



Global Environmental Change and Food Systems

Southern Africa Science Plan and Implementation Strategy

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Executive Summary

Social, economic and political factors are increasing food insecurity in southern Africa. Changes in the environment (Global Environmental Change, GEC) are further complicating what is already a food insecure situation for many.

A three-year consultation and planning exercise has identified the need for, and necessary components of, an integrated research endeavour on the links between southern African food security and GEC. The exercise, organised by the international research project Global Environmental Change and Food Systems (GECAFS), involved a diverse group comprising regional researchers, regional and international organisations and donors, and culminated in the preparation of this Plan for a GECAFS southern Africa project (GECAFS-SAF). Recognising and building upon ongoing national and regional GEC and food security research, the Plan provides a strategy to deliver policy-relevant information about the interactions between GEC and the food systems that underpin food security.

The goal of GECAFS-SAF is to determine strategies to cope with the impacts of global environmental change on southern African food systems and to assess the environmental and socioeconomic consequences of adaptive responses aimed at improving long-term food security.

GECAFS-SAF research will identify the social and geographical distribution of the vulnerability of the region's food systems to GEC in the context of other stresses. Based on these new insights, collaborative research with regional stakeholders will evaluate how, when and where adaptations to food systems can be instituted to reduce their vulnerability to GEC while also being in line with long-term national and regional developmental goals. Research will also assess the long-term social and environmental consequences of different potential adaptation measures designed to enhance regional food security. In addition to addressing regional priorities, proposed research is also fully consistent with the international GECAFS conceptual and methodological research agenda and will be networked with other GECAFS research worldwide.

GECAFS-SAF will be implemented over five years via:

- (i) selected Case Studies across the region, each addressing the food systems questions relating to GEC vulnerability and impacts, adaptation options and feedbacks;
- (ii) Regional Scientific Networking, to link case study research with other relevant research in the region and internationally; and
- (iii) a Science-Policy Interface, linking national researchers with policymakers, the private sector, civil society and representatives of regional food security programmes.

Research will be organised into defined phases with clear outputs at each stage. When integrated, outputs will provide policy-relevant information at both local and regional levels with the communications strategy underpinned by stakeholder engagement at all research stages. Research capacity will be developed by collaborative research within the international GECAFS project.

A GECAFS-SAF Regional Fund will be established to cover case study research (via regional calls for proposals), regional networking activities, the science-policy interface and research management. A GECAFS-SAF Regional Steering Committee (RSC) will be established to provide scientific oversight and manage the Fund. A GECAFS-SAF Regional Coordinator will be appointed. The "Food, Agriculture and Natural Resources Policy Analysis Network" (FANRPAN) will serve as the regional host institution.

The GECAFS Southern Africa Science Plan and Implementation Strategy offers an innovative and timely research framework on improving regional food security in the context of environmental stress. This is an issue of growing importance for the region.

GECAFS-SAF provides an integrated approach to food security and GEC research in southern Africa. It

- is based on a comprehensive set of research questions derived from wide regional consultation;
- directly addresses the stated information needs of regional policy and development agencies;
- builds on, and adds value to, existing research findings and infrastructure;
- networks researchers both regionally and internationally;
- contributes to an internationally endorsed research agenda; and
- proposes and justifies the establishment of a regional research fund, administered by an appropriate institution with a regional mandate.

GECAFS-SAF will contribute to a number of major food security initiatives in the region and support both local interests and those of major regional activities (e.g. COMESA, FARA, NEPAD and SADC-FANR). It will also constitute an integral component of the internationally-endorsed GECAFS agenda. Principal outputs will include:

- improved understanding of how GEC will additionally affect food security across the region and among different socioeconomic groups;
- assessments of how adaptation strategies designed to cope with GEC and changing demands for food will affect the environment, societies and economies;
- enhanced regional research capacity in food security and environmental issues;
- strengthened regional policy formulation capacity for food security and environmental governance; and
- policy recommendations for adaptation options.

1 Southern African Food Security and Global Environmental Change

Social, economic and political factors are increasing food insecurity in southern Africa. Changes in the environment (Global Environmental Change, GEC) are further complicating what is already a food insecure situation for many. The technical and policy interventions required to prevent the region's food security from worsening further (and therefore becoming even more dependent on outside assistance) need to take account of GEC. Interventions must consider three issues: (i) how GEC will further complicate food security across the region; (ii) the feasibility of policy and technical adaptation options at both regional and local levels; and (iii) the socioeconomic and environmental consequences of different adaptation options designed to improve food security.

1.1 Regional food security, GEC and the policy context

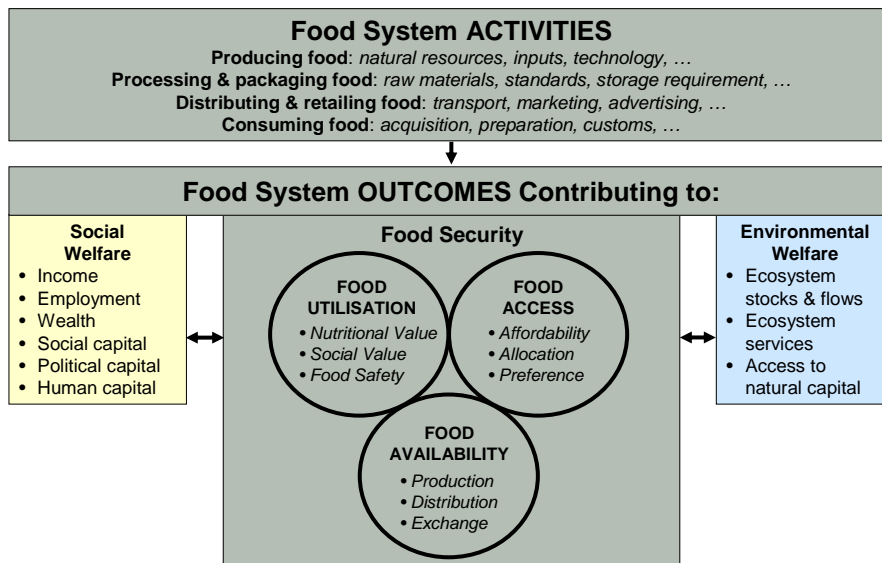
Food insecurity in southern Africa is increasing. Key indicators are the rising levels of chronic and severe malnutrition and rates of stunting in children (SADC RVAC Five Year Plan, 2005). Historically, food insecurity has resulted from a combination of factors, including inter alia changing demographics, poor agricultural infrastructure and widespread poverty. HIV/AIDS is now making the situation even more complex, further weakening the capacity for governance, increasing inequities in land distribution, and marginalising southern Africa in the global economy. While this situation is not atypical of the rest of the African continent, four of the ten southern Africa countries are classified as 'medium' and six as 'low' in the Human Development Index. Eight are listed in the lowest 20 of all developing countries in the Human Poverty Index (UNDP, 2005). The number of 'food surplus' countries in the region has decreased over the last decade. Food production has stagnated or even declined in countries such as Lesotho, Malawi and – most recently – Zimbabwe, resulting in their dependence on food aid (Arntzen, et al., 2004). Recent assessments have identified that over 10 million people in Zimbabwe, Malawi, Zambia, Mozambique, Lesotho and Swaziland are likely to face food shortages in the period up to April 2006 (DFID, 2005).

Against this background of socioeconomic-induced food insecurity, global environmental change (GEC, Box 1) is adding further stress (Misselhorn, 2005). Recent climate assessments conclude that the region will become warmer and drier (Hulme et al., 2001); a temperature increase of 2-5°C is predicted over coming decades (IPCC, 2001, Chapter 10-Africa) and increasingly-variable rainfall is anticipated, with the region becoming generally drier, especially in the east (Scholes and Biggs, 2004). An increase in extreme events (both droughts and floods) is also anticipated (IPCC, 2001; Tyson et al., 2002). As many farmers are dependent on rainfed agriculture (including animal grazing) concerns about how these climatic changes will affect the region's food systems are increasing (Hulme, 1996; IPCC, 1998; 2001). Non-climatic GEC factors are also of concern. Widespread land degradation is rapidly eroding the capacity of the region's ecosystems to support food production (USAID-RCSA, 2003). Losses in land cover, biodiversity and freshwater supplies increase the uncertainty about both agricultural food production and availability of veld products. (Many people rely on insects, small animals and birds for protein in drought years; Dube and Sekhwela, in press; Scholes and Biggs, 2004.) Loss of veld products will be exacerbated by fierce fires which are likely when periods of above-average rainfall (which produce large biomass fuel loads) are immediately followed by periods of dry, hot and windy weather (Rutherford et al., 1999). This further loss of habitat will further threaten livelihoods dependent upon the associated biodiversity.

Box 1: Definitions of GEC, Food Systems and Food Security

Global Environmental Change (GEC) includes changes in the physical and biogeochemical environment, either caused naturally or influenced by human activities such as deforestation, fossil fuel consumption, urbanisation, land reclamation, agricultural intensification, freshwater extraction, fisheries over-exploitation and waste production. GEC issues of particular relevance for southern Africa include changes in: climate variability & ENSO, climate mean values, water availability and quality, land degradation and biodiversity, and sea currents and salinity.

Food Systems encompass (i) activities related to the production, processing, distribution, preparation and consumption of food; and (ii) the outcomes of these activities contributing to food security (food availability, with elements related to production, distribution and exchange; food access, with elements related to affordability, allocation and preference; and food use, with elements related to nutritional value, social value and food safety). The outcomes also contribute to environmental and other securities (e.g. income). Interactions between and within biogeophysical and human environments influence both the activities and the outcomes (see figure below, from Ericksen, 2007).



Main features of food systems

Food Security is the state achieved when food systems operate such that ‘all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life’ (FAO, 1996). Food security is underpinned by food systems and is diminished when food systems are stressed. This stress can be caused by a range of factors in addition to GEC (e.g. conflict, changes in international trade agreements and policies, HIV/AIDS) and may be particularly severe when these factors act in combination.

GEC will have many implications for Africa, but the links between GEC and food security (Box 1) were identified as one of the top priorities for the continent by the 2005 AFRICANESS workshop¹. Given the socioeconomic and GEC issues mentioned above, the food security situation is particularly critical in southern Africa. Even without the added climate-related GEC concerns, links between food security and environment are of great importance for southern Africa. About 70% of the 200 million people in the region rely on their immediate environment for food security, either from agriculture and fishing, or from *veld* products; and over 80% rely on biomass energy (Yirdaw, 1996). Despite this high reliance, high population growth (3.5% on average over 1975-2003; UNDP, 2005) and migration to less favourable areas, low and volatile economic growth (1.9% in the period 1992-2003, with a range from -2.4% during the 1992 drought to a peak of 4.6% in 1996; Arntzen *et al.*, 2004) combined with poor environmental, natural resources and agricultural policies are resulting in the depletion of key land resources.

Ongoing attempts by SADC and some committed governments and international partners to address and relieve the massive food insecurities in the region offer hope for meeting some of the Millennium Development Goals targets for the region. For instance, the Declaration and Plan of Action from the 2004 SADC Summit on Agriculture and Food Security² is designed to promote agricultural development to help achieve food security. It forms a key component of SADC's 15-year Regional Indicative Strategic Development Plan (RISDP) (SADC, 2004; SADC RVAC, 2005). The RISDP also highlights sustainable food security, and environment and sustainable development as key aspects. However, despite the concerns reflected in the international GEC literature and from various UNEP programmes, GEC-issues are not a priority in national development plans in southern Africa and (with a few exceptions such as DFID and USAID) are rarely reflected in development policies and plans addressing food issues. This is due to a number of factors: policymakers are preoccupied with responding to short-term priorities and emergencies; a lack of resources; and few policymakers appreciate the significance of GEC for sustainable development. These factors are exacerbated by a lack of policy-relevant information on how GEC and food security interact within the region, and also that international research initiatives have treated food issues in a fragmented manner.

(Food security encompasses a wide range of complex and interactive dimensions. A fuller contextual analysis of the food security situation for the region in relation to GEC and other factors, and the role that GEC research can play in helping to alleviate the situation, is to be presented by mid-2006 as a GECAFS Working Paper/international journal article.)

1.2 Integrating GEC science within regional development policy

Better governance in relation to food security and GEC is needed in southern Africa based on improved links between science, government and society. Innovative research that builds on, and integrates the wealth of regional and internationally disciplinary studies and development projects, plays a crucial role. However, policymakers do not often fully adopt the results from research aimed at policy support because researchers leave interacting with the policy community until a project's closing phases. Further, the GEC research agenda related to food security in southern Africa (as elsewhere) has to date not been well linked with the development agenda, despite the fact that development goals and improved environmental management are often closely related.

GEC/food security research to support policy development in southern Africa must provide practical assistance to evaluate options for reducing the region's food systems vulnerability to GEC. It should help the region's policymakers and development planners to appropriately evaluate the necessary responses to improve the region's food systems. Research planning has therefore included a wide range of regional policy-making institutions, researchers and development practitioners and these will continue to be involved in the research implementation cycle. This will help ensure timely and strategic feedback of scientific research output to regional policy and planning activities.

¹ AFRICANESS: African Earth System Science Conference, Nairobi, September 2005, organised by ESSP and ICSU and supported by NSF, NEPAD and NRF.

² SADC Heads of State and Government, Extra-ordinary Summit on Agriculture and Food Security, Dar-es-Salaam, 15th May 2004

1.3 Research challenges

A set of consultative meetings in southern Africa (convened by GECAFS³) highlighted concerns that GEC will further complicate achieving regional food security (Annex 2: GECAFS-SAF project development). However, as outlined above, the interactions among GEC and food systems are complex and need to be better analyzed to assess the implications for food security in southern Africa. There is also concern that meeting the region's rising demand for food will further degrade the environment. If careful and appropriate natural resource management is not in place, further degradation of land, water, plant and animal resources is inevitable (Gregory *et al.*, 2002; Tyson *et al.*, 2002). This will, in turn, further undermine the food systems upon which food security is based. Reversing this negative cycle is key to sustainable development in the region, but there has to date been limited capacity to generate policy relevant information to address GEC effects for development agendas.

Research on three, inter-related areas is needed to provide information to help decision makers and resource managers develop policy and technical adaptation options which improve food security whilst minimising further environmental degradation:

- (i) How GEC will affect the vulnerability of food systems in different parts of the region.
- (ii) How food systems can be adapted using technical and policy options to cope with GEC and improve food security.
- (iii) How various adaptation options will feedback on environmental and socioeconomic conditions.

Addressing these requires an improved insight into some important aspects of the food security/GEC debate. First is the need to better understand what constitutes vulnerability to GEC in relation to food systems. This is key to helping to determine where, when and which sections of society and its resource base are most at risk. Second, scenarios of future conditions need to be constructed that incorporate the socioeconomic and biogeophysical factors that determine food security. Third, options for reducing the vulnerability of food systems to GEC need to be assessed. And fourth is how best to report and communicate research results, and so help devise improved policies to adapt the region's food systems to GEC with limited negative feedbacks.

³ Global Environmental Change and Food Systems (GECAFS) is an international research programme involving a wide range of social, physical and biological scientists, investigating the vulnerability of human food systems to, and interactions with GEC. It is sponsored by the international GEC research community (IGBP, IHDP and WCRP) and is being developed in active collaboration with FAO, WMO and the CGIAR. See Annex 1 and www.gecafs.org for more information.

2 Southern Africa Research in the GECAFS Context

A three-year consultation and planning exercise has identified the need for, and necessary components of, an integrated research endeavour on the links between southern African food security and GEC. The exercise, organised by the international research project Global Environmental Change and Food Systems (GECAFS), involved a diverse group of regional researchers, and regional and international organisations and donors, and culminated in the preparation of this Plan for a GECAFS southern Africa project (GECAFS-SAF). Recognising and building upon ongoing national and regional GEC and food security research, the Plan provides a strategy to deliver policy-relevant information about the interactions between GEC and the food systems that underpin food security. Research will contribute to a number of major food security initiatives in the region and support both local interests and those of major regional activities (e.g. NEPAD, FARA, COMESA and SADC-FANR). It will constitute an integral component of the internationally-endorsed GECAFS agenda.

2.1 The need for a GECAFS southern Africa regional project

Vision: Improved food security for those most vulnerable to environmental stress in southern Africa.

The GECAFS Southern Africa Project (GECAFS-SAF) is specifically designed at the sub-continental (meso) scale. This means the region comprising the 10 southern-most African countries: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe.

This is an important spatial scale for food security issues, food system research and GEC considerations for several reasons. First, climate and weather-related perturbations are often experienced at this scale in the region (Tyson *et al.*, 2002a) and adaptation strategies may be applicable across more than one district or nation. Second, the adaptation strategies themselves may prove most effective if managed at the regional level, e.g. in terms of improved intra-regional trade, food storage and transport facilities. Third, some environmental management issues manifest strongly at this spatial scale (e.g. water resource depletion, as the region's major basins are shared) and solutions to such problems may often require supra-national considerations (e.g. inter-basin transfers of water).

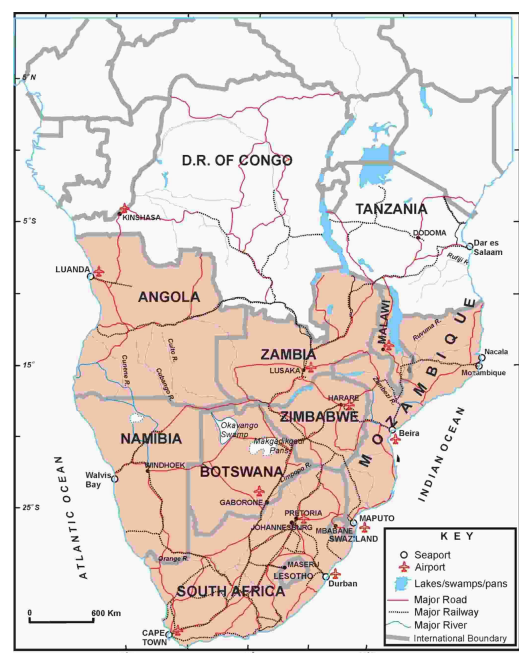


Figure 1: Proposed GECAFS-SAF region

Fourth, donors often plan at the regional scale (e.g. USAID-RCSA, 2003) and in many places regional governance structures have been established and are struggling to be effective. Fifth, there is a mechanism for regional development planning and discussing related international agreements (SADC) which is a clear ‘client’ for regional-level considerations. Finally, while many natural science issues are already being addressed at the meso-scale, social science theories, methods and data are however often better developed at the micro- (individual) and macro- (nation or larger) scales (Rayner and Malone, 1998). GECAFS-SAF is designed to bring these two areas of science together at the regional scale.

A wide range of technical, policy and institutional adaptations to increase food security have already been explored in several countries in the region. Some of the technical adaptations include introducing ‘best bet’ land, water and soil management technologies; building large-scale irrigation projects; providing free inputs to small scale farmers; and introducing high yielding crop varieties.

Policy options for adaptations have included changes in land policy; removing input subsidies; and liberalising input and output markets. Institutional changes have included developing community-based organisations in natural resources management; introducing user fees for water and other natural resources; and establishing farmers’ clubs, associations and cooperatives for managing input and output markets. Most of these adaptation measures do not however appear to have benefited the region as hoped, and the majority of smallholder households still live below the poverty line. Some measures have even backfired to some degree, often due to the lack of a “bottom-up” approach. For instance, government interventions of subsidising inputs and distributing free seed and fertilizer have created an unfavourable business environment for the private sector, resulting in the reduced availability of inputs and sharply rising food prices. The decline in the role of parastatal organisations for input supply and marketing of crops has thus led to a collapse of input supply chains, the private sector not having responded to fill this role as hoped/anticipated.

Research on food security/GEC issues can draw valuable lessons from these (often disparate) technical, local policy and institutional adaptation approaches, but needs to be designed specifically to underpin improved regional and national policy formulation. Key aspects are raising awareness of, and improving knowledge about GEC issues in the policy process, particularly on how food security will be undermined by GEC; and improving understanding by researchers of what the key food policy goals are, and the constraints on policy formulation. To this end, a new framework is needed which will (i) bring together research on the vulnerability of the region’s food systems to GEC; (ii) enhance collaboration with relevant stakeholders in food issues to identify viable options for adapting food systems to the additional stresses of GEC; and (iii) assess how possible adaptation options will affect development agendas, including enhanced environmental

management, in the short- and long-term. However, these issues need to be analysed within existing approaches to food security so that they are not seen as a different set of problems and also so as to capitalise on, and add value to, ongoing efforts.

The GECAFS Project has been designed to integrate all three issues by weaving together the array of cause-effects-adaptation options with feedbacks (Annex 1: Global Environmental Change and Food Systems (GECAFS): A summary). It thereby offers a framework for research that directly addresses the issues discussed in Section 1.1 and has provided the framework for planning the GECAFS southern Africa project (GECAFS-SAF).

GECAFS-SAF will help to develop a more integrated regional approach which will have direct relevance to regional planning bodies such as COMESA, SADC and NEPAD. It is particularly timely, given the urgency of food security issues in the region, the increased recognition of GEC issues for the region, and international political momentum from the G8 Gleneagles summit in 2005, which highlighted both development need in Africa, and trade and environment issues.

2.2 *GECAFS-SAF project planning*

While not all GEC research necessarily aims to be policy-relevant, one of GECAFS’s guiding principles is to address policy issues. Important aspects of GECAFS therefore include ascertaining the information needs of policymakers, resource managers and other stakeholders, developing with stakeholders relevant science questions, and delivering results that help policy formulation. This GECAFS-SAF Science Plan and Implementation Strategy has therefore been developed from the output from a series of coordinated planning workshops and associated activities involving regional researchers, policymakers, resource managers and donors (Annex 2). The regional planning process has also been influenced by developments both in the GECAFS conceptual research agenda, and in the Southern Africa Vulnerability Initiative (SAVI). This process has followed the general GECAFS method for developing GECAFS regional research to ensure the research questions are closely matched with key regional science interests, policy needs and donor priorities.

2.3 *GECAFS-SAF in relation to regional food security initiatives*

Given its regional mandate, SADC (and especially the Directorate for Food, Agriculture and Natural Resources) has played a key role in defining the GECAFS-SAF agenda. This involvement has helped ensure that research planning directly addresses SADC’s comprehensive Regional Indicative Strategic Development Plan (RISDP, which sets the fundamental social and economic policy framework for the

region). This means that GECAFS-SAF will contribute strategic scientific information that SADC and its implementation partners need to inform regional programmes and policies for developing national and regional integrated food security and poverty reduction policies and strategies.

Links to other regional food security initiatives (see Table 1) will also be developed as appropriate to ensure GECAFS-SAF outputs complement, build on, and contribute to ongoing efforts in the region.

Table 1: Potential contributions of GECAFS-SAF to regional food security initiatives

Organisation	Project	GECAFS Conceptual research	Q1 Research vulnerability and impacts	Q2 Research adaptation options	Q3 Research feedbacks
CGIAR	Sub-Saharan Africa FARA/CGIAR Challenge Program	*	*	*	*
	Inter-Center Working Group on Climate Change	*	*	*	*
	CIMMYT – Low Nitrogen Drought Resistant Maize Improvement Project			*	
	CIAT-TSBF and Bean Program			*	
COMESA	Agricultural Research and Up-scaling Programme for Strategic Food Crops		*	*	
DFID	Regional Hunger & Vulnerability Programme	*	*	*	*
IFDC	Fertilizers and Sustainable Agricultural Development			*	*
IUCN-ROSA	Transboundary Natural Resources Management				*
FAO	Agricultural Infrastructure Project			*	
SADC-FANR	(a) RISDP	*	*	*	
	(b) REWU Project		*		
	(c) Disaster management		*	*	
	(d) Irrigation and water management			*	
	(e) Regional vulnerability assessment system	*	*		
SCF	Humanitarian food aid programmes		*	*	
UNDP	Root Causes of Food Security & Vulnerability	*	*		
USAID (Southern Africa)	Southern African Strategy to End Hunger		*	*	*
	Regional trade	*	*	*	*
	FEWSNET	*	*		
UNICEF	Social protection and OVCs	*	*		

3

GECAFS-SAF Goal and Research Agenda

GECAFS-SAF research will identify the social and geographical distribution of the vulnerability of the region's food systems to GEC in the context of other stresses. Based on these new insights, collaborative research with regional stakeholders will evaluate how, when and where adaptations to food systems can be instituted to reduce their vulnerability to GEC while also being in line with long-term national and regional developmental goals. Research will also assess the long-term social and environmental consequences of different potential adaptation measures designed to enhance regional food security. In addition to addressing regional priorities, proposed research is also fully consistent with the international GECAFS conceptual and methodological research agenda and will be networked with other GECAFS research worldwide.

3.1 Goal

To determine strategies to cope with the impacts of global environmental change on southern African food systems and to assess the environmental and socioeconomic consequences of adaptive responses aimed at improving long-term food security.

This goal is derived from the regional planning process (Annex 2) and a number of research issues need to be addressed to achieve it. Collectively, these constitute an innovative regional research approach which will: (i) build upon and integrate natural and social science disciplinary studies within a policy context; (ii) link researchers, the regional and sub-regional policy communities, and resource managers to deliver new insights into how GEC will interact with the region's food systems that underpin food security; and (iii) be designed and implemented so as to help the region take advantage of opportunities that may arise, but also to help minimise further environmental degradation.

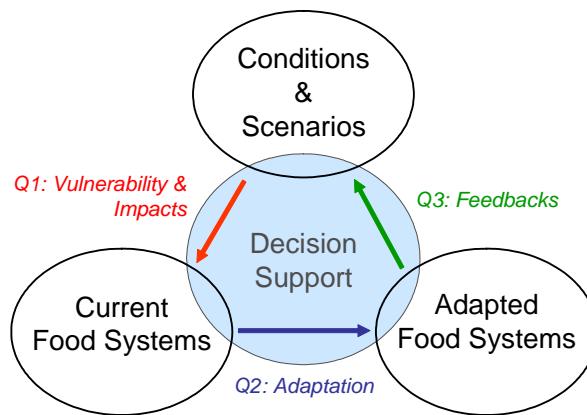
3.2 Overarching GECAFS-SAF research questions and conceptual framework

GECAFS-SAF research is based on three areas that interest both regional science and development agendas.

- Q1 How will GEC affect the vulnerability of southern African food systems?
- Q2 How might southern African food systems be adapted to cope with GEC so as to enhance food security?
- Q3 How would various adaptation options for southern African food systems feedback on environmental and socioeconomic conditions?

These questions are based on the generic GECAFS conceptual framework (Box 2), and were refined during the GECAFS planning process in the region.

The GECAFS approach recognises that research questions for policy and science outputs are not necessarily the same, but that there is great scope for complementarity. Two types of research questions have therefore been developed for the GECAFS-SAF project: those of immediate relevance to food security and environmental management policy objectives as relating to Q1-3, above (Section 3.3); and others aimed at delivering a stronger science foundation for addressing the policy-related questions (Section 3.4).

Box 2: GECAFS conceptual framework for research in southern Africa

A relationship exists between current socioeconomic and environmental conditions and current food systems. It highlights the importance of their vulnerability to future scenarios of changed socioeconomic and environmental conditions. It also shows how policy and/or technical adaptation options to cope with the added stresses of GEC lead to adapted food systems; and that adaptation options will, in turn, feedback to socioeconomic and environmental conditions. Finally it highlights the importance of decision support in assisting with credible assessment of adaptation options, and especially in analysing their trade-offs between environmental goals (e.g. minimising damaging feedbacks to carbon budgets, the hydrological cycle and other components of the Earth system) and regional developmental goals (e.g. maximising positive feedbacks to food security, livelihoods and other socioeconomic conditions).

3.3 Research questions for food security and environmental management

Three sets of more detailed questions were developed from the overarching questions (Q1-3) and are summarised below. (The full list of questions stemming from the planning exercise is listed in Annex 3.) Given the varied policy interests of regional stakeholders, and recognising the complex spatial and temporal dynamics in the region, each set was elaborated for three different situations:

- **Local-level questions**, researched in case-studies at the sub-regional level.
- **Cross-scale questions**, which integrate output from case studies up to the regional level (bottom-up view of the region).
- **Regional-level questions**, to address issues relating to the region as a whole (top-down view of the region).

3.3.1 Vulnerability of food systems to GEC (re Q1)

Southern Africa's food systems depend heavily on regional agriculture, and this is already exposed to climate stress (Mendelsohn *et al.*, 2000). Given concerns about further aspects of GEC, considerable work is underway to assess how GEC might affect crop, livestock, fisheries and *veld*

productivity, and hence on regional production. The potential damage from GEC may be large both in absolute terms and as a fraction of agricultural GDP (Vogel, 2005). GEC (especially floods and droughts, changing water availability and biodiversity, and land degradation) will interact with other stresses to affect southern African food systems and hence food security. Research needs to establish how southern Africa food systems operate across the region and how they are differentially vulnerable to GEC.

Key Q1 local-level questions

- How do socioeconomic and biophysical conditions determine how food systems operate at the local level?
- Which aspects of local food systems (activities and outcomes) are currently most vulnerable to environmental stress and which stresses are most threatening?

Key Q1 cross-scale questions

- How do southern African food systems vary across the region, especially regarding dependence upon subsistence production as opposed to purchases made with remittance or off-farm income?
- What are the trends in food availability, access and utilisation across the region?

Key Q1 regional-level questions

- How do regional-level policies affect the vulnerability of food systems to GEC across the region and why?
- Which aspects of GEC as manifesting at the regional-level are most important in relation to long-term development and food aid?

3.3.2 Adaptation (re Q2)

The increasing vulnerability of southern African food systems to GEC, as demonstrated by escalating land and soil degradation and rapid decline in food availability and access, are indications that technical, policy and institutional strategies are often weak and ineffective. Further, current strategies are mainly aimed at coping with the increasingly complex interaction of stresses in the short-term, and little attention is given to longer-term, sustainable options for adapting food systems to the additional stresses GEC is bringing. Such options will vary across the region, depending on the nature and extent of the inherently-dynamic vulnerability of food systems to GEC.

Key Q2 local-level questions

- What local-level technical, policy and institutional adaptation strategies will reduce food system vulnerability?
- How does local governance affect the development and implementation of food system adaptation options and strategies?

Key Q2 cross-scale questions

- How will interactions among regional-level and local-level food system adaptation strategies affect conditions and decision-making at local level?
- How would changes in donor philosophy for food- and seed-aid as applied at the local level affect regional self-reliance?

Key Q2 regional-level questions

- In what ways do current regional technical, policy and institutional adaptation strategies fail to reduce food system vulnerability to GEC?
- Which aspects of regional cooperation need to be improved (e.g. trade, infrastructure, research and development, strategic reserves, transboundary water management) to help reduce vulnerabilities of food systems?

3.3.3 Feedbacks (re Q3)

Technical, policy and institutional options for adapting southern Africa food systems to GEC will primarily be aimed at improving food security. There will however also be environmental, and other socioeconomic, consequences ('feedbacks'; see Box 2). New policies and technologies promoted at regional level will affect the capacity to adapt to change at local level. Population change, disease spread, and peoples' movements between countries influence national food security, and some policy adaptation options might hinder positive demographic aspects or promote negative aspects. Technical adaptation options, such as international water transfer projects, will influence large irrigation schemes, which will in turn affect regional self-sufficiency as well as local livelihoods and the environment. Policy and/or technical adaptations will affect greenhouse gas emissions and biodiversity, which could in turn influence decision makers' capacity to formulate and implement adaptation strategies (MA, 2005). Research needs to identify the potential feedbacks of possible adaptation options as identified in Section 3.3.2 and build such feedbacks into policy formulation and resource planning.

Key Q3 local-level questions

- How would different adaptation strategies affect rural food security and hence the rate of urbanisation?
- How would different adaptation strategies change local biodiversity, biogeochemical cycling and national greenhouse gas budgets?

Key Q3 cross-scale questions

- How would different adaptation strategies across the region help achieve SADC's food security goal?
- How would different adaptation strategies across the region affect regional water availability and access?

Key Q3 regional-level questions

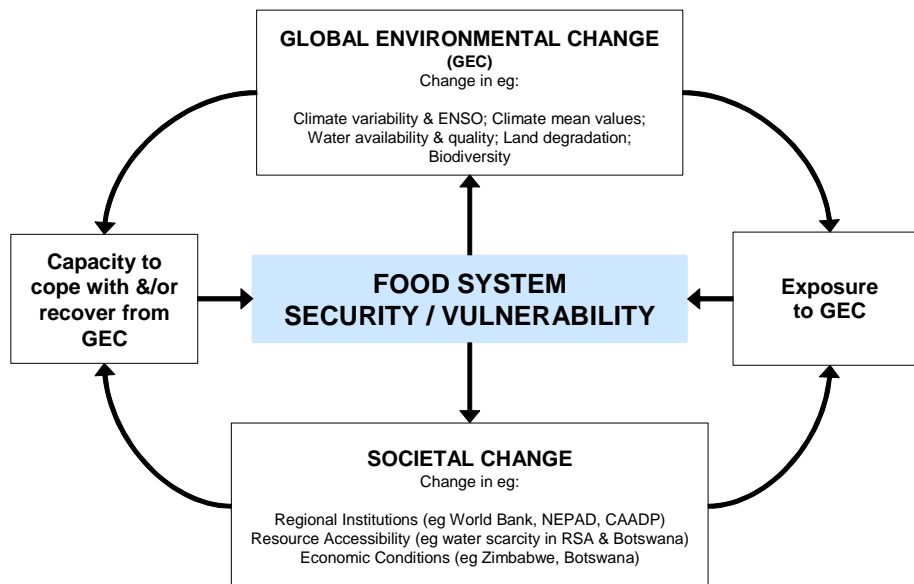
- How would improved regional cooperation aimed at reducing vulnerabilities of food systems affect international trade?
- What would be the environmental consequences of concentrating the region's food production in specific parts of the region?

These sets of Q1, Q2 and Q3 questions need to be considered for both current conditions and in the context of plausible scenarios of future conditions (see 3.4.2).

Box 3: Integrated concepts of food system vulnerability with GEC science

GECAFS is interested in the vulnerability of food systems to global environmental change. Vulnerability is ‘the interface between exposure to the physical threats to human well-being and the capacity of people and communities to cope with those threats’ (The *Global Environment Outlook 3* Report, UNEP 2002). Vulnerability thus has two sides: an external side of risks, shocks and stress, and an internal side which is the means for coping without damaging loss (Chambers, 1989).

The capacity to cope with, and adapt to stress is, in many cases, deteriorating in the face of multiple, interacting shocks (e.g. climatic catastrophes) and transformations (e.g. political and economic developments). Furthermore, negative outcomes for large numbers of people affect in turn, the context itself. A dynamic cycle results, where vulnerability is generated by both exposure to change, by responses to change, and by the outcomes of these processes (Gillespie & Kadiyala, 2005; Leichenko and O’Brien, 2002).



*Factors determining the vulnerability of southern Africa food Systems to GEC
(Adapted from Ingram and Brklacich, 2002)*

GECAFS is integrating social vulnerability concepts with those from natural science to provide a more holistic approach to vulnerability studies in the context of GEC in southern African. Regional networks will bring together researchers to assess existing paradigms and approaches. For the conceptual research on food systems and vulnerability for instance, studies could include livelihood-based food security assessments and future vulnerabilities (Marsland, 2004); multiple stresses (O’Brien, 2004; Quinlan *et al.*, 2005; Misslehorn, 2005) and climate vulnerability hotspots (Adger *et al.*, 2005); multi-level modelling (Downing *et al.*, 2004) linking vulnerability to food security (RHVP Proposed Programme of Research into Social Protection). Merging vulnerability assessments with adaptation and resilience research provides an opportunity to provide explicit links between vulnerability assessments and the formulation of policies supporting future food security (Adger *et al.*, 2003).

3.4 Southern African science in the context of GECAFS conceptual research

While research in southern Africa is primarily aimed at the regional project goal, it will also contribute significantly to the four key topics comprising the overall GECAFS conceptual research agenda: (i) food systems concepts, (ii) vulnerability of food systems to GEC, (iii) scenario construction, and (iv) decision support. Basic details of each of these research areas are given in the GECAFS Science Plan and Implementation Strategy (GECAFS, 2005); and latest concepts are reported in the GECAFS Working Paper Series (available on www.gecafs.org).

3.4.1 Research on vulnerability of food systems to GEC

One of the GECAFS conceptual topics, vulnerability of food systems to GEC, is attracting particular research interest in southern Africa. GECAFS research has developed a framework to integrate the many research projects investigating GEC impacts on food systems (see Table 2) with concepts related to society's capacity to cope with, and/or recover from GEC (Bohle, 2001; Wisner et al, 2004); and with changes in societal aspects, such as policy options, institutions and resource accessibility (Adger, 1999). This integrated concept will allow GECAFS-SAF researchers to better understand the vulnerability of the food system (as a whole) to GEC, rather than just the impacts of GEC on production. Box 3 illustrates how this research can be further developed within GECAFS-SAF.

3.4.2 Regional scenarios for GECAFS studies

GECAFS-SAF research needs to be set within clearly defined, plausible alternative futures (or *scenarios*) of biogeophysical and socioeconomic conditions. This is because so much uncertainty surrounds both policy development and implementation, and the nature and impact of GEC. Such scenarios will help to (i) research the interactions between regional food systems and GEC; (ii) assess which adaptation options are most appropriate for different future conditions; (iii) assess the resilience and adaptive capacity (Carpenter et al, 2001; Walker *et al.* 2004) of food systems under different scenarios; and (iv) raise awareness amongst decision makers about the potential vulnerability of food security strategies under different, and largely uncertain, future conditions.

For southern Africa, comprehensive scenarios need to include major drivers, such as global trade policies and agreement, northern agriculture subsidisation policies, the frequency and severity of droughts, HIV/AIDS and other major diseases, and tenure policies and the regional economy. The need to establish robust methods for constructing regional scenarios is common across all GECAFS regional projects, and southern African experience will be a valuable contribution to the conceptual research in this area.

3.4.3 Decision support research

Work on assessing the possible strategies for adapting southern Africa food systems to GEC must include those involved in policy formulation and decision-making. Decision support (DS) platforms can help by providing a structured dialogue between scientists and policymakers. Innovative DS approaches and tools need to be developed, evaluated and refined to help assess potential regional- and national-level policy options. DS tools will help analyse tradeoffs between feedbacks to the Earth system (included, for instance, changes in greenhouse gas emissions, soil erosion, water resource degradation and biodiversity loss), and to socioeconomic conditions (such as food security, potential markets, livelihoods) arising from potential adaptation options (Q3, above). Advances in DS concepts from GECAFS-SAF research will contribute to international GECAFS agendas on DS development.

4 GECAFS-SAF Implementation Strategy

GECAFS-SAF will be implemented over five years. It will be based on (i) selected Case Studies across the region, each addressing the food systems questions relating to GEC vulnerability and impacts, adaptation options and feedbacks; (ii) Regional Scientific Networking, to link case study research with other relevant research in the region and internationally; and (iii) a Science-Policy Interface, linking national researchers with policymakers, the private sector, civil society and representatives of regional food security programmes. Research will be organised into defined phases with clear outputs at each stage. When integrated, outputs will provide policy-relevant information at both local and regional levels with the communications strategy underpinned by stakeholder engagement at all research stages. Research capacity will be developed by collaborative research within the international GECAFS project.

GECAFS-SAF will concentrate on few (about five) case-study sites in southern Africa (Figure 1). This sub-region was selected for its common climate maintained by subcontinental circulation (Tyson *et al.*, 2002); a relatively small number of farming systems (Dixon *et al.*, 2001); the potential for enhanced intra-regional trade (Arntzen *et al.*, 2004); and the continued food insecurity that has persisted in many of the countries in the sub-region since 2002.

The project will be implemented in three principal ways, each supported by a GECAFS-SAF core fund:

- **Case studies**, to address Q1-Q3 (Section 4.1; cf. Section 3.3)
- **Regional scientific networking**, to address underpinning science and contribute to the GECAFS conceptual research (Section 4.2; cf. Section 3.4)
- **Science-policy interfaces**, to help ensure research output is incorporated into policy formulation (Section 4.3; cf. Section 1.3)

4.1 Case studies

4.1.1 Rationale for case study approach

Southern Africa encompasses wide-ranging socioeconomic and environmental conditions, and GECAFS-SAF planning identified SADC interest in describing how the food systems vary across the region as a result of this heterogeneity (cf. 3.3.1). Many of the food security issues are based on socio-ecological interactions that are too complex to study at a broad scale because they are dependent on sub-regional conditions. GECAFS-SAF research will therefore develop a set of case studies aimed at capturing main aspects of the regional diversity.

Each case study will provide a focus for collaborative GECAFS-SAF Q1-3 research involving national researchers closely linked to policymakers, the private sector, civil society (NGOs) and representatives of regional programmes. Using standard GECAFS methods to facilitate syntheses and integration, research will give insights into how diversity affects food security across the region and also what possible adaptation strategies can be considered both locally and for the region as a whole.

4.1.2 Selection criteria

About five sites will be selected in the region. A key aspect will be to build on ongoing research infrastructure and research sites, and existing data, rather than establishing GECAFS research sites *de novo*. The spatial scale of the sites needs to be established based on ongoing studies, providing these are suitable for addressing GECAFS-SAF issues. Discussion with appropriate teams will therefore be required to identify optimal GECAFS-SAF research sites. An initial step will be to review existing work (e.g. FARA/CGIAR CP, APIS, SA/MA, START; see Table 2) to identify research sites for which suitable socioeconomic and environmental data are already available. Several selection criteria could also be considered, depending on detailed research planning:

- Lie along gradients of anticipated temperature and precipitation change (IPCC Africa Chapter 10, 2001) and current and anticipated grazing pressure (Scholes and Biggs, 2004).
- Represent different governance (eg, land tenure) arrangements.
- Represent the region's principal farming systems (Dixon, 2001).
- Represent key drivers in regional scenarios.
- Build on work where interventions have been shown to be effective (Scott et al., 2004).

The final choice of case-study sites would be based on the rationale given by successful proposers (see 4.1.3).

4.1.3 Implementation strategy for case studies

Integrated research addressing Q1-Q3 will be conducted in each case study. A GECAFS-SAF core fund will be established and a competitive bidding process used to identify multidisciplinary teams of researchers selected from across the southern African region. The process of selection and management of research proposals – and hence the selection of case-study sites – will be done by the GECAFS Regional Steering Committee (RSC, see Section 5.2.1 for a detailed description of composition and functions). It will involve a series of steps (Table 3).

The research teams must satisfy a number of requirements:

- Core values regarding professionalism, commitment to deliver applied research products on time, accountability, interest in developing capacity at national and regional levels, openness to participatory learning and sharing with stakeholders and policymakers.
- Team composition regarding size and distribution of members by discipline, gender, age and countries.
- Capacity and track record of team leader, members and host institutions; breadth and depth of technical competence and scientific research experience.
- Commitment to GECAFS-SAF research aims.
- Commitment to building regional research capacity for GEC impacts and adaptation assessments.

4.1.4 Regional synthesis and integration

Regional synthesis and integration will be implemented by closely linking the case studies in the context of key 'synthesis questions' as outlined in Section 3.3. The GECAFS-SAF Regional coordinator (see Section 5.2.2), assisted by the GECAFS Science Officers, will liaise between sites to ensure consistent approaches are followed across the region to facilitate this process. GECAFS-SAF Synthesis workshops will draw together case-study research output to address regional synthesis questions.

A number of recently-completed, ongoing and/or imminent region-wide research activities could be very relevant to the GECAFS-SAF goal. Table 2 lists some of these, and indicates with which aspects of the GECAFS-SAF agenda collaboration might be to best mutual advantage. The GECAFS-SAF synthesis workshops will also include output from such studies to ensure that there is no duplication of effort, and that GECAFS-SAF and other projects can mutually benefit from advances made outside the case studies.

Establishing links with, and building on research as exemplified in Table 2 both helps deliver the GECAFS goal and adds value to the initial studies. A major GECAFS-SAF synthesis workshop and reporting exercise will be held in the final months of the five-year project in collaboration with other, major regional efforts.

Table 2: Example potential collaborations with regional research activities

Regional research activity	GECAFS-SAF Q1-3 Research			GECAFS Conceptual Research			
	Q1 Vulnerability & Impacts	Q2 Adaptations	Q3 Feedbacks	Food systems	Food system vulnerability	Scenario construction	Decision support
APIS (Kleynhans and Kunneke, 2002)		Crop production locations based on land suitability and transport modelling					Development of DSS tools
CC-INREF (Giller, 2005)			Dynamic models of sustainability and productivity				Complex systems analysis
CEEPA / CC and Ag in Africa (CEEPA, 2005)	Regional impact analysis	Climate change adaptation options	Economic feedbacks				Establishing science-policy dialogue
CGIAR/ICWG-CC	GEC impacts on food productivity	Technical and policy adaptation options for production systems	GHG emissions from alternative cropping/livestock management		Productivity "vulnerability hotspots"		
COMESA/ AMPPIP		Alternative marketing options					
FANRPAN/MSU Maize Marketing Project		Alternative marketing options		Marketing aspects of food systems			
FARA/CGIAR SSA CP (FARA, 2004)		Technical and policy adaptation options for production systems					
FAO FIVIMS (FAO, 2005)	ID key aspects re food systems				Concepts of vulnerability		
FEWSnet (FEWSnet, 2005)	Early warning systems				Concepts of vulnerability		
GOFC-GOLD/ BGCC SAFNet	GEC (fire) impact on food production	Fire management policy and strategies	Change in vegetation community and species composition	Ecosystem goods and services – <i>veld</i> products	Climate, land use and vulnerability of food production to fire incidents	Climate and land use change scenarios	Policy to balance fire as a tool and fire as a hazard
IFPRI / SAKSS (IFPRI, 2005)			Trade-off analyses				Development of DSS tools
SAAMA (Scholes and Biggs, 2004)	Regional food supply and protein levels					Regional scenarios construction	Approaches to raising GEC awareness in policy community
NOVAFRICA					Gender aspects of vulnerability		
SAVI (GECHS, 2005)	ID key aspects re food systems				Concepts of food system vulnerability to GEC		
START AIACC Limpopo project	Food production and food security	Cultural heritage tourism and community adaptation strategies	Facilitated Conservation and adaptation / socio-cultural change	Income generation, ecosystem good and services	GEC and community adaptation capacity	Climate, community response and external interventions	Community adaptation options and types of GEC
START Rangelands Project (CAZS, 2003)		Role of alternative governance in resource management					Raising GEC awareness in policy community

Table 3: Selection and management of GECAFS-SAF case study research

Team Selection Activity	Input from RSC	Output
1. Call for concept notes for case studies	<ul style="list-style-type: none"> • Draft guidelines for concept note • Draft announcement for advertisement 	<ul style="list-style-type: none"> • Guidelines for concept notes • Announcement for concept notes
2. Review of concept notes and short-listing of successful teams	<ul style="list-style-type: none"> • Evaluate concept notes • Evaluate teams 	<ul style="list-style-type: none"> • Short list of successful teams
3. Call for full proposals from short-listed teams	<ul style="list-style-type: none"> • Guidelines and format for proposal • Restricted call made for proposals from short-listed teams • Identifies technical reviewers of proposal 	<ul style="list-style-type: none"> • Guidelines for proposals • Names of technical reviewers
4. Review of proposals and announcement of short-listed teams	<ul style="list-style-type: none"> • Organise technical review of proposals • Short list candidates for inception workshop 	<ul style="list-style-type: none"> • Reviewed proposals • Final list of successful teams
5. Inception Workshop 1 for the successful teams	<ul style="list-style-type: none"> • Prepare for learning and sharing workshop for peer review and feedback to improve quality of proposal and synergies across case study areas 	<ul style="list-style-type: none"> • Shared vision and common understanding of the project, integrated methodologies across teams, synchronised time frame for deliverables
Replicate for 2 nd Call (to cover years 1.5 - 5)		

4.2 Regional scientific networking and endorsing research

There are many national research projects in social, agronomic, fisheries, policy, economics, ecological and climate sciences which could be very relevant to the GECAFS objectives. Where appropriate these will be drawn upon to contribute to case studies, but a key GECAFS principle is also to network and synthesise ongoing research in the region relevant to GEC and food systems but which may not be directly involved in the case studies. This will be an initial fast-track exercise, outputs of which will (i) help address the stated research questions by including a wider range of researchers; (ii) add value to the individual case studies by integrating them with other work to address questions the case studies cannot address alone (e.g. of a regional nature); and (iii) link regional research to the international GECAFS conceptual research agenda.

To this end, and working in close collaboration with ICSU-Africa, GECAFS-SAF will network relevant, high quality disciplinary and interdisciplinary research directly related to this Plan. The GECAFS-SAF Regional Steering Committee (see Section 5.2.1) will establish endorsement criteria in consultation with the international GECAFS project. Funds for regional networking activities (e.g. at GECAFS-SAF synthesis workshops) will be included in the core fund budget.

In addition to intra-regional networking, researchers addressing issues that can contribute to GECAFS conceptual research (section 4.5, below) would be invited to join the relevant GECAFS international networks. This would contribute to GECAFS' overall integration by placing the regional work in a broader international context, and would also help in regional capacity building. Such contributions would be endorsed as formal inputs to the respective international network.

4.3 Building science-policy interfaces

One of the fundamental aims of GECAFS research agenda in southern Africa is to assist regional policymakers and development planners to develop a southern African perspective on responses to GEC (cf. Section 1.3). To ensure strong linkage between scientific research and food systems development, GECAFS-SAF is based on the participation of stakeholders in all stages of research planning and will maintain this during research implementation. This has been a valuable awareness-raising exercise in its own right, and will also pave the way for fruitful collaboration during the implementation phase. Working in close collaboration with FANRPAN, GECAFS-SAF will ensure that the wide range of regional policy-making institutions, researchers and development agencies engaged in the planning stage will continue to be involved in the research implementation cycle.

The direct engagement of regional policy making institutions, development practitioners and the research community from the early stage of defining the research themes has ensured that the research agenda focuses on issues of practical interest to policymakers in southern Africa. Major regional policy institutions (SADC, COMESA, FARA, NEPAD) and development partners like DFID, FAO and USAID have participated to varying degrees in the research planning process, and GECAFS-SAF directly relates to the specific objectives of these organisations.

GECAFS-SAF will continue to develop interfaces between scientists and regional policy decision-makers by holding regular meetings and developing a project website. These activities will be used to discuss the research proposals and disseminate results. The GECAFS-SAF RSC will aim to meet key regional policymakers on an annual basis linked to scheduled meetings in the region, such as the Southern Africa Regional Climate Outlook Forum (SARCOF), the SADC Council of Ministers Meetings, the SADC VAC dissemination meetings, etc. Major organisations will be invited to nominate focal points to work closely with the regional coordinator.

The science/policy interface is an ongoing dialogue based on several activities:

- (i) GECAFS-SAF approves and posts the research themes on the GECAFS website and also develops a publication on the research agenda for circulation to scientists and policymakers. This would be prepared by a specialist in science communication.
- (ii) Annual GECAFS-SAF science fora discuss the technical content of the research proposals, in the light of the GECAFS planning exercises.
- (iii) The annual science fora are followed immediately with a policy- and decision-makers meeting (involving FANRPAN, NEPAD, FARA and SADC) to discuss how well the research plans are contributing to the information needs for development (as identified during the planning/earlier phases).
- (iv) GECAFS-SAF adapts research proposals in the light of the policy dialogue.

The GECAFS-SAF website will have an area for the scientific publications and another area for disseminating policy and development related products; and summary policy briefs will be circulated to principal agencies in the region. The media and NGOs have an important role to play in enhancing the science-policy interface, and will be engaged in this process.

4.4 Phased approach

The GECAFS-SAF project will be implemented in two phases over a five-year period (see Figure 2). Three capacity building workshops for regional collaborators will be held, with input from GECAFS Science Officers. These workshops will update collaborators in latest GECAFS methodology to establish a standardised approach across case studies and initiate/strengthen collaboration.

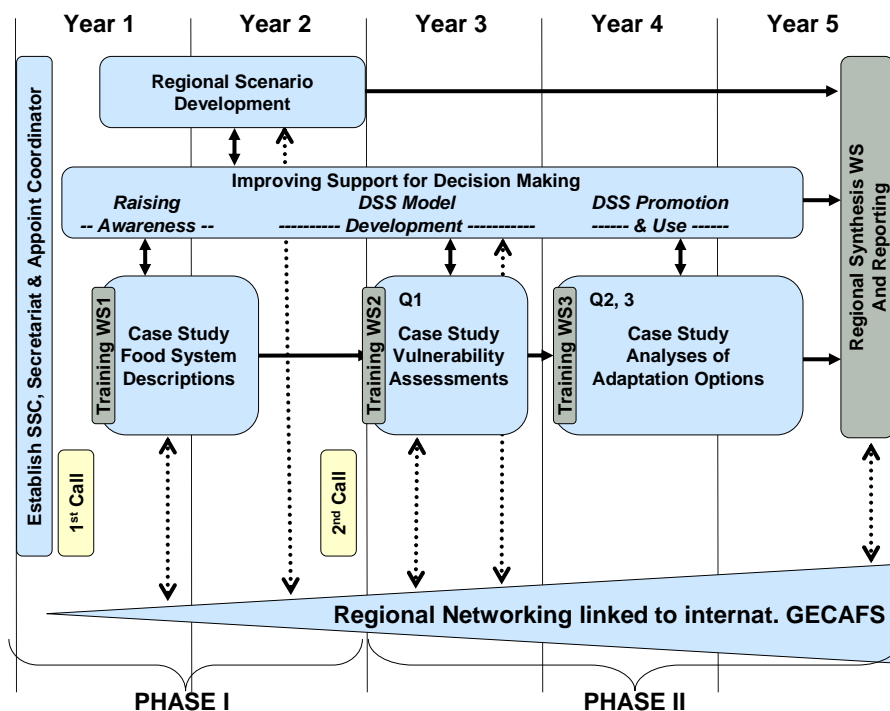


Figure 2: GECAFS-SAF timeline

4.4.1 Phase I implementation (1.5 years)

Key activities:

- Establish RSC through links created from the GECAFS-SAF planning phase and appoint a GECAFS regional coordinator (see Section 5.2.2)
- Establish research teams and identify case studies sites based on criteria in Section 4.1.2
- Describe case study food systems using standard GECAFS methodology
- Strengthen stakeholder dialogue
- Launch scenarios exercise

Key products:

- Regional GECAFS RSC and coordinator established in appropriate institution
- Standardised food system descriptions for each case study for use in immediate and longer-term planning; and as foundation for GECAFS regional research
- Potential intra-regional research network members identified
- Prototype scenarios combining GEC and socioeconomic drivers

4.4.2 Phase II implementation (3.5 years)

Key activities:

- Undertake GECAFS research on vulnerability and impacts, adaptation and feedbacks
- Launch intra-regional research networks and link to GECAFS international networks
- Consolidate intra-regional networks and further involvement in GECAFS international networks to contribute to GECAFS conceptual research
- Finalise regional scenarios

Key products:

- Improved understanding of southern African food system vulnerability to GEC, based on case studies
- New insights of regional hotspots for food systems vulnerability to GEC based on analyses of changing food supply and trade, wealth, food preferences and interactions with GEC
- Use of past records of social adaptations to biogeophysical changes to provide inputs to decision support methods
- Comprehensive, regional scenarios of future socioeconomic, environmental and ecological conditions involving the food system

- Decision Support approaches and tools to aid policymakers' decisions in response to GEC
- Increased awareness of potential environmental feedbacks from adaptation options
- New insights in research design for 'science to aid policy development'.

The sustainability of the GECAFS-SAF initiative will result from regional policy bodies such as the SADC using GECAFS-SAF research products and from incorporating new insights into national development plans.

4.5 Communications strategy

Achieving the objectives of the proposed research relies on a mechanism or system to facilitate communication between researchers and policymakers at each step. The involvement of researchers and policymakers throughout the planning phase and the regional scenarios development raises awareness of GEC issues and what needs to be considered in decision-making (Zurek *et al.*, 2004), and thus is a key part of the communications strategy. To expand the system, adaptive management approaches (Lee, 1999; Gunderson, 2002) will be built upon, with specific support for key decision makers at national and regional levels as outlined by Lal *et al.* (2001).

In addition to the active participation of stakeholder groups, the communications strategies will also employ presentations at regional and international workshops and conferences; submissions to the international, peer-reviewed literature; policy briefs, other publications; and the web. Close liaison with major regional programmes (e.g. SADC, FARA and NEPAD) will be maintained throughout.

Decision support (DS) development will play a major role in the communications strategy. It will be based on research on how best to determine stakeholder information needs, and on communicating and interpreting research findings (ODI/RAPID, 2004; see www.odi.org.uk for details about this approach). This will allow the DS process to be used to help retrieve information and evaluate scenarios in policy exercises that depend on multi-stakeholder negotiations. GECAFS conceptual research in DS will also contribute to regional communications by, for example, demonstrating the Questions and Decisions (QnD) system (Kiker *et al.*, 2005; Kiker and Linkov, 2005). QnD is a structured platform for modelling environmental processes and management decisions as a means to stimulate GECAFS discussions and analysis amongst stakeholders.

4.6 Capacity development

GECAFS-SAF will help build regional capacity in both science and policy-making. This will be achieved in a number of ways:

Science capacity will be built by:

- networking scientists across the region and across disciplines to jointly address common research issues.
- inception workshops run by GECAFS Science Officers to bring regional researchers up to date on latest GECAFS methods.
- linking regional researchers with scientists world-wide through the GECAFS international research networks.
- meetings with regional policymakers so that the science community are more aware of the key issues facing policymakers and the constraints under which they have to work.

Policy capacity will be enhanced by:

- involving regional policymakers in scenarios exercises to raise their awareness of GEC issues and the consequences of given scenarios for development.
- working with policymakers to interpret research findings in the context of policy formulation.
- providing decision support tools to help with analysing tradeoffs between socioeconomic and environmental goals for given adaptation options.

4.7 Linking GECAFS-SAF research with GECAFS international networks

GECAFS-SAF will undertake research on impacts, adaptation and feedbacks (Q1-3) relating to the policy issues identified in the planning process. Such research is conducted in close association with GECAFS conceptual and methodological research worldwide on generic topics derived from science questions and policy issues. In addition to directly addressing Q1-3, GECAFS-SAF case study and other regional research will be networked with the worldwide GECAFS conceptual research agenda. In this way, regional scientists can contribute to a global undertaking and build contacts with scientists working on similar issues in other parts of the world. This approach relates to all GECAFS conceptual research as follows:

Food systems concepts, where applying standard GECAFS methods in southern Africa, capitalising on the regional heterogeneity, will provide a valuable insight into the methods' robustness and will feedback into further conceptual development of the approach.

Food system vulnerability to GEC: As noted in Section 3.4.2, considerable vulnerability research is underway in southern Africa. This needs to be built upon and made specifically relevant to food systems research focussing on GEC aspects. Case study research on vulnerability and impacts, especially when networked with other regional research on this topic, will contribute to the overall development of this area and its relevance for policy and practice.

Regional scenarios for GECAFS studies: Methods for cross-scale linkages developed in other GECAFS regions and in the southern Africa Millennium Ecosystem Assessment (SA/MA) will be used to develop suitable methods for constructing regional-scale scenarios. Regional scenario workshops will develop up to four southern Africa scenarios combining socioeconomic and environmental conditions. The proposed GECAFS-SAF scenarios research will be networked with similar GECAFS efforts in other regions to help provide stronger conceptual frameworks for global-regional cross-scale linking.

Decision support research: This aims to refine a mechanism, based on a structured dialogue, to integrate the other research activities and so assist in responding to policy information needs. It will encompass a range of approaches and tools, ranging from general discussions and mutual awareness-raising (including formal joint exercises such as scenarios construction and analyses) to simulation modelling, GIS and other tools for conducting quantitative analyses of trade-offs of given policy options.

Regional researchers will be invited to join worldwide GECAFS research networks and participate in international integration and synthesis activities.

4.8 Links to IGBP, IHDP & WCRP Core and ESSP Joint Projects

Research at a sub-continental scale is important in its own right and it also brings possibilities for collaboration with other GEC programmes working at similar spatial scales. These include research in other GECAFS regional projects; in other ESSP Joint Projects (see Table 4).

Table 4: Example potential collaborative activities with other International GEC Projects

International Project	Potential collaboration with GECAFS-SAF
IGBP-GLOBEC	Regional marine fisheries, e.g. CLIOTOP
IGBP/IHDP-GLP	FS policy/LUC links; vulnerability/resilience concepts
IGBP/IHDP-LOICZ	Vulnerability of coastal zone systems
IHDP-GECHS	Southern African Vulnerability Initiative (SAVI)
IHDP-IDGEC	Relationship between NEPAD, SADC and national policy
WCRP-CLIVAR	Extending and improving ENSO predictions
WCRP-GEWEX	Land surface changes in the hydrologic cycle
ESSP-GCP	Range management in relation to carbon dynamics
ESSP-GWSP	Ground water assessments
ESSP-GECHH	GEC-induced changes in disease prevalence
START-AIACC	Adaptations to climate change by the biodiversity sector

5 GECAFS-SAF Funding Strategy and Governance

A GECAFS-SAF Regional Fund will be established to cover case study research (via regional calls for proposals), regional networking activities, the science-policy interface and research management. A GECAFS-SAF Regional Steering Committee (RSC) will be established to provide scientific oversight and manage the Fund. A GECAFS-SAF Regional Coordinator will be appointed. The “Food, Agriculture and Natural Resources Policy Analysis Network” (FANRPAN) will serve as the regional host institution.

The GECAFS-SAF agenda is largely aligned to development issues related to the region as a whole, so development agencies are expected to be the principal funders for the case study Q1-Q3 research. However, because the innovative research agenda also contributes to – and is strengthened by – GECAFS conceptual research (for instance regarding improved insights into food systems vulnerability and scenario construction), additional support can be sought from science agencies (the traditional investors in GEC research). This means that a wider range of funding sources can be engaged, a fact which the donor community welcomes because it helps them to work towards common goals.

5.1 Funding strategy and indicative budget

The GECAFS-SAF funding strategy will be developed by the GECAFS-SAF RSC (see Section 5.2.1) and the GECAFS IPO. Donors will be approached to establish a GECAFS-SAF core fund. This will cover:

- Regional Steering Committee travel
- Regional coordinator post and operating costs
- Case study research
- Training workshops
- Regional networking
- Regional synthesis exercises.

Establishing this core fund will be critical to the successful implementation of GECAFS-SAF. It will allow for the integrated package of case studies, regional synthesis and communication with stakeholders to be coordinated from within the region, overseen by leading regional scientists. This will encourage regional collaboration and help ensure wide scientific and policy contributions and capacity building.

The conceptual research aspects will be developed in close collaboration with the GECAFS international networks. Proposals prepared to science funding agencies for specific activities (e.g. regional scenario methodological development) will thereby complement the activities covered by the core fund.

5.2 Governance

5.2.1 Regional Steering Committee

The GECAFS Executive Committee, in consultation with the GECAFS SAC member responsible for the region, will establish a six-person GECAFS-SAF Regional Steering Committee (RSC) comprising:

- Chair: GECAFS SAC member with responsibility for GECAFS-SAF region (*ex officio*)
- Four members representing regional and skills coverage and science/policy balance
- Host institution representative (*ex officio*).

The GECAFS-SAF regional coordinator will serve as secretary.

The GECAFS Executive Officer will attend key meetings to help ensure links with the overall GECAFS project.

The RSC (Figure 3) will:

- provide overall scientific guidance for GECAFS-SAF
- prepare funding proposals with the GECAFS IPO
- maintain financial oversight of the project and report to donors
- launch calls for proposals for case study research based on core budget
- select case study research teams/proposals
- identify relevant regional research to network within the region and with GECAFS internationally
- maintain a quality control on endorsed network research

- organise regional synthesis workshops
- be transparent in operation and have an independent relationship with research teams
- be served by a regional coordinator based in an appropriate regional institution administered by a regional institute
- establish and maintain good links with SADC, FARA and NEPAD
- establish and maintain good links with regional, national and district policymakers
- report via the Chair/regional coordinator to the GECAFS SAC and to donors.

Further details will be established with potential donors.

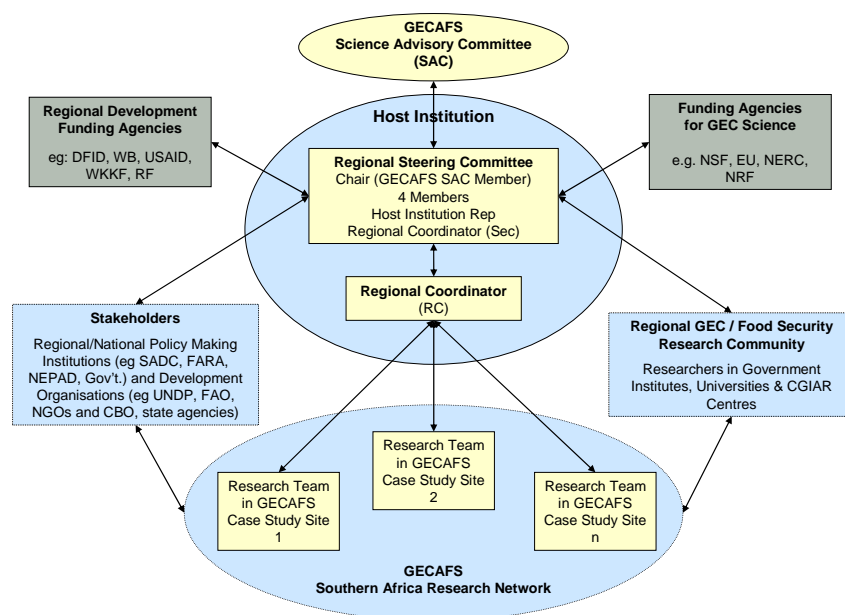


Figure 3: GECAFS-SAF Governance and Management Structure

5.2.2 GECAFS-SAF regional coordinator

A regional coordinator will be appointed, funded as a specific budget line in the core grant. Working to support of the RSC, and especially with the Chair, the position will coordinate all aspects of the GECAFS southern Africa project, and in particular:

- Help launch and facilitate all aspects of GECAFS-SAF research
- Plan and facilitate integration and synthesis exercises
- Maintain close working links with strategic partners and donors
- Develop an external communication (or outreach) programme

- Maintain project accounts and prepare financial statements
- Manage the project office on a day-to-day basis
- Report to the RSC.

5.2.3 Institutional home

A Letter of Agreement has been signed between GECAFS and the “Food, Agriculture and Natural Resources Policy Analysis Network” (FANRPAN). This makes provision for FANRPAN to serve as host institution for GECAFS activities in the region, and it will also contribute significantly to regional networking.

6 Conclusions

The *GECAFS Southern Africa Science Plan and Implementation Strategy* offers an innovative and timely research framework on improving regional food security in the context of environmental stress. This is an issue of growing importance for the region.

This Plan:

- provides an integrated approach to food security and GEC research;
- is based on a comprehensive set of research questions derived from wide regional consultation;
- directly addresses the stated information needs of regional policy and development agencies;
- builds on, and adds value to, existing research findings and infrastructure;
- networks researchers both regionally and internationally;
- contributes to an internationally endorsed research agenda;
- proposes and justifies the establishment of a regional research fund, administered by an appropriate institution with a regional mandate.

Principal outputs will include:

- improved understanding of how GEC will additionally affect food security across the region and among different socioeconomic groups;
- assessments of how adaptation strategies designed to cope with GEC and changing demands for food will affect the environment, societies and economies;
- enhanced regional research capacity in food security and environmental issues;
- strengthened regional policy formulation capacity for food security and environmental governance;
- policy recommendations for adaptation options.

1 Annex

Global Environmental Change and Food Systems (GECAFS): A summary

Global Environmental Change and Food Systems (GECAFS) is an international, interdisciplinary research project focussed on understanding the links between food security and global environmental change. GECAFS was launched in 2001 as a Joint Project of the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP) and the World Climate Research Programme (WCRP), and has formal research partnerships with the Consultative Group on International Agricultural Research (CGIAR), the UN Food and Agriculture Organisation (FAO) and the UN World Meteorological Organisation (WMO).

The GECAFS goal is to determine strategies to cope with the impacts of global environmental change on food systems and to assess the environmental and socioeconomic consequences of adaptive responses aimed at improving food security. GECAFS undertakes research that not only studies food security in the context of GEC but also the feedbacks of adaptation strategies to the Earth system.

GECAFS addresses three major questions of interest to science, development and society:

- (i) How will global environmental change affect the vulnerability of food systems in different regions?
- (ii) How can we adapt food systems to cope with global environmental change and improve food security?
- (iii) How will various adaptation options feedback on environmental and socioeconomic conditions?

GECAFS is addressing these questions by bringing together and synthesising a worldwide portfolio of conceptual and methodological research and closely linking this to a set of regional projects.

Conceptual and methodological research topics include:

- *Food systems*, to improve understanding of the interactions between food systems and Global Environmental Change.
- *Vulnerability and adaptation*, to (i) integrate social science and natural science concepts of what makes a food system vulnerable to GEC; and (ii) use this understanding to investigate adaptation options.
- *Scenarios*, to construct plausible futures of socioeconomic and environmental conditions for food systems analysis.
- *Decision support*, to improve dialogue between scientists and policymakers on the interactions between food security and environment.

Regionally-based projects investigate GEC impacts on food security, food system adaptation options and possible feedbacks of different interventions, in the context of policy formulation. They are designed at the sub-continental scale, which is an important spatial scale for food security, food system research and GEC considerations. Initial GECAFS regional projects are underway for the *Indo-Gangetic Plain*, the *Caribbean*, and *Southern Africa*. Collectively they cover a range of major GEC issues and food systems.

More information on GECAFS is available from www.gecafs.org.

2 Annex

GECAFS-SAF project development

An important aspect of the GECAFS regional approach is to ensure that the research agenda closely matches major regional GEC science interests, policy needs and donor priorities. The process to achieve this constituted the project planning phase and involved workshops⁴, informal conversations and discussions with a wide range of potential stakeholders in the region. A report identifying major policy issues was prepared based on follow-up meetings with key stakeholders (Arntzen *et al.*, 2004).

The development of the GECAFS-SAF Science Plan and Implementation Strategy has followed the overall international project approach for developing GECAFS regional research. Figure A2.1 shows the main steps in this process, and the publication of this Plan is the culmination of planning phase (Steps 1-3). (Steps 4-6 constitute research implementation as described in Section 4.)

Step 1 Regional scientists interested in GECAFS interdisciplinary approach were identified from IGBP, IHDP and WCRP contacts and National Committees and a GECAFS initial regional planning group was established. This group included members from the university, policy and private sector in South Africa, Botswana and Zimbabwe, joined by representatives of the international GEC SAC.

Step 2 Working with the initial regional planning group, regional science, policy and potential donor interests and information needs were identified in a series of workshops (see Figure A2.2, and Annex 3), consultancies and informal contacts.

Step 3 Working with the initial regional planning group, and with other stakeholders, GECAFS regional research questions were established and the GECAFS-SAF Science Plan and Implementation Strategy developed and published.

Step 4 Working with the regional SAF RSC and joined by Core Project/ESSP representatives as appropriate, establish regional research/Core Project/ESSP collaboration and jointly design and implement GECAFS analyses.

Step 5 Working with regional scientists and policy community, and Core Project/ESSP representatives as appropriate, deliver and interpret GECAFS results in policy context.

Step 6 Integrate results across GECAFS studies in other regions to develop improved generic understanding of food systems and their vulnerability to GEC, scenarios and decision support.

Figure A2.2 shows the main meetings in the planning phase, and also shows how the regional planning process has also been influenced by developments in the GECAFS conceptual research agenda, and that in SAVI.

⁴ http://www.gecafs.org/gecafs_meetings/southern_africa.html

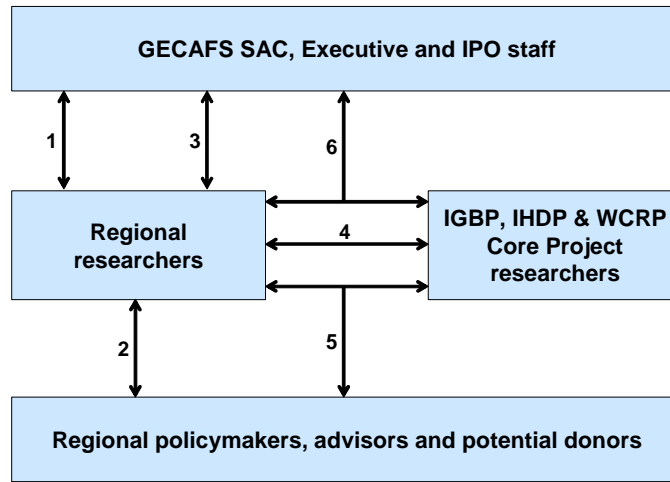


Figure A2.1 Key steps in design (Steps 1-3) and implementation (Steps 4-6) of GECAFS-SAF food systems research

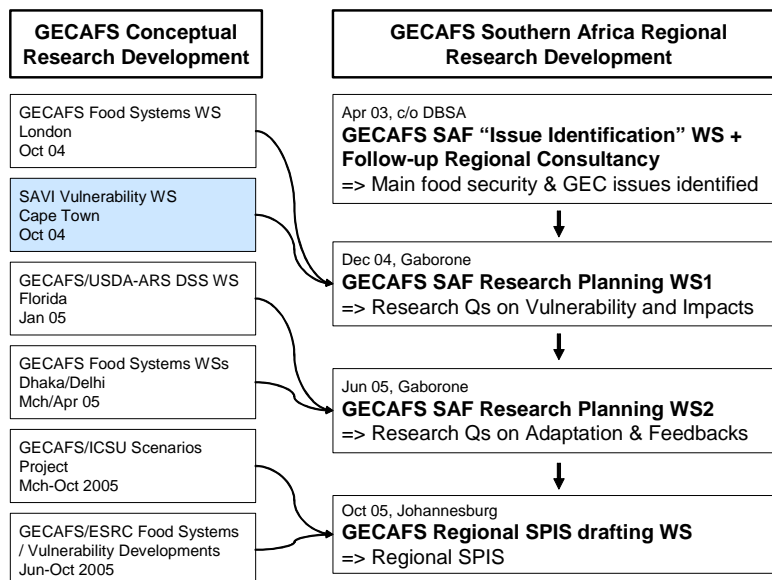


Figure A2.2: Development of GECAFS-SAF Science Plan and Implementation Strategy.

3

Annex

Research questions derived during GECAFS-SAF planning

The series of planning workshops (Annex 2) developed a large number of research questions, some of which have been brought together to derive the key questions listed in Section 3.3. This workshop output may well be useful in addressing these key questions, either singly or in combination, and is listed here. The order is not intended to reflect any particular emphasis.

GECAFS-SAF Vulnerability/Impacts questions (Q1)

- How do food systems vary across the region, especially subsistence vs. remittance/purchase?
- What are the trends in food availability, access and utilisation across the region?
- How does the vulnerability of food systems vary across the region and why?
- How will extreme weather events affect regional infrastructure related to bulk food storage and distribution?
- How do local socioeconomic and biophysical conditions determine how southern Africa's food systems operate?
- Which aspects of southern Africa's food systems (activities and outcomes) are most vulnerable to environmental stress and which stresses are most threatening?
- How does GEC affect the stresses, the determinants, and the interaction between them in southern Africa's food systems?
- How might food system vulnerabilities change and to what extent might GEC either heighten or mitigate these vulnerabilities?

Adaptation questions (Q2)

- In what ways do current technical, policy and institutional adaptation strategies at regional level fail to bring about change in food systems?
- What are the interactions among regional and national food system adaptation strategies and how will these affect sub-national conditions and decision making?
- How will GEC affect national comparative advantages for given crops?
- How would improved regional cooperation (in trade, infrastructure, research and development, strategic reserves, transboundary water management) help reduce vulnerabilities of food systems?
- How would changes in the philosophy of food aid donors affect adaptation strategies and capacity (regional self-reliance)?
- What are relative benefits of large-scale commercial farms versus small-holder schemes versus sustainable livelihood systems to adapt to GEC?
- What are current technical, policy and institutional food system adaptation strategies at sub-regional level?
- To what extent are food systems adapting to ongoing GEC; to other stresses; and to double exposure from GEC and globalisation (or other social and political pressures)?
- What are the current technical, policy and institutional food system adaptation strategies at sub-regional level?
- What are the potential technical, policy and institutional food system adaptation strategies at sub-regional level?
- What are relative costs and benefits (CBA) of targeted input strategies (e.g. fertilizer subsidies) versus resource transfer in other sectors (e.g. social safety nets)?

- How will changing the allocation of national resources towards agriculture and food issues help adapt to GEC?
- What is the role of governance in the development and implementation of food system adaptation options and strategies?
- What are the best ways to bring about cultural change towards different crops/food systems?
- What can be learned from adaptations of the last few decades to inform current and future food systems policy?
- What are the best criteria for evaluating adaptation of food systems to GEC?

Feedbacks Questions (Q3)

- How would transboundary water management affect national livelihoods and environmental parameters?
- How would transboundary water management affect regional diversification?
- What are the potential trade-offs, conflicts and synergies among adaptation strategies at the national level and regional goals?
- How would different adaptation strategies change regional-level biodiversity, and how would changes in biodiversity influence the capacity and options for adaptation at different levels?
- How will different food system adaptation strategies affect the region's economic development, and how will changes in economic development influence the capacity of food systems to adapt?
- How would diversification driven by emerging international marketing niches affect regional products?
- How would be the cultural consequences of relying on new foods?
- How would different adaptation strategies change biogeochemical cycling and national greenhouse gas budgets and how will changes in emissions influence the capacity to adapt?
- What are the feedbacks among national and regional adaptations, population movements and demographics and national food security?
- How would food- and seed-aid programmes affect local economies?

4 Annex

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5

Annex

Acronyms and abbreviations

AFRICANESS	African Network of Earth System Science	FEWSnet	Famine Early Warning System Network
AIACC	Assessments of Impacts and Adaptations to Climate Change	FS	Food Systems
AMPRIP	Agricultural Marketing and Regional Integration Project (of COMESA)	GCP	Global Carbon Project
APIS	Agricultural Potential and Trade Information System	GDP	Gross Domestic Product
BGCC	Botswana Global Environmental Change Committee	GEC	Global Environmental Change
CAADP	Comprehensive African Agricultural Development Programme	GECAFS	Global Environmental Change and Food Systems
CBA	Cost-Benefit Analysis	GECHH	Global Environmental Change and Human Health
CBO	Community Based Organisation	GECHS	Global Environmental Change and Human Security
CGIAR	Consultative Group on International Agriculture Research	GHG	Green House Gas
CIMMYT	International Maize and Wheat Improvement Centre	GLOBEC	Global Ocean Ecosystem Dynamics
CLIVAR	International Research Programme on Climate Variability and Predictability	GLP	Global Land Project
COMESA	Common Market for Eastern and Southern Africa	GOFX	Global Observation of Forest Cover
DFID	Department for International Development (of the UK)	GOLD	Global Observation of Land use Land Cover Dynamics
DIVERSITAS	An international programme of biodiversity science	GWSP	Global Water Systems Project
DSS	Decision Support System	ICSU	International Council for Science
ENSO	El Niño Southern Oscillation	ICWG-CC	Inter Center Working Group on Climate Change
ESRC	Economic and Social Research Council	IDGEC	Institutional Dimensions of Global Environmental Change
ESSP	Earth System Science Partnership (of DIVERSITAS, IGBP, IHDP & WCRP)	IFDC	International fertilizer Development Centre
FAO	Food and Agriculture Organisation (of the UN)	IFPRI	International Food Policy Research Institute
FAO-FIVIMS	FAO Food Insecurity and Vulnerability Information and Mapping Systems	IGBP	International Geosphere-Biosphere Programme
FANR	SADC Food, Agriculture and Natural Resources Directorate	IHDP	International Human Dimensions Programme on Global Environmental Change
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network	IPCC	Intergovernmental Panel of Climate Change
FARA	Forum for Agriculture Research in Africa	IPO	International Project Office
		IRS	Integrated Regional Studies
		IUCN-ROSA	The World Conservation Union's Regional Office for Southern Africa

LOICZ	Land-Ocean Interactions in the Coastal Zone	SADC	Southern African Development Community
MA	Millennium Ecosystem Assessment	SAF	Southern Africa
NAS	National Academy of Sciences	SAFNet	Southern Africa Fire Network
NEPAD	New Partnership for Africa's Development	SAKSS	Strategic Analysis and Knowledge Support System
NGO	Non-Governmental Organisation	SARCOF	Southern Africa Regional Climate Outlook Forum
NRF	National Research Foundation, South Africa	SAVI	Southern African Vulnerability Initiative
NSF	National Science Foundation	SCF	Save the Children Fund
ODI-RAPID	Overseas Development Institute, Research and Policy in Development	START	SysTem for Analysis, Research and Training
OVC	Orphan and Vulnerable Children	UN	United Nations
QnD	Questions and Decisions	UNDP	United Nations Development Programme
REWU	SADC Regional Early Warning Unit	UNEP	United Nations Environment Programme
RHVP	Southern Africa Regional Hunger & Vulnerability Programme	USAID	United States Agency for International Development
RISDP	SADC Regional Indicative Strategic Development Plan	USAID-RCSA	United States Agency for International Development - Regional Centre for Southern Africa
RSA	Republic of South Africa	VAC	Vulnerability Assessment Committee
RSC	Regional Steering Committee	WCRP	World Climate Research Programme
RVAC	Regional Vulnerability Assessment Committee	WFP	World Food Programme (of the United Nations)
SA/MA	Southern Africa Millennium Ecosystem Assessment		
SAC	Scientific Advisory Committee		

6

Annex

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