategically concentrating our program efforts in areas where land-grant universities offer a comparative advantage in providing cutting-edge research, education, and extension support. By recognizing and embracing our traditional role and the broad-based partnerships and roles other development partners must play to effectively promote sustainable agriculture and natural resource management (SA/NRM), we will maximize our impact as well as that of our partners. Our program, management approach, management structure, and capacity to achieve this impact are described below.

1. Overview of recent trends and critical issues

The research and technical transfer landscape of SA/NRM has changed enormously in the 12 years since SANREM was launched. To maintain relevance, the SANREM CRSP must change to meet new challenges and take advantage of new opportunities. Specifically, SANREM must be re-oriented toward a more appropriate role for a university-led consortium to play in the broad, complex, and multi-front development strategies dominated by large donors, private sector consulting firms and NGOs working in tandem with emerging host country leadership. This new role must recognize the major trends that have shifted the entire landscape. These include:

- SA/NRM-related issues have matured and become mainstreamed internationally. Today, virtually all stakeholders pay at least lip service to some SA/NRM principles and related action plans. Witness, for example, the Johannesburg Summit on Sustainable Development, the Convention to Combat Desertification, the Convention on Climate Change, the Cartegena Protocol, and innumerable lesser conventions and agreements at all levels. As a consequence, there is much more project and learning activity being undertaken all over the world.
- Although the Internet has greatly increased the potential to widely share new information generated by these activities, it has paradoxically made access to SA/NRM information and knowledge much more problematic. Much of the high quality information and knowledge demanded by stakeholders is lost in the disorganization of the Internet.
- New themes and stakeholder priorities have emerged at the same time that the thematic and disciplinary (holistic) integration of all areas has become the norm for every stakeholder working in SA/NRM. Unfortunately, the much larger number of actors, themes, and communication breakdowns makes this even more difficult.

Related to these mega changes in the SA/NRM landscape, expectations about what SANREM should become and what a land grant university-led consortium must bring to such a project have changed substantially. Sector strategies and EEP reports have helped to identify a number of relevant issues in past phases that must be addressed including the need to:

- Stress the importance of sustainable agriculture as the main driver in determining NRM strategies
- Integrate activities and synthesize lessons learned across intervention sites
- Share information and knowledge more broadly with the development community
- Ensure close coordination with USAID Mission programs through Mission buy-ins in intervention countries
- Open up the CRSP for an influx of new thinking, new partnerships and new strategies
- Integrate SANREM strategy into broader development strategies by building relationships with other development partners in order to achieve long-term sustainability of program outcomes

Despite these necessary changes, care must be taken to retain and build on the positive contributions made by previous phases of SANREM. Key stakeholders recognize that SANREM I & II were products of their times that made very substantial contributions to the science of SA/NRM. Among these contributions was strong validation for the general landscape orientation of much of the work. In addition, SANREM provided support for issues such as biodiversity, production and livelihoods as inter-related and cross-cutting themes that must be addressed within a range of general *areas of inquiry*. Recent trends in these areas of inquiry are discussed below followed by a listing of emerging critical issues where SANREM can play supportive and leadership roles and brief descriptions of where we plan to place our priorities.

Emerging and Critical Issues in Inquiry Areas

Technology Integration

The integration of new technologies into the research and technology transfer systems potentially offers much to further the development of SA/NRM systems. Below we discuss three such tools: biotechnology, geospatial information and spatial analysis tools, and other decision support tools.

Biotechnology is one of the most promising tools for the development of sustainable agriculture systems. The term should be interpreted broadly to encompass a wide range of biology-based tools and procedures ranging from the analysis of gene characteristics to the development of genetically modified organisms (GMOs) with novel characteristics. The development and use of GMOs are by far the most controversial aspect of biotechnology with serious food safety, environmental and market issues. Although GMOs are widely used in some developed countries, if they are to improve the livelihoods of poor people in developing countries, research must address "orphan crops" such as teff, pearl millet, sorghum, eggplant and pigeon pea. Traits of particular interest to the poor include resistance to production stresses such as drought, salinity, disease and pests, as well as nutritional enhancement (FAO, 2004).

However, before GMOs can be considered for widespread use in developing countries, decision makers and civil society must be educated about their potential benefits, costs, and risks. Biotechnologies that do not involve GMOs offer a more immediate and non-controversial potential for increasing food and fiber in a safe and sustainable manner. For example, genomics and molecular marking techniques are being used to identify varieties of banana with desirable characteristics. Clones may then be used to rapidly build up a breeding stock of the improved varieties. This process holds out much promise to control the fungal disease "black sigatoka" that has devastated smallholder banana farms throughout Central America.

Emerging critical biotechnology issues where SANREM can contribute include:

- Disseminating emerging science-based biotechnology and biosafety information related to food, environmental safety and market access and its consequences for SA/NRM
- Non-GMO biotechnologies and their potential to increase food security and SA/NRM
- Review of GMO technologies and issues for orphan crops benefiting the poor in developing countries

SANREM Priorities. We do not see any comparative advantage for SANREM to develop new biotechnology products or procedures. Instead, the project will liaise closely with projects such as the Agricultural Biotechnology Support Program II and the Program in Biosafety Systems. We will also coordinate closely with our IARC partners and their very significant efforts in these areas. The principal emerging issue where SANREM has a comparative advantage and will produce significant impact is in the area of biosafety outreach, particularly as it relates to the environment. The project will use its "honest broker" university status to organize, analyze, and disseminate unbiased scientific information and knowledge to inform the debate.

Geospatial information and spatial analysis tools, such as remote sensing and GIS have become indispensable data management and analysis tools in developed countries. Recent advances in computer hardware, the user-friendliness of new spatial analysis software, declines in the cost of hardware and software, and increasing access to the Internet and its data sources have made spatial analysis tools more practical for decision support in developing countries. Where spatial data are lacking, cheap and accurate Geographic Positioning Systems (GPS) tools may be used to collect what is needed. The use of such tools as well as support for emerging data and software standards is already being broadly promoted by projects such as the USAID's Geographic Information for Sustainable Development (GISD) and the Natural Resources Database (NRD), a public domain GIS developed for use in developing countries.

Emerging critical geospatial information and spatial analysis issues where we may contribute include:

- Use of GIS and spatial analysis tools to assist water associations in allocating scarce water resources for irrigation in Central Asia and Africa
- Promoting newly accessible GIS, remote sensing, and GPS technologies for improving SA/NRM at different landscape scales
- Fostering communication and coordination among projects, promotion of the development of software and data (including resolution) standards, and sharing of digital data to promote SA/NRM at different landscape scales
- Innovative strategies to integrate remotely sensed socioeconomic and biophysical data to promote SA/NRM technology transfer

Priorities. Given SANREM's mandate to assist scaling up, interdisciplinary research in this latter issue is of particular interest. In addition, we will make extensive use of these tools and data sources in our site intervention areas and will conform to all appropriate standards to facilitate collaboration with related projects.

Unlike geospatial tools, no consistent standards have emerged for ***other decision support tools and systems*** **(DSS)**. Literally hundreds of such tools and models (e.g., simulation, optimizing, expert) are available and, within the limits of their individual objectives and data requirements, offer great potential for understanding and improving SA/NRM in developing countries.

Emerging priority issues in DSS where we can contribute include making priority DSS tools and models accessible to decision makers at different landscape scales through training and outreach

Priorities. SANREM does not need to develop more DSS tools. Rather, given the large and confusing number of existing tools and the broad array of potential uses, the project should concentrate on identifying and applying appropriate tools in our activity interventions and supporting outreach and training efforts to inform and add value to existing DSS resources.

Governance

The principal governance issue has been, and continues to be, resource access and control. The adoption of SA/NRM technologies requires that the right institution offer the proper incentives for local investment (Meinzen-Dick and Di Gregorio, 2004). Property rights, however, are a function of power relations and negotiations between different groups claiming rights. Various individuals, groups, and the state make claims to different bundles of resource rights according to applicable treaties, statutory, customary, religious or organizationally-defined laws or rule systems (which are often contradictory). The dynamics of this legal pluralism has enormous implications for the adoption of SA/NRM technologies throughout the world.

For over a decade central governments have been decentralizing responsibility and, on occasion, authority to the local level and direct resource users (Ribot, 2002). Devolution has increased the opportunities for more active local participation in resource management decision making; however, it has not necessarily secured local access and control over those resources. Indeed, there is often considerable conflict over control of those resources. For individuals or groups to assert and sustain their claim to a particular bundle of rights, collective action is necessary. Building social capital and bridging relationships between groups and across institutions has been central to forging consensus within rural civil society.

Governments, donors, and NGOs have been quite active in creating or adapting these civil society organizations to develop networks and communities of practice for SA/NRM (Dietz et al, 2003; Moore, forthcoming; Ribot, 2002; USAID/AFR/SD, 2003). A number of lessons have been learned and need to be communicated.

Emerging critical issues in governance where SANREM can contribute include:

- The establishment of enabling environments for the growth of civil society organizations (CSOs) and their development of co-management agreements in the context of decentralization
- Identifying factors that foster sustainable (beyond project cycle) collective action
- Developing mechanisms whereby rural CSOs can be scaled up into larger federations for more extensive impact on NRM

Priorities. SANREM is well-placed to address all of these issues separately or in combination with other program initiatives. Initially, we will be most effective by providing the academic hub for gathering, organizing, analyzing, and disseminating related knowledge and lessons learned to our education networks and communities.

Economic Policy and Enterprise Development

Internal and external forces are driving developing countries to come to grips with a wide range of inter-related domestic and global issues impacted by economic policy and enterprise development. On the development assistance front, a new initiative from the U.S. government in the form of the Millennium Challenge program is providing a powerful incentive to "encourage economic freedom" through policy reform directed particularly at enterprise development. Meanwhile, the World Trade Organization (WTO), through its concluding Doha Round of negotiations, holds out at least the hope of reducing developed country agricultural subsidies that have greatly restricted agricultural imports and reduced economic growth in developing countries. Internally, civil society in many parts of the world is finding its voice and demanding transparency and change that will foster economic growth.

The promotion of agricultural enterprises to service niche markets is a strategy that holds much promise for developing countries. In particular, organic agriculture offers a system for improving ecosystem services (e.g., maintaining or

improving soil fertility, improving water conservation and quality, preserving natural and agro-biodiversity) while at the same time, providing price premiums that result in improved household incomes, food security and secondary generation of local employment. However, before they can take advantage of the benefits of export-oriented organic markets, developing countries face with a bewildering array of national, regional and international standards as well as high certification costs. Because it is knowledge intensive, producer training for niche and specialty crops is a time-consuming and costly investment at the local level. The market information needs for efficient production and distribution are large. Even where farmers are well versed in the production technologies associated with organic farming, the costs of international certification may prevent expansion beyond small local markets.

Emerging critical issues where SANREM can contribute include:

- Fostering enabling policies and broad-based training strategies to provide essential market and business development services (BDS) in support of upstream and downstream microenterprises that facilitate sustainable agriculture
- Optimal strategies for broad-based provision of market information including prices, standards, and risk. Optimal provision of related technical agricultural training related to targeted niche crops and value added products
- Enabling policies and training to support targeted eco-friendly industries (e.g. eco-tourism, non-timber forest products, product certification)
- Fostering policies, markets, BDS, and training support for niche markets offering the highest potential for supporting food security and SA/NRM goals. Developing strategies for maintaining 'first mover' economic advantages as the market matures and the niche supply significantly increases.
- Developing "alternative agriculture" income strategies consistent with SA/NRM in the coca growing regions of South America and poppy regions of Asia
- Emerging economies in the former Soviet Union, policy reform and implications for SA/NRM
- SA/NRM implications of "Relief to Development" (R2D) strategies

Priorities. SANREM has a strategic interest in all of these areas but is best placed to examine policy and enterprise development strategies for niche markets, particularly organic crop production and certification. In so doing we will liaise closely with regional IARCs and CG initiatives (e.g., the CPWF, IRRI for rice-based niche market systems, ICRISAT, IITA, ICRAF for dry, humid, and agroforestry niche markets in Africa, respectively) and private sector partners (World Cocoa Foundation for agroforestry niche systems) to develop coordinated programs. We will especially examine gender issues related to niche market development since these issues and impacts are not well understood.

Social and Institutional Capacity Building

The main attention of the international community working on SA/NRM has turned to the issue of technology transfer with the aim of overcoming technology and practice barriers to adoption. It is now recognized that the optimal technology transfer strategy is inextricably bound to the technology itself. There is no "silver bullet" technology transfer methodology; different technologies require different transfer methodologies. The type of message to be used at community-level will depend on its complexity. Simple messages can be propagated through the media; more complex ones may need personal contact or even long-term interaction such as farmer field schools. Experience shows that messages found useful and intelligible and which communities feel they 'own', gain a momentum of their own accord and this ensures their passage from farmer to farmer, community to community. The targeting of messages to women has been shown to be particularly important for dissemination, especially in the African context, where they play such an important role in farming. However this also applies in other contexts where their role may not be so obvious. The inclusion of women as professional farmers is vitally important especially for the percolation of information throughout the community (Harris et al 2003).

Training has been of considerable importance in preparing the human capital necessary for organizational leadership. Training in conflict resolution and consensus building has been particularly valuable for empowering local groups, as has training in transparent financial management, NRM laws, lobbying and new technologies. The demand for such knowledge is large and growing rapidly. Institutions and related networks within civil society that have the potential to positively impact SA/NRM are multiplying as never before.

Emerging critical issues where SANREM can intervene include:

- Efficacy, efficiency, and gender equity implications of new technology transfer and capacity building methodologies
- The implications of strategies investing in local (potentially unstable long-term) NGOs as key technology transfer agents
- The optimal use of sophisticated information and communications technologies (ICT) for different targeted populations (e.g., illiterate, women, extension workers, etc.)
- Optimal strategies for civil society leadership training

- Strategies for accessing and making available local knowledge bases
- Optimal local university strategies and curricula for impacting SA/NRM

Priorities. SANREM will address all of these issues separately or in combination with other program initiatives. The primary audiences for these knowledge and technology transfer efforts will be NGOs, administrative/political, university, private sector personnel involved in higher-level resource management. By improving curricula and training the trainers, the secondary audience, including landowners and farm/enterprise organizations, will be indirectly impacted. A significant proportion of the SANREM knowledge base including publications, fact sheets, pictorial booklets, etc. will be dedicated to addressing these issues. ICT tools will include web-based and distance-learning programs including degree and certificate programs.

Biodiversity Conservation and Environmental Services

A new definition of sustainable agriculture must evolve that recognizes its essential role in maintaining biodiversity and producing environmental services as well as producing food and fiber. Some innovative approaches leading to this re-definition are already well-known (e.g., eco-agriculture, permaculture, wildlife farming). The need here is to determine how to adapt them to a wide range of environmental settings and scale them up. New approaches will need to be developed. All approaches must link environmental management with the economic concerns of the local population under conditions of good governance.

Successful implementation requires planning and implementation at multiple scales. Biotechnology has assisted in habitat restoration or adaptation through the use of genetic markers to characterize area-wide populations. Approaches to field and farm management based on eco-agriculture (Scherr and McNeely, 2002) and analog forestry (Sennanayake, 1987) offer not only the opportunity for raising rural incomes but also restoring biodiversity. While these approaches and many others have been established in a variety of environmental niches around the world, the mechanisms by which they can be scaled up to impact global markets have yet to be determined. Certification systems and fair trade initiatives have something to offer in this regard, but the policies and system mechanisms need to be developed. The growing value of Non-Timber Forest Products (NTFP) for energy, food, feed, medicinal, and cosmetic products poes both a threat to these resources and a potential opportunity for income generation. The poor and women are disproportionally involved in these productive activities (Shively, 2004).

Payments for environmental services may come in a variety of forms, from direct payments to individuals for services or labor (food for work) to tradable allowance regimes (Pagiola and Platais, 2003; Rose, 2002). Land use practices providing carbon sequestration or improved watershed services may be identified with individual actions for which land holders could be paid directly as individuals or through local government or user groups. Alternatively, certain environmental services (e.g., habitat conservation) might be best provided through community-based management of common property resources. Resource size and complexity affects the potential successful implementation of the various alternatives. Transactions costs, validation of service performance, and formal market development are major concerns.

Critical emerging issues where SANREM can intervene include:

- Effective scaling-up strategies for successful small-scale biodiversity enhancement projects
- Poverty alleviation, gender and environmental management in biodiversity hotspots
- Use of biotechnology to protect biodiversity and improve environmental services
- New strategies to monetize non-market biodiversity benefits
- New strategies to promote inter-administrative district cooperation in protecting wide-area and multipurpose habitat
- Implementing alternative incentive systems to support provision of environmental services (e.g., carbon sequestration payments, NTFPs)
- Efficacy of emerging eco-agriculture strategies (e.g., co-management, forest islands and gardens, agroforestry)
- International biodiversity conventions and their impact on international trade and poverty

Priorities. No other inquiry area is so information rich and knowledge poor. SANREM's essential role is to use its comparative advantage to organize, synthesize, disseminate, and determine gaps in the knowledge base relating to this broad category. Specific research needs are wide-ranging. We will work closely with our IARC (especially, ICRAF and ILRI) and NGO (Winrock, Rodale) partners and the private sector to develop, test, and scale up environmental service payment strategies. Ongoing SANREM efforts to support and extract lessons learned from the NASA Carbon Sequestration Project in West Africa should continue.

Globalization, Vulnerability, and Risk

The consequences of globalization are pervasive for the environment as well as for societies and economies. Two areas are particularly relevant: trade and health.

Trade

Export-oriented production by smallholders can create competition among developing countries that is detrimental to the environment if there is a "race to the bottom". Countries are beginning to recognize that such competition is also damaging for them economically. For example, in recognition of current supply-demand imbalances in the robusta coffee market, Vietnam and Indonesia are currently negotiating a bilateral agreement to voluntarily reduce robusta area in both countries. The problems with commodity agreements are well known but as long as countries are pursuing the same (mature) export markets, the problems will remain.

Intra-regional trade can be an important vehicle for economic growth. It is common that developing country tariffs are quite high for goods they trade among themselves, which constrains the growth in developing regional trade. The explosion of free trade agreements and special preferences such as the Africa Growth and Opportunity Act has very important implications for trade and development policy, especially for the least developed countries. The SA/NRM implications of such agreements need critical examinations. Similarly, in Asia, China has become a huge economic center of gravity, and economists are aware that China's import/export policies will be an important driver of land use change in Asia in years to come.

Emerging critical trade issues where SANREM can intervene include:

- The consequences of export-oriented agricultural trade on SA/NRM: a race to the bottom?
- Developed country tariff policies and consequences for developing country SA/NRM
- Consequences of China's emergence as a trading giant on SA/NRM in neighboring countries
- International market development for environmental services and the role of universities in developing and monitoring compliance regimes
- The price and income risk consequences of open economies on resource poor farmers: implications for SA/NRM

Priorities. As a university-based project, SANREM is uniquely placed to conduct wide-ranging research programs in all of these policy areas. We will begin by building the necessary knowledge base and issuing related program RFAs for sub-awards.

Health

The global HIV/AIDS epidemic has emerged as a new challenge to food security and environmental stewardship. The scourge of HIV/AIDS is increasing exponentially. It is estimated that 42 million cases existed worldwide at the end of 2002, with 95% of these in developing countries (Rosengrant and Cline, 2003). Although the highest percentage of the population living with HIV/AIDS is still in sub-Saharan Africa, parts of Asia, especially Central Asia and India, have rapidly increasing caseloads. The African scenario demonstrates how strongly this syndrome affects agriculture and natural resource management. A recent FAO study in Zambia showed that HIV/AIDS has a very negative impact on gender-based differences in access to land, water, labor, technology, and credit.

AIDS has been responsible for an exponential rise in both female-headed and orphan-headed households, and in both cases those headed by females have significantly lower access to resources than the comparable male-headed ones. This is partly because of women's reduced access to human resources as well as lower educational levels, which are being prolonged in the next generation when girls are taken out of school to help with agricultural chores.

Malnutrition exacerbates the onset of AIDS among the HIV positive. Despite the depletion of forests and their declaration as preservation zones, the poorest households (i.e., those most affected by the AIDS epidemic) are forced to ignore the law and continue to plunder (Barany et al., 2003). Agricultural production is lower in AIDS-affected households and especially in female-headed ones. Moreover, the generation gap resulting from adult deaths negatively affects the passing-on of knowledge concerning traditional local production practices to the younger generation. This means orphan-headed households have a particularly strong need for technical training with respect to SA/NRM.

Emerging critical health issues where SANREM can contribute include:

- The SA/NRM and gender consequences of the global HIV/AIDS epidemic

Priorities. SANREM is well-placed to build on the information and knowledge bases surrounding this issue and lead related inquiries, either separately or in combination with other interventions. In so doing, we will work closely with the NGO community in the HIV/AIDS impacted areas.

2. VT Consortium Response: Program Vision and Overview

In response to recent trends and the wide-ranging critical issues presented above, the VT Consortium will guide the SANREM CRSP in becoming the recognized national and international *education* leader in SA/NRM by focusing on *knowledge-- its discovery, organization, and dissemination.* By so doing we concentrate our efforts on the traditional strengthens and comparative advantage of the land grant university system. We are in the knowledge business; we educate the leaders of tomorrow through our classroom, extension and outreach programs with today's knowledge, generated through leading-edge research organized to build tomorrow's insights and advances. By implementing this vision, we empower stakeholders including our development partners in both the U.S. and throughout the world.

This vision highlights our role in the SA/NRM development milieu. Other actors are much better suited to do broad-based, on-the-ground interventions and to plan and execute multi-dimensional development strategies. As a university-based consortium, we are best placed to help extract the knowledge learned from these interventions and strategies, help place it in its proper development context, organize it into the universal knowledge base, and disseminate it through our vast education systems, partnerships, and networks.

Under the VT Consortium, the SANREM CRSP will build on work and knowledge gained from the previous SANREM CRSP phases as well as the more general body of knowledge created around the world. Our program efforts will be organized through a novel landscape systems approach as described below.

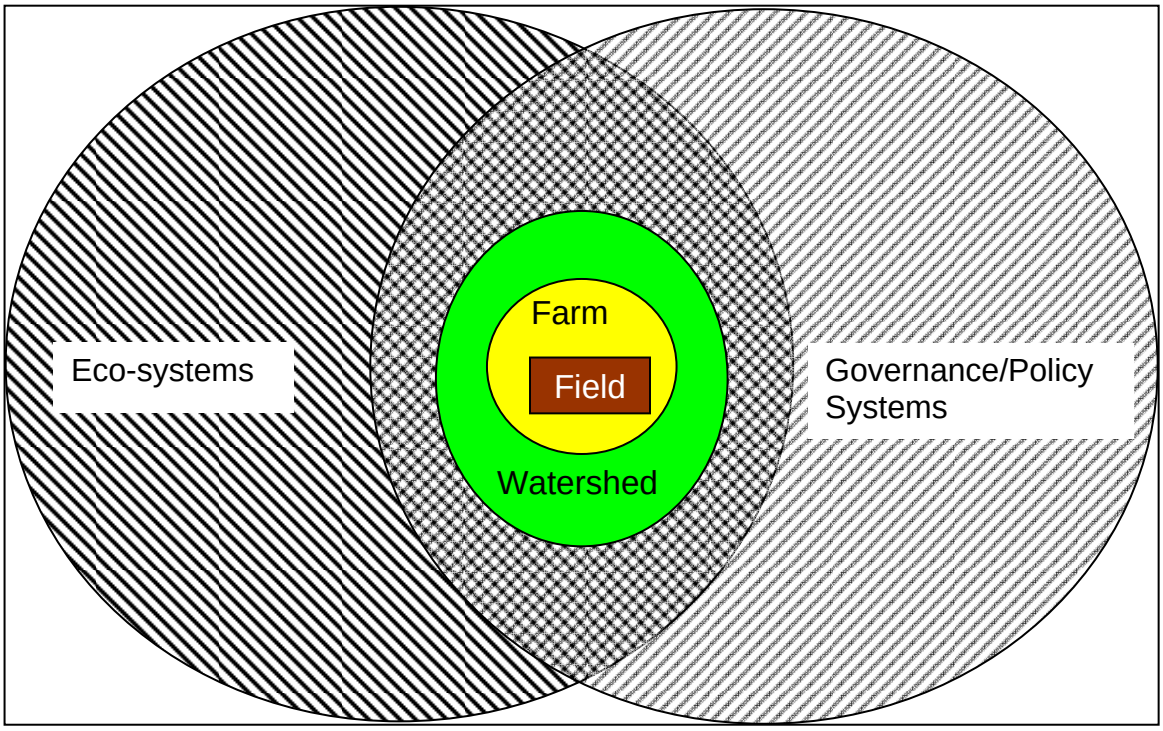


Figure 1: Nested Landscape Systems

SANREM III Landscape Approach. Figure 1 illustrates our view of the landscape complexity confronting SA/NRM researchers and stakeholders. Five landscape systems intersect and interact to impact SA/NRM. The systems are differentiated by the type of decision maker and the predominant incentives they face. The extent to which decision makers and incentives are different has very important implications for many aspects of SA/NRM including the appropriate types of technologies and practices and optimal technology transfer strategies. The systems and primary characteristics are:

Field/production unit-based systems which comprise the most basic systems. The trend to move away from the level of the farmer's field as a level of analysis in SA/NRM research notwithstanding, field-level production systems remain extremely

important. The decision maker is the field or unit manager who in many cases is distinct from the farm or household head. In West Africa for example, the same "exploitation" usually has a number of different parcels allocated by the head of household to its members. Wives, sons, and others often manage with great autonomy their different parcels and their respective outputs may be destined to satisfy completely different household needs. Thus, profit may be a motive but very often incentives are production related. On the same farm one may find that "cereal self-sufficiency" might be the primary decision driver for one manager while another may wish to maximize production of another crop subject to some minimum labor availability. Long-term planning horizons and implications of their decisions are less important at this level since their tenure or usufruct rights may be very tenuous. Field managers are often less well-educated than household heads and improved technologies, practices, and decision support tools may need to be less sophisticated. Gender considerations, particularly access to resources such as extension services, are often paramount in these systems. Scaling out of improved technologies follows an arithmetic progression: manager by manager. Consequently, mass extension campaigns may be most effective.

Farm/enterprise-based systems may include a number of fields or unit systems with activities under the same overall management control (although the manager may delegate responsibility to field/unit managers. The driving management incentive is achievement or maintenance of household livelihood. This may be achieved through a number of other (non-farm) strategies such as microenterprise development and more complex decision making to allocate household resources among different agricultural field/unit strategies. More complex strategies include the management of complementary and competing animal, crop, and agro-forestry systems. Decision support tools need to be more complex since strategies are more long term. Resource allocations within households are often gender issues and revolve around related power relationships. Scaling out is again an arithmetic exercise but often economies of scale in technology transfer may be facilitated by working through producer groups, farmer field schools and farmer-to-farmer strategies.

Farms/enterprises exist within one or more *watershed-based systems,* delimited by well-defined hydrologic boundaries that comprise complex social and biophysical interactions well beyond the decision-making control of individual heads of households. Incentives to manage watersheds are provided primarily by local recognition of the need to mitigate negative externalities caused by these dynamic interactions (e.g., silting of stream, gully erosion control, etc). Effective social organization and consensus building/conflict resolution are preconditions for effective decision-making. Essential system goals include planning and adaptively managing toward a shared watershed vision. Complex tools are often required to assist the planning process. Buy-in from disadvantaged groups and conflict resolution and leadership training are paramount. Long-term support and community confidence in local NGOs, government, and technical service providers is necessary. Unfortunately, watershed boundaries are virtually never coterminous with local government boundaries necessitating the creation of new "watershed management" organizations in order to proceed. However, the scaling out of new practices in watershed management can be geometric – practices building up horizontal scaling of micro-catchments to large watersheds to still larger watersheds.

Intersecting all of these systems is a virtually limitless number of *ecological systems* required for individual species or system preservation. The resulting biodiversity system is the most complex and problematic since it often deals with unknown technical parameters and non-market social values or undervalued environmental services. Complicating these factors even more is extreme diversity of critical geographic sizes or ranges for species ecologies. Some may be very small, sufficiently contained within a single field while others may require vast expanses of land extending over continents and oceans. As a consequence, decision makers in all systems with very diverse incentives may play crucial roles in biodiversity preservation and a multitude of strategies may need to be brought into play. Market forces and legal systems are the predominant determinants of long-term system viability although socio-cultural strictures may be very effective (e.g., sacred forests and mountains in West Africa and Asia, respectively). Scaling up strategies are species or system dependent. Decision support tools are varied and include detailed species inventories, sophisticated tools, and related policy studies. Ultimately, unless markets provide protection, the decisions and policies of governments determine which ecologies are priorities and how they will be preserved. Nevertheless, localities are becoming much more involved through community-based, buffer corridor planning and co-management activities.

The government or political administrative levels are the *governance and policy systems* that provide the enabling environment for the effective functioning of the other landscape systems. Foremost among the components of this environment are policies that affect the markets for related goods and services. However, the consequences of governmental, social, as well as economic policy on SA/NRM are pervasive. Because the consequences of decisions are so important, training for decision makers and civil society at the various levels is extremely important and decision support tools and policy analyses may be very sophisticated. Incentives are driven by the interests of the powerful at each level.

The VT Consortium proposes to use the above landscape typology because it allows us to identify and target key decision makers with interventions, build a nested and integrated knowledge base, and identify useful and measurable performance indicators. In addition, it offers three main organization and management advantages. These are:

- It helps us organize our program management and related interventions around a coherent set of principles for doing embedded systems work related to the targeted areas of inquiry. We will be better able to organize, integrate, and disseminate previous and newly acquired knowledge related to our systems.
- It takes full advantage of the expertise of individual researchers in our present and future partner institutions. By organizing around systems rather than institutions, we recognize and use the fact that relevant expertise in a specific landscape system is spread around the university system - it does not reside in just a few institutions. As a result, we will be better able to build the multidisciplinary and inter-institutional teams necessary to work effectively.
- It facilitates finding SANREM partners in the Missions and obtaining Mission buy-ins and Associate Awards that will advance both the SANREM and Mission's priority programs. Missions will seldom have a broad "sustainable agriculture and natural resource management" SO that would be an obvious and natural fit for a broad project like SANREM. Instead, they generally target their SOs and IR interventions to specific systems. Thus, it's much more likely that our nested landscape systems structure will allow us to "fit in" and add value to a strategic framework that includes a specific agricultural production SO (field-based), a rural livelihoods/microenterprise SO (farm/enterprise); a watershed management or 'ridge to reef" SO; a biodiversity SO; or a governance/policy SO. Our structure will permit us to readily identify and contribute to the Missions' specific performance indicators while also contributing to our broader, more systemic knowledge seeking and management approach. We will nest these system-level lessons learned and indicators into the holistic knowledge base.

Quick Startup Plan

The VT Consortium is structured to facilitate a rapid and efficient startup toward the new directions of the SANREM CRSP. The essential components and sequencing of the startup are as follows:

1. Project mobilization including ME staffing and quartering will occur virtually immediately after the cooperative agreement award since all proposed ME staff are current internal Virginia Tech employees.
2. The ME will prepare and issue invitations during the two weeks after grant signing to previous phase SANREM PIs as well as the broader university community soliciting high impact, short-term proposals that bridge to the previous SANREM phases. The concise five-page proposals will describe follow-on activities (12-18 months) that add value to previous accomplishments of the CRSP and may include related technology transfer activities, policy or impact studies. Former SANREM PIs will be especially targeted since they are best placed to suggest potentially high value and feasible follow-ons. A proposal to fund continuing SANREM support for the carbon sequestration research work in West Africa, funded principally by NASA (with previous SANREM support), is one example of a project that might be supported through this program. Proposals will be reviewed and recommended for funding by the Technical Committee (TC) within the first two months.
3. An initial Technical Committee (TC) meeting will be convened within 45 days after signing the award. Subgrants to initial partner institutions will be issued during this period. The TC will be composed of the System Coordinators representing consortium university members, a range of disciplines (social and biophysical), and the sustainable agriculture and NRM systems. Terms will be for two years, with a possibility of renewal. The responsibilities of the TC will be to provide the ME with technical advice concerning the landscape system, the technical merit of proposed interventions, and implications for program implementation.
4. The TC will immediately take up the business of assisting the ME in preparing an RFA(s) to fund up to 20 planning grants averaging about $50,000 each during the first year. The RFA(s) will be issued during the first quarter of the first year with a due date 30 days later. The planning grants will provide a "level playing field" for the university community to competitively generate a broad array of ideas and options for a rich and relevant long-term core program. In consultation with USAID, proposals will be sought for cross-thematic and landscape areas. Illustrative examples of RFA topics are presented in the previous areas of inquiry section. Proposals may also address comparative analyses of technologies, tools, applications across sites; and scaling up and technology transfer at the regional level.

   Planning grants proposals would involve:

   a. a 10-15 page proposal covering activities of 6-9 months
   b. a multidisciplinary, inter-institutional team
   c. specification of a SA/NRM problem related to the RFA
   d. a justification for site or sites
   e. a plan for developing institutional partners in a host country
   f. a plan for partnering with local NGOs

g. a partnership with at least one IARC
h. a monitoring and evaluation plan following the TOP framework (described below)
i. an areas of inquiry orientation (technology integration, governance, economic policy and enterprise development, social and institutional capacity building, biodiversity, system linkages, and globalization)
j. addressing cross-cutting issues (gender, knowledge management, scale, impact sustainability)

5. A three-person External Evaluation Panel (EEP) will convene to evaluate and make funding recommendations related to the planning grant proposals one month after the due date. The EEP will be composed of three SA and NRM experts from non-consortium universities representing both the social and biophysical sciences. The EEP will meet as needed to review competitive planning grant and long-term proposals (discussed below) and perform program evaluations. Long-term project proposal selection will also involve four additional non-consortium university members.

   Planning Grant Proposal review procedures will involve:
   - EEP recusals with replacement where appropriate to avoid conflicts of interest
   - a formal evaluation grid with specified point totals and space for comments. The evaluation forms will be returned to the submitting PI upon request at the end of the competition.
   - a quick turn-around
   - selecting up to 3 proposals in each RFA area

6. The planning grants will ultimately be the source of the project's long-term sub-award core program activities (3-4 years) that will be awarded based on a second stage of competition. At the end of year 1 the planning grant award winners will submit long-term proposals that will be evaluated by the EEP and other external experts following the rules given below. Based on the recommendation of the evaluation panel and with USAID concurrence, the successful 5-6 long-term projects will be approved for funding and subsequently launched in Year 2.

   Long term project proposals will be required to have the following elements:
   a. a plan for participant training (host country and U.S.)
   b. a multidisciplinary research team
   c. a plan for the utilization of participatory processes
   d. an approach that works at or toward a landscape scale
   e. involvement of multiple institutions both in the U.S. and developing countries
   f. host country NGO involvement
   g. a partnership with at least one IARC
   h. contributions to curriculum development in host country universities
   i. a monitoring and evaluation plan
   j. an areas of inquiry orientation (technology integration, governance, economic policy and enterprise development, social and institutional capacity building, biodiversity, system linkages, and globalization)
   k. address cross-cutting issues (gender, knowledge management, scale, impact sustainability)

7. An initial Board of Directors meeting will be convened within three months of project award to review established policies and discuss new policy initiatives.

Additional startup activities

In addition to bridging to previous SANREM activities and building a high quality, competitive long-term research program, the VT Consortium will immediately launch three other activities:

1. begin construction of the project knowledge management system with direct links to the Systems Coordinators, the SARE knowledge base, and the INFOMINE Scholarly Internet Resource Collections. The knowledge management strategy and system is described in Section B. Systems Coordinators will play key knowledge gathering and coordination roles for themes relevant to their respective systems. The Coordinators responsibilities include:
   a. Field-based systems. The Coordinator will serve as the point person for all work and relevant information/knowledge related soil fertility, soil/water interactions, soil erosion, and crop production. The Coordinator will liaise with commodity CRSPS and relevant IARCS.
   b. Farm/enterprise-based systems. The Coordinator will serve as point person for all farm-level systems work including integrated crop and animal systems, agroforesty systems and related microenterprise systems. The Coordinator will liaise with the system CRSPs (IPM, Global Livestock, Pond Dynamics) and related IARCS (ICRAF, CIFOR).

c. Watershed-based systems. The Coordinator will serve as point person for all watershed, 'ridge to reef' and water-related work including water association and irrigation association support. The Coordinator will liaise with all relevant water and watershed projects and IARC programs (e.g., IWMI, CPWF).
d. Ecology-based systems. The Coordinator will serve as coordinator for all biodiversity, environmental assessments, eco-tourism, biotechnology and biosafety work. The Coordinator will liaise with Agriculture Biotechnology Support Program (ABSP II), Program in Biosafety Systems (PBS), and related IARC work.
e. Governance/political systems. Coordinator will serve as point person for all policy, market, and governance-related work. The Coordinator will liaise with BASIS CRSP, IFPRI and others as appropriate.

2. Initiate the SANREM Technical Assistance Program. Limited funds that may roll-over from year to year will be set aside in the budget to provide demand-driven SA/NRM technical assistance in response to the Missions. The ME will publicize the program as well as the broad-based VT Consortium capacity to respond to technical needs in the SA/NRM area.
3. Initiate Associate Awards collaboration with the Missions (see Section B).

3. Program Impact

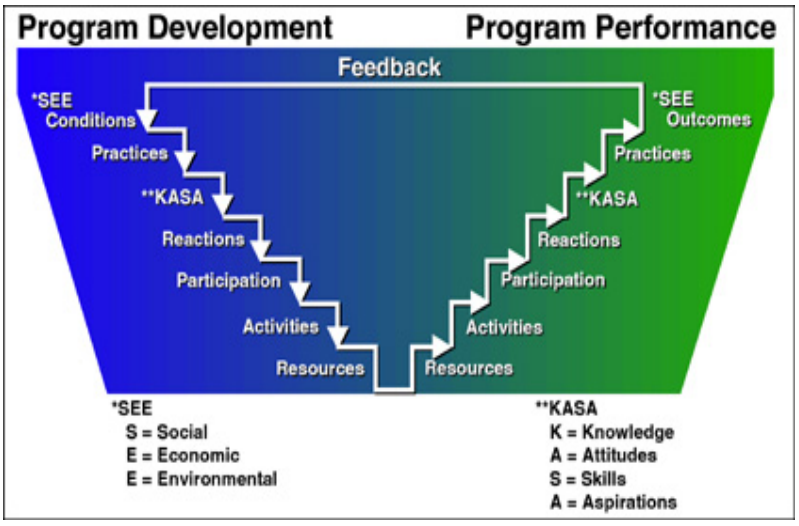
Assessment methodology

Impact assessment is integral to the VT Consortium's *empowerment through knowledge* approach to SA/NRM. In order to assure consistency and comprehensiveness, a standardized assessment system will be integrated into each SANREM CRSP program and project. This will accomplish three purposes: (1) provide feedback to US and local partners concerning what works, what doesn't, and what needs to be done; (2) provide comparative information to draw conclusions across sites and circumstances increasing global knowledge transfer; and (3) provide indicators demonstrating impacts and progress toward the Land Resources Management Team Intermediate Results.

Project assessment and reporting will be structured by the Targeting Outcomes of Programs (TOP) framework (http://citnews.unl.edu/TOP/english/index.html). This framework will guide the development of research proposals, reporting of activities, and help structure the SANREM III web-based Knowledge System. The seven-level framework will also be adapted to the systems structure of SANREM III to aggregate and facilitate comparisons between project interventions and results.

The diagram of the TOP hierarchy (Figure 2) describes the process of program (or project, activity) development and assessment. The descending levels on the left sequence and describe program development steps, while corresponding ascending steps on the right depict intervention performance.

Figure 2: The TOP Seven-Level Hierarchy



In the figure, the analysis of the Social, Economic and Environmental (SEE, or correspondingly, nature, wealth and power) level provides the starting point and an initial impact orientation for program development. The SEE initial conditions describe the problem situation with regard to the three key general elements and will look for long-term impact in terms of such indicators as biodiversity and landscape health, the state of women, children, and other disadvantaged groups, poverty levels and food security, and governance and resource access. Descending one level, current practices are analyzed at the ecosystem, governance, watershed, farm or field-based system levels through Knowledge, Attitudes, Skills, and Aspirations (KASA) assessments. This step will often provide some form of quantitative baseline (*ex ante*) data that, at the corresponding performance stage (*ex post*), will provide the basis for assessing intermediate change or impact. It is not expected that every research project will collect primary data at this step since often sufficient secondary data is be available from previous research or key informants to make this initial KASA assessment.

The KASA results are analyzed in the next step in conjunction with broad-based participation of stakeholders. The resulting specific description of constraints leads to plans for collaborative activities to address priority problem areas. In the last program development step, resources are committed and employed in the planned intervention.

The performance assessment begins immediately upon program initiation following the ascending TOP steps. The efficiency of resource inputs in generating activity outputs is the initial performance measure. Participation levels and reactions of stakeholders are additional and subsequent performance measures that are usually captured by activity monitoring systems. The KASA provides intermediate performance indicators of activity results. If knowledge, attitudes, skills and aspirations have been modified sufficiently by the intervention, practices change and the ultimate impact on SEE is brought about. It is often desirable to specifically examine impact through formal economic impact assessments at the SEE level. The indicated changes in economic surplus provide a broad-based measure of changes in social welfare that extend well beyond simple practice adoption rates and income measures. The use of the TOP framework will facilitate VT Consortium work in this area.

The TOP system will be adapted to suit each specific project activity. Activities will choose which steps to concentrate on, depending on the type of activity and its intervention level. Some activities, such as the planning grants, will work only on the program development side of the TOP, emphasizing the last four steps while planning to fill any holes in KASA data after a successful long-term proposal bid. Long-term sub-awards will build on the program development of the planning grants by filling any KASA holes and then concentrating on performance steps. In this way, the TOP framework will provide structure that can be used for conceptualizing different levels of project development and assessment. Using this framework will permit the program to carry out standardized assessments of all project activities and align indicators consistently to assess SANREM III impacts and the processes leading to them.

Illustrative targets and indicators based on the TOP hierarchy:
Indicators at the SEE, practices, and KASA levels are used to identify outcome objectives as well as measure long-term impact. These indicators must also serve for planning data needs and collection procedures. Indicators at the practices level target overt stakeholder actions. Implied changes in practices can be measured relatively soon after specific project interventions occur by examining changes in KASA variables. For ultimate performance impact at the SEE level however, long-term practice adoption rates are the minimum data required.

Listed below are key targets, illustrative indicators of impact, and benchmarks of progress that the SANREM CRSP and USAID can use in assessing the extent to which project activities will contribute to the EGAT/NRM/LRM goals. We have also indicated where appropriate which landscape systems will provide the critical data for the indicators. In general the VT Consortium project elements and IRs align as follows:

1. Scientific knowledge and land resource management IR: field, farm, and watershed-based systems
2. Improved knowledge management IR: overall project implementation and management
3. Reformed and strengthened governance and policies IR: ecosystems and governance systems
4. Sustainable resource-based enterprises IR: watershed and governance systems

Specific targets, illustrative indicators (and relevant landscape systems), and benchmarks are as follows:

Target: increased scientific knowledge and technical innovations in sound land resource management as indicated by:

- improved approaches to soil, water, and crop management (field, farm)
- increased number of hectares under improved management (watershed, ecosystem)
- increased agriculture, fisheries and forestry production and income (farm, watershed)
- increased biodiversity and environmental services provided (watershed, ecosystem)

- greater understanding and use improved soil and water management technologies (field, farm, watershed)
- improved seed varieties disseminated (farm, watershed)
- improved nutrition (farm)

Benchmarks Year 1: landscape systems knowledge bases developed, gaps determined; Missions with SOs and programs where SANREM can add value identified and approached; carbon sequestration potentials of improved pasture management determined.
Years 2-5: Specific benchmarks to be determined by selected sub-award projects and Associate Awards.

Target: improved knowledge management and communication leading to behavioral changes in adaptation and adoption of new technologies and practices as indicated by:

- linkages with USAID/IFPRI's Strategic Analytic and Knowledge Support System (SAKSS) for Africa and adapting it for other regions
- linkages with SARE and INFOMINE developed
- development of a web-based SA/NRM knowledge system
- development of a listserv newsletter for SA/NRM apprising recipients of new producer technologies and methodologies in the field and relevant IARC and national system developments
- number of graduate students trained
- number of publications and technical communications
- number of NGO staff and government extension agents trained in innovative and empowering technology transfer methodologies
- increased participation of women and disadvantaged minorities in all activities in order to facilitate communication within local communities

Benchmarks Year 1: landscape systems knowledge bases developed; linkages with SAKSS, SARE and INFOMINE established; SA/NRM web-site up and running; listserv newsletter functioning on a quarterly basis; five graduate students begin training; at least 5 articles published.
Years 2-5 Specific benchmarks to be determined by selected sub-award and Associate Award projects.

Target: reformed and strengthened governance, policies, and local institutions as indicated by:

- increased capacity and willingness of communities to collaborate in managing watersheds and other cross-boundary landscapes (watershed, ecosystem, governance)
- strong grass-roots groups able to conduct their own initiatives (watershed, governance)
- improved synergy between civil society and local and national governments (governance)
- active and successful national associations and federations (governance)
- improved tenure laws/policies that will encourage sustainable management of natural resources (governance)
- strengthened capacity of project participants, especially CBOs and governments to make informed decisions on how best to utilize participatory and empowering strategies at the country-level (governance)
- increased sensitivity of local governing units to gender issues and to those of disadvantaged minorities (watershed, governance)
- improved transparency, accountability, predictability and participation in local governance (watershed, governance)

Benchmarks Year 1: governance, ecosystem and watershed landscape systems knowledge bases developed; Missions with SOs and programs where SANREM can add value identified and approached; linkages with national associations and federations in targeted countries established.
Years 2-5 Specific benchmarks to be determined by selected sub-award and Associate Award projects.

Target: sustainable resource-based local enterprises functioning in national, regional, and global markets as indicated by:

- Increased numbers of organic farms and non-farm enterprises in intervention areas (watershed, governance)
- Increased numbers of producer groups marketing together (watershed, governance)
- Increased numbers of certification programs and certified producers (governance)
- Increased volume and value of agro-forestry and NTFP products marketed (watershed, governance)
- Strengthened farm-to-market linkages (governance)
- Increased incomes from sustainable agriculture (farm)
- Increased value-added products from SA/NRM (farm, governance)

Benchmarks Year 1: Missions with SOs and programs where SANREM can add value identified and approached; farm/enterprise system-level knowledge base developed; farmers trained in organic crop production and marketing.
Years 2-5 Specific benchmarks to be determined by selected sub-awards and Associate Award projects.

4. Virginia Tech Technical Accomplishments and Ability to form Strong Collaborative Partnerships

Virginia Tech has a long and distinguished record of collaborative research in SA/NRM with developing country institutions. Over the course of the last decade, this research has been conducted in 24 countries of Africa, Asia, Central Asia , Eastern Europe and Latin America involving over 40 host country institutions (NARS, universities, NGOs, etc) and 20 U.S. universities (both 1862 and 1890 institutions).

At the outset of SANREM CRSP Phase II, Virginia Tech took over and revived a moribund West Africa program. Although funded at a much lower level than the other SANREM sites, a full interdisciplinary research program was implemented in Mali in collaboration with Washington State University, the NARS (*Institut d'Economie Rurale*) and both local and international NGOs (*Groupe de Recherche et Action pour la Développement* (GRAD) and CARE/Mali). In the course of Phase II, SANREM CRSP West Africa Team published 1 book (17 chapters), 3 journal articles, 18 working papers, and made 42 conference presentations. Four graduate students completed degrees. Collaboration has included regular information sharing with INSAH, CIRAD, ICRISAT , ICRAF, and IFDC as well as NARS researchers and NGOs from other West African countries.

SANREM CRSP-West Africa developed a research program addressing NRM conflict issues directly, through building mediating institutions and conflict resolution capacity, and indirectly, by providing accurate data and tools for agricultural and natural resource management decision-making and scaled-up policy dialog. The innovative Natural Resource Management Advisory Committee (NRMAC) built social capital within the community and the region for improved land use management planning and sustainable agriculture, bridging relationships between villages and with government services and local authorities. Collaborators established a multi-year, geo-referenced database of weather, soil, cropping system, land use, and water-point data, which provided the basis for decision-making tools to determine sustainable production systems and immediate economic impacts of soil fertility and forage management innovations. The application of GIS tools, soil, crop and climatic models has allowed the projection of 30-year impacts of various soil fertility technologies. Paddocking of animals on fields proved to have the greatest yield effect under the variable rainfall conditions of the Sahel. Among the most significant contributions to human capacity development during Phase II has been the development of conflict management skills among community members, researchers, and NGO collaborators.

IPM CRSP: As Management Entity of the Integrated Pest Management CRSP over the last 11 years, Virginia Tech has managed a program of collaborative research in 10 countries, directly coordinating the collaborative research activities of more than 21 developing-country research institutions and 14 U.S. universities. The IPM CRSP Team has published more than 117 refereed journal articles, 3 books, 26 Working Papers, 29 extension publications, and more than 164 conference proceedings. The long-term training program has led to 21 PhDs, 49 Masters Degrees, and 10 Bachelors degrees.

Demand for IPM CRSP Consortium services was very strong during Phase II. At six of the eight primary sites, the USAID Missions have requested assistance amounting to more than $5 million in additional funding.

Virginia Tech was selected to coordinate the NRM InterCRSP for West Africa. This seven-year initiative linked seven CRSPs to leverage their multidisciplinary expertise and experience to increase and disseminate the number of techniques available for sustainable use of natural resources in West Africa. Researchers from the Universities of Hawaii, Nebraska, Alabama A&M, Iowa State, Michigan State, Purdue, and Virginia Tech joined with researchers from the NARS of Burkina Faso, Cameroon, Cape Verde, Chad, The Gambia, Mali, Niger, Senegal, Mauritania, Ghana and Guinea-Bissau and development practitioners from the international NGO World Vision to develop and test three models for collaborative regional research and technology transfer. Close collaborative relationships were established and maintained throughout the project with the Institut du Sahel (INSAH) and the Sahelian-led NRM Research Pole. Twenty-three technologies were disseminated beyond their country of origin to the wider region often with the assistance of local NGOs acting as technology transfer agents. This fruitful exchange of information and technologies has led to the creation of sustained regional synergies and complementarities in the area of NRM and production systems and led to the publication of many journal articles, extension publications, and one book.

Virginia Tech also coordinated the Pest and Pesticide Management Project (PPMP) in the Ukraine. The Pesticide Safety and Integrated Pest Management Training and Demonstration Centers set up by the PPMP were reinforced by collaborative research projects between U.S. and Ukrainian plant protection specialists. This research was essential for the development

and adaptation of IPM techniques and practices to Ukrainian conditions as well as furthering scientific knowledge relevant to American agriculture. American and Ukrainian researchers published 30 research and extension documents as the result of six sponsored research projects, including a book-length Guide for Integrated Pest and Diseases Management Systems for Orchards in the Western Regions of Ukraine.

In collaboration with its partners (Purdue; Ohio State; Penn State; US EPA; the State Commission on Testing and Registration of Plant Protection Products, Growth Regulators and Fertilizers; the Central State Station for Soil Fertility and Plant Protection; Oblast Plant Protection Stations; the Ukrainian Crop Protection Association; Ukrainian Academy of Agrarian Sciences (UAAS) Agricultural Research Institutes; and State Agricultural Universities), OIRED/Virginia Tech strengthened the network of national and oblast pesticide safety and integrated pest management institutions. With a primary focus on pest and pesticide management, the first wave of training involved 710 farmers and local plant protection specialists. Training activities continued totaling more than 4,700 individuals with 1,169 Pesticide Applicator Certifications issued.

5. Training and Institutional Capacity Development

Building on the Land Grant university tradition, the VT Consortium will implement an innovative training and institutional capacity building program to address the range of training needs associated with SA/NRM technology generation and transfer. Our strategy will: (1) develop appropriate training programs; (2) assure that research and training benefits both the U.S. and host countries; and (3) target especially women participants.

Integrated research, education, and outreach programs will animate all SA/NRM activities. All long-term projects will be required to develop a plan for participant learning and education that supports the research objectives necessary to achieve USAID objectives. During the competitive proposal evaluation process, emphasis will be placed on identifying training programs that are *innovative and cost-effective.* The use of new tools in information and communications technology (ICT), especially distance-delivered and on-line university level courses, will be encouraged. A combination of short and long-term (degree) training for host–country researchers, extension and other front-line personnel will be used to promote more effective technology generation and transfer. Training will focus on meeting critical needs and gaps that complement and support host-country efforts.

Our program will ensure sustainability by providing the next generation of scientists and development practitioners with essential SA/NRM knowledge and skills. Maximum sustainability will be ensured by working with host country establishments of higher education on curricula development for courses on SA/NRM-related subjects that will include the newly gained knowledge necessary for the improvement of the particular landscape systems. Host country participants trained in the U.S. will contribute to building their own institutions through course and curriculum development, where necessary along with U.S. university faculty. Furthermore, U.S. institutions will support host-country institutions in improving internet access so as to enable them to make use of the project's web-based knowledge system. This multi-pronged approach will guarantee maximum impact and sustainability of our training programs.

Long Term Training

SANREM III will use degree training to strengthen the technical skills of researchers and teachers from host country universities, NARS, and relevant ministries. While developing a global knowledge base in US universities, we will be addressing specific host country SA/NRM questions, opportunities, and constraints.

Initial long term graduate training will focus on building the knowledge management systems under the supervision of the System Coordinators. Subsequent long-term training will be linked to specific long-term sub-award projects targeting key host country issues. In order to ensure sustainability and expand program impact to the maximum, emphasis will be laid on networking developing-country educational establishments with their national research systems (NARS) and regional IARCs and developing capacity for them to undertake further knowledge production and dissemination.

The program will facilitate and support collaborative research and extension programs through enrollment of researchers in targeted degree programs. We will lay the groundwork for a new model for training the next generations of scientists, teachers and extension educators. Our approach includes:

- Curriculum development at host country universities
- Sandwich degree programs: By ensuring the research component is carried out within the host countries, degree training will be less expensive and scientists will be taken out of their systems for shorter periods
- On-line degree training: Enrolling students in Consortium graduate degree programs such as Virginia Tech's on-line Master of Science in Extension degree program

Short-Term Training

Short-term training programs will be demand-driven, linked to long-term program goals and will target professionals at different levels. Illustrative programs include:

- State-of-the-art research and research methodologies in priority disciplines
- Innovative new bio-friendly technologies
- Sustainable agricultural practices
- Cutting-edge approaches to technology transfer and communication principles for behavior change
- Niche marketing and certification programs
- Governance and policy issues

The ability to develop relevant and innovative short-term training methods will be a key criterion in the evaluation of proposals for long-term projects. Short-term training will take place in-country or within the region wherever possible, otherwise collaborating partners will be trained in the US. Potential recipients of short-term training include university or institute researchers, government policy makers, extension and NGO workers, community leaders, and local government representatives. Both long-term and short-term training will make use of specific course modules developed by U.S. university partners. Students will be able to choose among modules, depending on relevance to their own specialty and receive a certificate for completing, for instance three modules out of six on offer. An illustration of what we can offer for this type of short course is North Carolina State's Center for Environmental Farming Systems (CEFS) which offers a module-based training for extension personnel (training the trainers), researchers or policy-makers. In addition, CEFS offers an 8-week summer training program in sustainable agriculture that draws students and researchers from around the world. The development of intensive stand-alone modules will be encouraged so that participants will be able to benefit from any one module, or any combination of modules on different subject areas and in different locations.

While the details of individual programs will be unique to the proposals submitted, some core principles can be outlined. Module content must be directly and practically relevant to the needs of host-country researchers, extension workers and/or teachers. Teaching methods should in addition be transferable to the host-country students so that they gain not merely knowledge but also effective skills for transmitting knowledge to their own trainees upon return.