

Natural Resources and the Environment

NRE Research & Development Strategy

2010

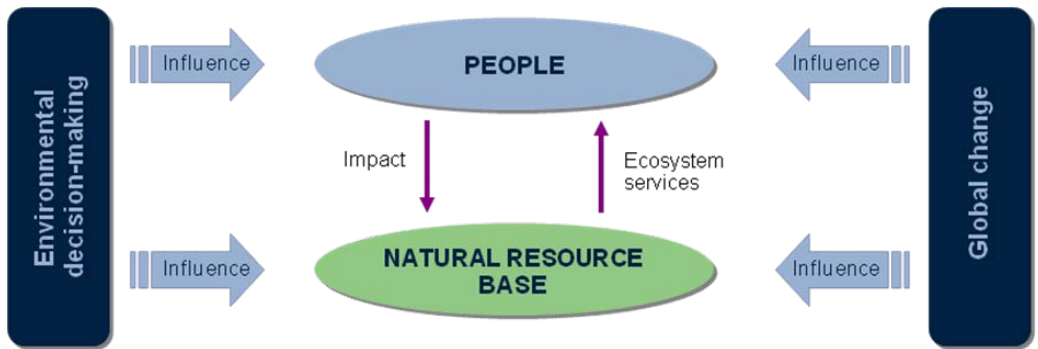


Figure 1: The relationship between four focus areas that provide the framework for a programme of directed research within NRE.

CONTENTS

1	Introduction	4
2	Scope of NRE research	5
3	Strategic R&D framework	6
4	Focus areas:	
4.1	The effective utilisation of the resource base	7
4.1.1	Theme 1: Forestry	8
4.1.2	Theme 2: Freshwater resources	9
4.1.3	Theme 3: Ecosystems	10
4.2	Global change	11
4.2.1	Theme 4: Global change and ecosystems	12
4.3	The interface between people and the environment	14
4.3.1	Theme 5: Pollution and Waste	14
4.3.2	Theme 6: Human health and the environment	16
4.4	Environmental decision-making	18
4.4.1	Theme 7: Environmental assessment and management	18
4.4.2	Theme 8: Energy	20

List of figures

Figure 1

The relationship between four focus areas that provide the framework for a programme of directed research within NRE 6

Figure 2

The three research themes associated with the focus area that addresses the effective utilisation of the natural resource base 7

Figure 3

Research under this focus area will take place within a single theme 11

Figure 4

The two research themes associated with the focus area that addresses the interface between people and the environment 14

Figure 5

The two research themes associated with the focus area that addresses environmental decision-making 18

1. Introduction

At the heart of the CSIR operation is the obligation to adhere to its founding purpose and mandate. The CSIR was constituted as a Science Council by the Scientific Research Council Act (Act No 46 of 1988, as amended by Act 71/1990), with the following objects (referred to here as the mandate):

“The objects of the CSIR are, through directed and particularly multi-disciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act.”

The CSIR NRE vision is

“to be the world-leading R&D unit contributing to the optimal utilisation of the natural resource base for the sustainable benefit of South Africa and Africa”.

The unit has defined its mission in line with the CSIR mandate and this vision is

“to conduct world-class, directed, inter-disciplinary research and technological innovation, with partners and stakeholders, in the field(s) of natural resources and the environment to contribute to the social, economic and environmental improvement of South Africa and Africa”.

This document outlines the NRE research and development (R&D) strategy that will underpin the unit's core activities.

2. Scope of NRE research

Environmental problems are complex and addressing them requires integrated approaches using a broad skills base. Researchers in NRE are on the one hand confronted by the need to cover a wide range of issues, while on the other hand to focus on fewer issues in order to improve their effectiveness and their chances of achieving real impact. We address this in two ways. Firstly, we focus on a few issues within selected theme areas. Secondly, we aim to provide integrated solutions based on our own basic research as well as that of others and working across disciplinary boundaries.

In reality, what NRE does, is defined by a range of factors, including:

- **What others do** – in other words, NRE will not address issues that are adequately provided for elsewhere;
- **What is important** – NRE is guided in this respect by its own understanding of environmental issues, as well as by national priorities; and
- How it can best utilise the particular set of skills and experience that it has.

In deciding on the content of our research, NRE uses this strategy to provide scientific-based solutions to the challenging environmental and natural resource issues facing society now and in the future.

3. Strategic R&D framework

The strategic framework comprises four focus areas (Fig. 1). These are:

- A primary concern around the natural resource base;
- An imperative to consider the potential impacts of global change on the natural resource base and the ecosystems upon which people depend;
- The need to manage the interface between people and the environment, both to reduce the negative impacts of degradation, pollution or disease, as well as to benefit sustainably from the services that ecosystems provide; and
- The improvement of environmental decision-making at all levels.

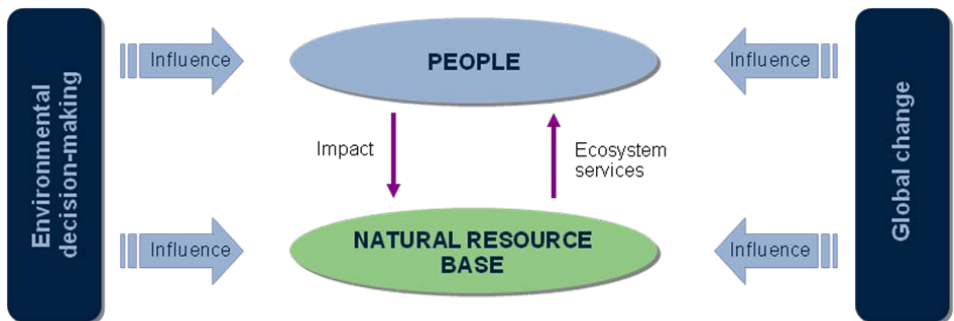


Figure 1: The relationship between four focus areas that provide the framework for a programme of directed research within NRE.

The purpose of the focus areas is to direct research so as to achieve both integration and focus. It is important to note that research focus areas are not aligned with competence areas within NRE, but rather that they provide a

framework within which the required competencies can be marshalled towards the achievement of our research goal. Each focus area will be associated with one or more themes, each of which is outlined below.

4. Focus areas

4.1 Effective utilisation of the resource base

This focus area will address three themes: forestry, freshwater resources and ecosystems (Fig. 2).

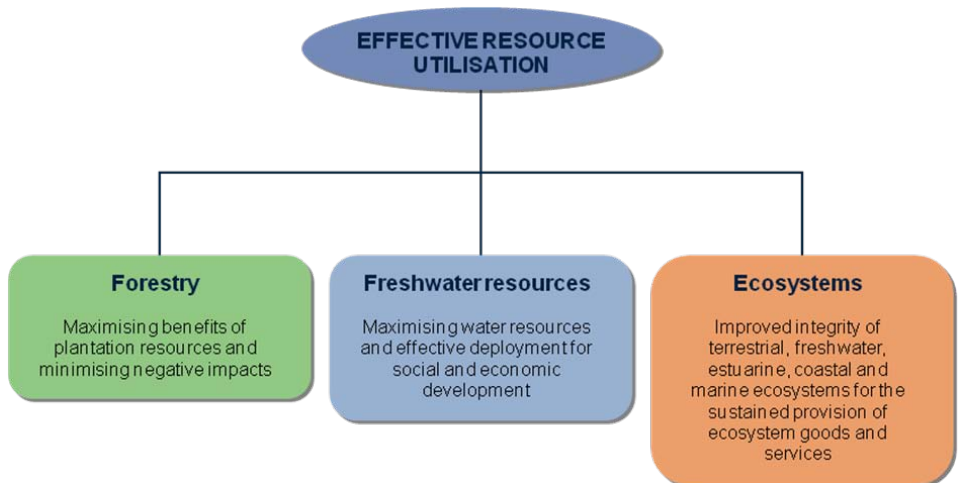


Figure 2: The three research themes associated with the focus area that addresses the effective utilization of the natural resource base.

4.1.1 Theme 1: Forestry

Need

Forestry competes with other potential land uses for land and water resources. A key challenge in the forestry, timber, pulp and paper (FTPP) sector is to maximise benefits of the forest plantation resource to society, with minimal environmental cost. A further challenge in the South African context is associated with the changes in ownership in the sector. Land ownership and processing of wood fibre has traditionally been conducted by large corporates. This is changing and there is an urgent need for research to address the specific needs of emerging growers and processing operations.

Approach

The theme applies to all sectors involved in growing and processing natural fibre (predominantly timber fibre), including government, the private sector and rural tree-growers, conservation bodies and investors.

The theme is aimed at achieving the following:

- Maximising the quality and quantity of the plantation resource;
- Maximising the value derived from the plantation resource through the development of novel processing and products;
- Using the plantation resource and processing operations in support of local development; and
- Providing insight on how best to avoid and manage the negative environmental consequences of the FTTP sector.

Key research areas include:

- Development of appropriate plantation species and hybrids

- for a competitive South African sector
 - for small/emerging growers, especially in marginal areas
 - using innovative deployment technologies to support uptake of novel germ plasm for plantations;
- Development of a predictive understanding of wood properties in plantations to ensure maximum profitability, efficiency and productivity of the resource base and processing operations;
 - Basic research on wood chemistry and structure;
 - Competitive processing technologies (high-yield pulp optimisation);
 - Improved efficiency of recovery of recycled fibre; and
 - How best to use the plantation resource and processing industries in support of local development.

4.1.2 Theme 2: Freshwater resources

Need

South Africa is an arid country and faces an imminent shortage of water. Water shortage is aggravated by the poor quality of raw water, arising from pollution, and the need to share water with neighbouring countries on an equitable basis.

Approach

The theme will be targeted at government (regionally and within South Africa at national, catchment and municipal levels), the private sector (including mining, industry and agriculture) and society at large which must be empowered through knowledge). The theme focuses on securing, sharing and sustaining South African water resources:

Securing:

- Illustrate how water available to users for development can be increased and secured specifically and significantly beyond current “balance” estimates; and
- Develop scenarios and strategies that result in a conceptualised and developed national plan for long-term water security in South Africa.

Sharing:

- More equitable and increased distribution of water-related benefits among South Africa and its neighbours; and
- Demonstrate how to break down current barriers preventing us from more rapidly reaching national development goals.

Sustaining:

- Determine and evaluate the appropriateness of existing and novel mechanisms that incentivise wise water use.

4.1.3 Theme 3: Ecosystems

Need

This theme addresses the problems of degradation of ecosystems and the accompanying risks to the ability of these ecosystems to provide a range of services to humanity. It seeks to improve our understanding of the links between coupled ecosystems and strives to find means to adequately prioritise, protect, sustainably utilise and develop ecosystems in a holistic manner.

Approach

The theme will be targeted at government (regionally and within South Africa at national, provincial, and municipal levels), conservation and rurally-focussed NGOs, private landowners, the fishing industry and developers.

The theme is aimed at improving the integrity of ecosystems, including terrestrial, freshwater, estuarine, coastal and marine ecosystems, by establishing approaches to ensure the holistic, integrated and sustainable management of such ecosystems, so that they retain their integrity and resilience in order to continue to deliver significant ecosystem services. Currently, all ecosystems research falls within the global change focus area and theme.

4.2 Global Change

Research under this focus area will take place within a single theme (Fig. 3).

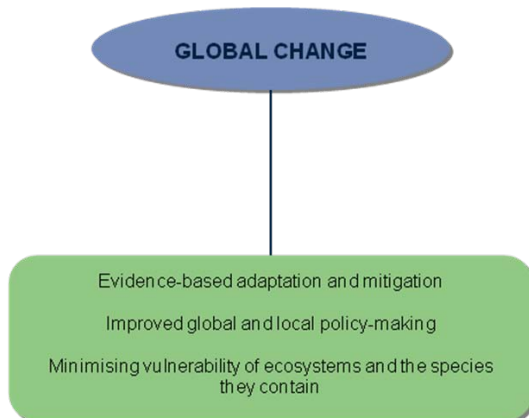


Figure 3: The focus area of global change will contain a single research theme.

4.2.1 Theme 4: Global change and ecosystems

Need

Global change refers to an interconnected set of phenomena, resulting largely from human interactions which have altered the environment over virtually the entire planet at an accelerating rate during modern times. It includes

- changes to the composition of the atmosphere and oceans (biogeochemistry and ocean acidification);
- the nutrient loading of the biosphere;
- the global, regional and local climate;
- the distribution and abundance of species;
- the cover and use of the land surface;
- the use of marine and coastal goods and services; and
- the size, location and resource demands of the world's human population, as well as its patterns of governance and economic activity.

South Africa is likely to be particularly vulnerable to global change, given its aridity, highly diverse ecosystems and the high dependence on ecosystem services for water, agriculture, fisheries, forestry and tourism. Southern Africa is also influenced strongly by oceanic systems such as the southern oceans and El Niño.

Approach

The theme focuses on understanding the consequences of global change to southern African socio-ecological systems and the impact of the surrounding oceans on them. The desired outcomes are:

- Understanding a changing planet – by providing the basic understanding of drivers, changes and trends of the earth system, and the impacts of these on the ecosystem services that support the economy and quality of life; and
- Adapting the way we live – by acquiring scientific information to inform strategies to improve resilience and sustainability in a variable and changing environment.

Key research areas are:

- Understanding a changing planet;
- Observation and monitoring;
- Long-term environmental observation;
- Earth observation, using remote sensing technologies;
- Ocean dynamics around southern Africa;
- Improved measurements of southern ocean dynamics;
- Managing the drivers of coastal system dynamics;
- Linking air, land and sea;
- Coupled modelling of the earth system;
- Ocean / atmosphere and land / atmosphere interfaces - improved characterisation and interactions;
- Adapting the way we live;
- Understanding vulnerability and building resilience; and
- Preparing for rapid change and extreme events.

4.3 Interface between people and the environment

This focus area has two themes: Pollution and waste, and human health and the environment (Fig. 4).

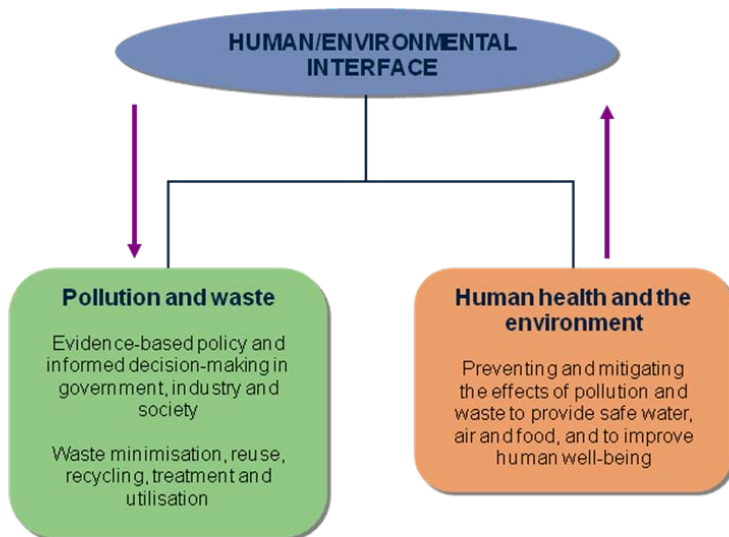


Figure 4: The two research themes associated with the focus area that addresses the interface between people and the environment.

4.3.1 Theme 5: Pollution and Waste

Need

Research into pollution and waste management is undertaken in view of the impact of an increasing population and a strong national focus on industrial, agricultural and urban growth on the environment. The research challenge lies in breaking the link between South Africa's

economic development and the resultant waste and pollution generation (across all media; air, water and soil). With this in mind, NRE research in pollution and waste aims to address the core problem of increasing anthropogenic waste and pollution and the resultant risk to the environment and human health.

Approach

The theme will be brought to the attention of national and local government (the environment, health and water ministries), industry and waste service providers.

Key research areas are:

- Assessing the problematic situation of the resource base, across all media (air, water [inland and marine] and soil) and the analysis and interpretation of this information to form the cornerstone of informed response, whether it be through evidence-based policy development or implementation, society intervention, or technology development;
- Waste and society. The research focus here is on evidence-based decision-support to government, society and industry, focusing on the upper part of the waste hierarchy (reuse, recycling, energy recovery), with a focus on domestic, commercial and industrial waste streams; and
- Technology intervention in pollution and waste. Technology solutions for waste treatment, product recovery and pollution mitigation focus largely on support to industry and municipalities (e.g. industrial and municipal wastewater treatment), thereby supporting the objectives of sustainable development and industrial ecology.

Key priorities for 2010 to 2013 are

- Aiming for improved service delivery through the provision of knowledge; particularly through

- the development and dissemination of best-practice guidelines for municipal waste management; and
- improved municipal waste-water treatment;
- Growth of capabilities related to acid mine drainage; including
 - transfer of acid mine water treatment technologies on demonstration and full scale operations; and
 - development of a strategic approach to technology development / improvement;
- Application of existing CSIR technologies to new waste streams;
- Establishment of research partnerships around air quality; and
- Development of a solution-focused approach to pollution of the natural resources, through identification and assessment of key issues.

4.3.2 Theme 6: Human health and the environment

Need

The link between the environment and human health and well-being, has long been acknowledged. A study by the World Health Organization (WHO) showed that an estimated 24% of global disease and 23% of all deaths in Africa (estimated at 2.4 million) can be ascribed to avoidable environmental hazards and that there was a greater tendency for such conditions to impact upon the poor and most vulnerable groups in underdeveloped countries. An estimated 33% of disease in children under the age of five years is also believed to be due to environmental hazards. The main diseases influenced by environmental factors include diarrhoea, lower respiratory infections and malaria. The draft national environmental health policy for South Africa identifies water-borne diseases; acute respiratory tract

infections; lung diseases; vector-borne diseases; food-borne illnesses and chemical poisoning as diseases associated with environmental health in South Africa.

According to the WHO country profile of environmental burden of disease, South Africa is “strongly underestimating” the health impacts caused by the environment with 118 400 environment related deaths per year (16%). At least 12 300 deaths per year are attributed to water, sanitation and hygiene (diarrhoea only), 3 200 to indoor air quality and 1 100 to outdoor air quality. An estimated 69 disability-adjusted life years (DALYs) per 1000 persons are lost due to environmental burden of disease, per annum in South Africa. This makes a significant percentage of disease, death, disability and associated economic burden, preventable in South Africa through the control of hazardous environmental factors.

Approach

The theme will be targeted at national and local government (the environment, health and water ministries), industry, and waste service providers.

Several NRE themes identify pollution and the effects of pollution on ecosystems. This theme addresses the implications of that pollution and the degraded ecosystems on human health.

The theme focuses on assessing the risk of environmental (pollution) factors (sources, pathways, receptors, and vulnerability to human health. It includes aspects of

- Social vulnerability
- Prevention and control and
- Socio-economic implications.

4.4 Environmental decision-making

There are two themes under this focus area: Environmental assessment and Energy (Fig 5).

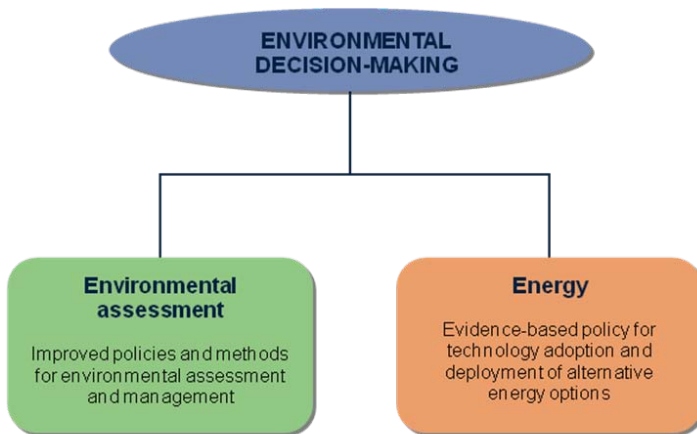


Figure 5: The two research themes associated with the focus area that addresses environmental decision-making.

4.4.1 Theme 7: Environmental assessment and management

Need

It is essential that decision-making associated with development and development initiatives (e.g. Asgi-SA, NEPAD, etc.) is properly informed and guided by effective and efficient environmental

assessment and management (EA&M) to ensure that the intended benefits are sustainable. However, during the past five years there has been an increase in the expression of frustrations associated with the effectiveness and efficiency of EA&M in South Africa. These frustrations are primarily associated with the perceived delays caused by EA&M processes, as well as with the quality and efficacy of process outcomes and the associated decisions. Although the most vocal concerns from stakeholders, environmental practitioners, business and government have been primarily associated with the environmental impact assessment process, the problems are much broader and are influenced by both limitations in current praxis and theory associated with the full suite of approaches used for EA&M and development planning.

The complexity and integrative concepts of sustainability are not sufficiently addressed by current EA&M theory, approaches and practice. Therefore there is an urgent need for improvement and the development of new approaches which can more effectively guide decision-making towards achieving sustainability.

Approach

The theme aims to provide solutions that will be used by EA&M practitioners, developers and regulators alike. The desired outcome of the theme is improved EA&M decision-making to direct development in southern Africa along sustainable trajectories. This will be achieved by the following approach:

- Advancement of current EA&M theory and sustainability science to better understand how to address the complex and integrated concept of sustainability;
- Development of existing and new tools and approaches for EA&M, informed by a new theoretical approach and based on case studies of applications; and
- Mainstreaming of integrative and systemic approaches for understanding and managing social-ecological systems.

4.4.2 Theme 8: Energy

Need

Energy is an important input for economic growth and development. This theme addresses the need to secure sufficient energy to meet South Africa's needs, while at the same time minimises the potentially adverse environmental impacts of the wide-scale adoption of alternatives to the use of fossil fuels.

A further challenge in South Africa (and elsewhere in Africa) is that many rural communities still lack access to modern and appropriate energy services. Consequently, the quality of essential services that could assist in improving their livelihoods (e.g. income-generation opportunities, schooling, access to health care and clean water) are severely compromised.

Approach

The goal of this theme is to improve the diversity and efficient use of energy resources for grid and non-grid applications that do not compromise the integrity of social-ecological systems. In non-grid applications, the aim is to promote increased access to modern energy services, mainly in low-income communities, by facilitating the adoption of new technologies in order to contribute to improved livelihoods.

The goal is achieved through R&D in support of:

- Policy advice;
- Appropriate scenario analyses and resource planning;
- Technology selection;
- Successful technology diffusion approaches;

- Energy options assessment and management;
- Sustainability assessment frameworks;
- Resource planning and evaluation models and tools;
- Management frameworks and procedures for technology development;
- Energy technology guidelines;
- Energy end-use analysis ;
- Energy diffusion for productive activities;
- Sustainable energy financing and diffusion models; and
- Integrated energy and development planning.

The theme aims to provide solutions to be used by government (the ministries responsible for energy, science and technology, and the environment, as well as parliament and the presidency), energy suppliers (both Eskom and independent power providers), local government, NGOs, and the international science community.