Journal of Environmental Assessment Policy and Management
Vol. 10, No. 4 (December 2008) pp. 333–360

Imperial College Press
www.icpress.co.uk

ENVIRONMENTAL MANAGEMENT FRAMEWORKS AS AN ALTERNATIVE TO FARM-LEVEL EIA IN A GLOBAL BIODIVERSITY HOTSPOT: A PROPOSAL FROM THE CAPE FLORISTIC REGION, SOUTH AFRICA

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Received 21 November 2007
Revised 26 August 2008
Accepted 28 August 2008

Cultivation has been the primary driver of habitat transformation in South Africa. This paper explores the effectiveness of agricultural and, latterly, Environmental Impact Assessment (EIA) authorisation procedures in stemming biodiversity loss resulting from cultivation in the lowlands of the Cape Floristic Region, a global biodiversity hotspot. Owing to an activity-based focus, agri-environmental regulation has been largely unable to mitigate the cumulative effects of large-scale land clearance in threatened ecosystems. Case studies in the Sandveld and Slanghoek districts are used to argue that revised EIA regulations published in 2006 partly perpetuate the structural shortcomings of activity-based EIA. An ecosystem-based strategy for agri-environmental screening in biodiversity hotspots is introduced, drawing on conservation plans, the agricultural LandCare programme and the provision for Environmental Management Frameworks (EMF) in the 2006 EIA regulations. "Agri-EMFs", as a collaborative initiative that involves government, agricultural and non-governmental representatives, may present an effective alternative to the inefficiencies of project-level EIA.

Keywords: EIA; agriculture; threatened ecosystems; Environmental Management Frameworks.

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Introduction: Environmental Assessment, Agriculture and Biodiversity

The introduction of Environmental Impact Assessment (EIA) to the agricultural domain is a relatively recent development in South Africa and its utility to agri-environmental sustainability assurance has yet to be established. Early indications suggest that EIA promises more than it can deliver.[1]

Limitations on the effectiveness of EIA, and its attendant biodiversity assessment, in an agriculture context include:

- A reactive and piecemeal focus on cultivation-related impacts at the level of the farm rather than anticipating and assessing changes to affected ecosystems that are not confined to property boundaries;
- An inability to anticipate and manage cumulative impacts arising from repeated, often similar, farm-level perturbations that individually may not seem significant but aggregate and manifest themselves negatively at scale;
- A lack of sustainability objectives that give strategic guidance to land-use planning and decision making in areas with high biodiversity and agricultural value;
- The relative isolation of farms and their distance from major centres that can impose significant time and travel expenses on EIA processes and reduce the value of public participation; and, allied to this,
- The risk of regulatory non-compliance and delays because farmers prefer to "go it alone" due to the perceived high costs of appointing an Environmental Assessment Practitioner (EAP).

These shortcomings are certainly not unique to EIA in South Africa or in its application to agriculture (cf. Thérivel *et al.*, 1994; Brown and Hill, 1995; Treweek, 1996; Glasson *et al.*, 1999; Dalal-Clayton and Sadler, 2005). It is in agricultural settings, though, with its large-scale use of land, where biodiversity loss and ecological degradation have been most extensive, and where regulatory and market failure have been most evident (The World Bank, 1991; Hoffman, 1997; Cowling *et al.*, 1999a; UNEP, 1999; Department of Environmental Affairs and Tourism (DEAT), 2005a; Rouget *et al.*, 2006).

EIA and land-use decision making have a particularly crucial role in those landscapes where formally protected areas alone will be insufficient to achieve targets for the conservation of threatened biodiversity (Brownlie *et al.*, 2005). One such example is the Cape Floristic Region (CFR), a global biodiversity hotspot. In terms

[1] In this paper, the term "Environmental Assessment" (EA) is defined as the general form that includes Strategic Environmental Assessment (SEA) of policies, plans and programmes and Environmental Impact Assessment (EIA) of projects, as per usage in the International Study of the Effectiveness of EA (Sadler, 1996).

of a systematic conservation plan for this bioregion, Cowling *et al.* (2003) concluded that 42% of the extant area of the CFR had to be allocated some form of conservation management in order to promote the persistence of the region's documented biodiversity. Most of this land is in private ownership. With conservation being realigned towards securing threatened habitats and ecosystems on privately owned farmland, an ecosystem-wide application of EA represents a potentially useful means of facilitating ecologically, socially and economically justifiable trade-offs between biodiversity and agricultural imperatives. There are strong indications that conventional (i.e., project or activity-specific) EIA cannot alone fulfil this task effectively.

According to a major study on the institutional context of biodiversity conservation in the CFR, institutional fragmentation and uncoordinated government action were the principal causes of reduced efficiency and effectiveness in the conservation and management of biodiversity in the region (CSIR, 1999). It is argued that inefficiencies arising from fragmented, activity-based EIA procedures in the agricultural domain can be countered by means of a strategic, ecosystem-based approach that harnesses systematic conservation plans to agricultural LandCare area-wide planning and statutory Environmental Management Frameworks. In this scenario, EIA is reassigned to assessing, where appropriate, the "fit" of an agricultural activity or project with the greater, strategic framework and providing more detailed information on the significance of impacts in particular locations.

The environmental impacts of cultivation in South Africa

Extensive clearing of land, arresting of natural succession and simplification of agro-ecosystems are the primary environmental impacts associated with the conversion of natural habitat to intensive agriculture (Giliomee, 1996; Ryskowski and Jankowiak, 2002: Rodrigues *et al.*, 2003; Reidsma *et al.*, 2006).

Unsustainable agricultural practices translate into impacts on biodiversity at the ecosystem, species and genetic levels (Convention on Biodiversity, 2001), resulting in the large-scale degradation of agri-biodiversity and habitats. Where the receiving environment is no longer able to absorb these impacts, natural capital is reduced, ecosystem goods and services are compromised and agriculture may no longer be sustainable (Aronson *et al.*, 2007). For example, in the Little Karoo region of the Western Cape province, clearing for cultivation and commercial ostrich farming have resulted in changes in hydrology and sedimentation patterns that have reduced the productivity and viability of farming in the region over the past century, and facilitated invasion of water courses by alien trees (Le Maitre *et al.*, 2007).

Globally, there is a spatial overlap of agricultural land-use with areas of high conservation value that holds the risk of extinction for potentially vulnerable species (Mattison and Norris, 2005). Intensive agriculture ("croplands" or "cultivation") has been the single greatest driver of irreversible habitat loss in South Africa, Lesotho and Swaziland (Scholes and Biggs, 2004; Rouget *et al.*, 2006). It is estimated that nearly 18% of South Africa's natural land cover is transformed, mainly by cultivation (10.5%), degradation due to sheet and gully erosion (4.5%), urban land use (1.5%) and forestry (1.4%) (DEAT, 2006). The impacts of cultivation on biodiversity have been felt most intensely in the grassland and fynbos biomes (Rouget *et al.*, 2006; Hoffman, 1997). Altogether 66% of South Africa's 21 "Critically Endangered" terrestrial ecosystems occur in the Fynbos Biome (Driver *et al.*, 2005). This biome is the major eco-regional constituent of the Cape Floristic Region (CFR), which has the highest known concentration of Red List plant species in the world, numbering 1 406 species (Cowling and Richardson, 1995). Owing to its high concentration of endemic taxa, especially plants, and vulnerability to processes that threaten its biodiversity, the CFR is one of 34 global biodiversity hotspots (Cowling and Heijnis, 2001; Mittermeier *et al.*, 2005). The CFR is also one of nine national priority areas for conservation action in South Africa (Driver *et al.*, 2005). The marked overlap of threatened ("Endangered" and "Critically Endangered") ecosystems and the Fynbos Biome is shown in Fig. 1.

Biodiversity loss has been particularly acute in those Fynbos Biome vegetation types (such as renosterveld) associated with the relatively fertile shale and

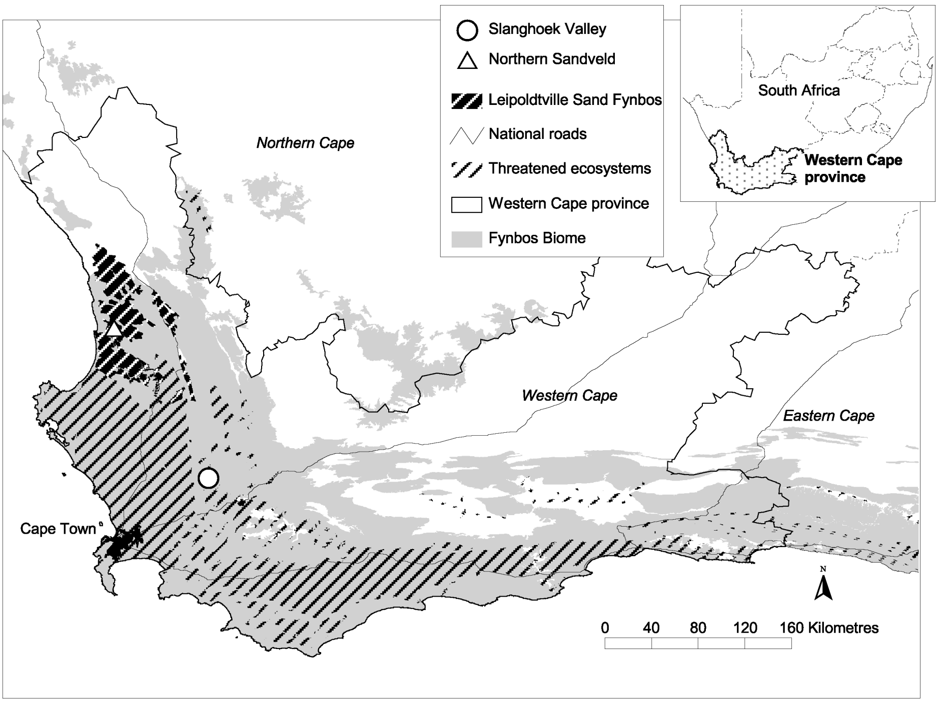


Fig. 1. The distribution of threatened ecosystems in the Fynbos Biome.

granite-derived soils of the Western Cape lowlands that also provide conditions suitable for the cultivation of cereals adapted to a Mediterranean climate (Hoffman, 1997). The challenge in addressing these pressures is to effectively conserve biodiversity while sustaining an economic growth rate of 6% per annum that halves poverty and unemployment by 2014 (DEAT, 2007).

"Biodiversity mainstreaming" in agricultural planning

As a signatory to the Convention on Biological Diversity (CBD), South Africa has a commitment to the implementation of the Global Strategy for Plant Conservation (GSPC) (Willis, 2006). One of the targets of the South African response to the GSPC is "Conserving plants within production lands", which states that 30% of production lands must be managed in a manner consistent with the conservation of plant diversity (Willis, 2006). Furthermore, the South African National Biodiversity Strategy and Action Plan (NBSAP) views "biodiversity mainstreaming" into all levels of EA as an urgent priority (DEAT, 2005a; Van Schalkwyk, 2006). In terms of the NBSAP's definition (DEAT, 2005a: p. 26),

> "Mainstreaming implies that the full value of biodiversity should be recognised, so that activities that conserve biodiversity or use it sustainably should be rewarded economically and/or in other ways, while activities that destroy biodiversity should bear the associated cost".

In furtherance of these "mainstreaming" commitments, the South African National Biodiversity Framework identifies the development of tools (such as ecosystem guidelines for EIA) that support and streamline environmental decision making as a priority for conserving biodiversity (DEAT, 2007). In the agricultural domain, the body representing organised commercial agricultural interests, Agri-SA, is identified as a lead agency for promoting biodiversity-friendly resource use. In the Western Cape, in turn, the provincial Department of Environmental Affairs and Development Planning (DEADP) and the South African National Biodiversity Institute (SANBI) have a joint project for mainstreaming biodiversity in the EIA and land-use planning sectors. This initiative is funded by the Global Environment Facility through the World Bank.

EIA and Agricultural Regulation in the Western Cape Province, South Africa

As noted by De Villiers and Turner (2000), official decision making about the transformation of habitat on agricultural land with high biodiversity significance in the Cape Floristic Region (CFR) is legally, administratively and functionally divided between at least three statutory agencies with different objectives and powers.

EIA (predominantly a function of provincial government) is a relatively recent addition to the agricultural regulatory framework in South Africa. Prior to the promulgation of the first EIA regulations in September 1997, the Conservation of Agricultural Resources Act (CARA) 43 of 1983 (Republic of South Africa (RSA), 1983) was the chief statute dealing holistically with agricultural resources (Glazewski, 2000). The CARA is enforced by the National Department of Agriculture (NDA). Provincial agricultural departments, such as the Western Cape Department of Agriculture, provide extension and advisory services in support of the national department. The EIA regulations are enforced by the Department of Environmental Affairs and Development Planning (DEADP) in the Western Cape. CapeNature has statutory responsibility for biodiversity conservation in the province. CapeNature does not have regulatory powers and its role is limited to commenting on the biodiversity aspects of applications for agricultural and environmental authorisations (De Villiers, 2007).

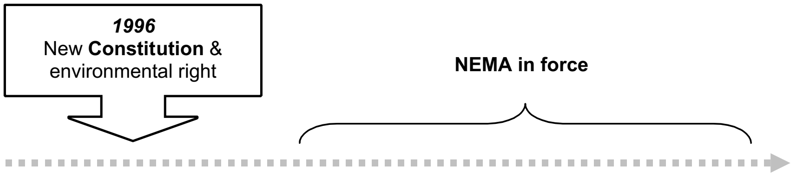
This section provides an overview of the main shifts in agri-environmental regulation over a 22-year period, namely:

— January 1984–September 1997: Exclusive control under the CARA over cultivation-related decisions;
— September 1997–July 2006: Limited EIA coverage of cultivation under the Environment Conservation Act 73 of 1989 (the CARA still predominates);
— January 1999: The National Environmental Management Act 107 of 1998 (NEMA) comes into force, but with limited influence over agri-environmental decision making; and,
— July 2006–present: A revised EIA system introduced under NEMA brings cultivation directly under the control of the state's environmental regulatory function (the CARA still in force).

Figure 2 provides an overview of this regulatory time line, which is further elaborated in the following sub-sections. This section concludes with an assessment of the effectiveness of agri-environmental land-use control as a biodiversity safeguard in the context of the development of large scale potato production in the Sandveld region of the Western Cape.

The conservation of Agricultural Resources Act: January 1984–September 1997

The CARA came into force in 1984. It has direct relevance to the conservation of biodiversity on farmland as one of its chief control measures is



	1984	1997 (Sept)	1999	2002 (May)	2006 (July)
Laws and regulations	**Conservation of Agricultural Resources Act (CARA) promulgated.**	**EIA regulations published under the Environment Conservation Act (ECA).**	**National Environmental Management Act (NEMA) promulgated.**	**ECA EIA regulations amended.**	**NEMA EIA regulations published.**
Provisions relating to agri-environmental regulation	Controls over the ***cultivation of virgin soil***: permit needed to cultivate land that has not been mechanically disturbed in preceding 10 years.	***Change of land use*** from grazing to any other agricultural use requires environmental authorisation.	National environmental principles serve as ***guidelines*** to all official decisions that may significantly affect the environment.	Provision that cultivation of ***virgin soil*** requires environmental authorisation; not enforced in the Western Cape province.	Clearance of indigenous vegetation ≥3 ha needs Basic Assessment. Projects ≥20 ha must undergo full EIA. Introduction of ***Environmental Management Frameworks***.

Sandveld potato boom, following electrification of region

Identification of biodiversity priorities by means of systematic conservation planning

* Cape Floristic Region (1999), Succulent Karoo and Sub-tropical Thicket biomes (2003).
* National Spatial Biodiversity Assessment published in 2005.
* Biodiversity mapping scales improve: 1:250 000 (c. 1999-2003) to 1:10 000 (2008).

Fig. 2. Time line for agricultural-environmental regulation in South Africa.

concerned with regulating the clearance of "virgin soil" for cultivation where "virgin soil" refers to land "which in the opinion of the executive officer has at no time during the preceding ten years been cultivated" (RSA, 1983, Section 1, "Definitions").

South African agricultural conservation policy between 1910 and the 1950s was dominated by "the language of efficiency" (Beinart and Coates, 1995: p. 65), which culminated in a policy of "optimal resource utilisation" in the 1970s (Donaldson, 2002: p. 43). Since the promulgation of the CARA, the definition of agricultural "resource use" has moved towards a more inclusive and holistic notion of "conservation farming" that aims to secure ecosystem goods and services linked to biodiversity (Donaldson, 2002).

However, the administration of the CARA is strictly interpreted in terms of the objectives of the Act, namely the conservation of agricultural resources, which includes maintaining the productive potential of land, combating erosion, protecting vegetation and combating weeds and invader plants (De Villiers, 2007). Considering aspects such as ecologically sustainable development or adjudicating cultivation applications by means of a broad definition of "the environment" (or "agri-biodiversity"), formally lie beyond the administrative purview of the NDA's Directorate: Land-Use and Soil Management. The CARA does not require that off-site impacts or alternative land use options be considered by applicants. Neither do its procedures require public participation. Cultivation permits are issued for individual, cadastrally-defined land parcels and typically include conditions relating to soil conservation works to divert run-off, establishment of fields perpendicular to the dominant wind direction, and the planting of cover crops on cleared lands (De Villiers, 2007).

EIA regulations under the Environment Conservation Act: September 1997–July 2006

The official system of environmental authorisations established a tenuous hold over the transformation of land for agricultural use with the inclusion in September 1997 of the "change of land use from use for grazing to another agricultural use" (RSA, 1997a: Item 2(d)) as an activity requiring authorisation in terms of section 21 of the Environment Conservation Act 73 of 1989 (ECA) (RSA, 1989). Indications are, however, that this listed activity was rarely enforced by the environmental authorities.

In the Western Cape, this situation was to remain unchanged until the introduction of a revised EIA system in July 2006 under the National Environmental Management Act 107 of 1998 (NEMA) (RSA, 1998). An amendment to the ECA EIA regulations in May 2002 that identified the "cultivation or any other use of virgin ground" as a listed activity requiring environmental authorisation (RSA, 2002: Item 10) was not enforced in the Western Cape because the amended regulations did not stipulate a commencement date for this additional listed activity (De Villiers, 2007). In practice, this meant that the cultivation of virgin soil was rarely subject to the type of broad environmental scrutiny, mandatory consideration of alternatives, public participation or biodiversity impact assessment that would have applied were a farmer to have undertaken other listed activities such as bulldozing a track, diverting a watercourse, or constructing chalets on a farm.

The National Environmental Management Act: January 1999–July 2006

Although the CARA remained the primary statutory instrument for controlling the agri-environmental aspects of cultivation, its provisions were supposed to have been implemented from 1999 onwards in accordance with the principles of the newly promulgated NEMA (RSA, 1998).

The NEMA is based on a set of national environmental management principles which require that development must be socially, environmentally and economically sustainable. In terms of section 2 of the Act, an authority such as the NDA must, in the exercise of its powers under the CARA, consider factors such as avoiding, minimising and remedying the disturbance of ecosystems and avoiding jeopardising ecosystem integrity. Similarly, the NEMA requires that specific attention must be paid to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems, especially when they are subject to significant human resource usage and development pressure. The national environmental management principles also state that public participation must be promoted in the course of decision making processes that may significantly affect the environment. The CARA application procedures were not modified to require public participation subsequent to the promulgation of the NEMA. Unless an application for a permit under the CARA also triggered a parallel need for environmental authorisation of a listed activity, decisions about the cultivation of virgin soil were taken without any public oversight (De Villiers, 2007).

The Sandveld: A model case of regulatory failure?

A schematic picture can be drawn of the environmental regulation of cultivation in South Africa prior to the introduction of the NEMA EIA regulations in July 2006 by referring to the effects of a potato boom on biodiversity and groundwater systems in the Sandveld district.

The Sandveld is located about 160 km north of Cape Town in the Western Cape (Fig. 1). It covers about 2500 km^2 of undulating sandy flats, sandstone koppies (buttes) and shallow wetlands. The Sandveld represents the most threatened component of the Greater Cederberg Biodiversity Corridor.

The introduction of electricity to the area in the late 1980s supported intensive groundwater abstraction at cheap rates, which unleashed boom conditions for centre-pivot, irrigated potato farming. Large-scale clearance of land and borehole development resulted in a dramatic loss of indigenous vegetation and major pressures on groundwater. The Department of Water Affairs and Forestry (DWAF) estimates an annual water deficit of six million m^3 for the Sandveld, attributable to urban and irrigation water requirements that exceed the limit of available resources

(DWAF, 2005; C.A.P.E., 2006). Shortfalls are made up by over-exploitation of groundwater. Resulting impacts include reduced borehole yields, saline contamination of aquifers and degradation of groundwater-dependent ecosystems (C.A.P.E., 2006).

The impact on Leipoldtville Sand Fynbos, an “Endangered” ecosystem, has been enormous. CapeNature calculates that 11 692 ha of Leipoldtville Sand Fynbos was transformed between 1989 and 2001, amounting to the equivalent of 2,7 ha of pristine vegetation being cleared daily for 12 years (Love and Burger, 2004). By 2004, about 86 600 ha of the Sandveld had been placed under either potato or rooibos tea cultivation (Love and Burger, 2004; Burger, pers. comm.). A significant percentage of this clearance of vegetation was believed to be illegal as producers had not obtained the necessary authorisations (Ranger, 2006). The widespread and rapid conversion of the Sandveld to intensive agriculture has caused irreversible loss of “Endangered” habitat and ecosystem functioning, undermined the ability to meet national biodiversity conservation targets for Leipoldtville Sand Fynbos, and increased the long-term vulnerability of agriculture in the region to the impacts of climate change (C.A.P.E., 2006).

All cultivation in this period would have required a permit under the CARA, unless fields were to be established on land cultivated in the previous 10 years. EIA authorisation may have been required from September 1997 onwards if land had been grazed previously, but this would have been exceptional. The situation outlined here reflects a significant failure on the part of the agri-environmental regulatory system to ensure that farming in the Sandveld met the most basic requirements for environmental sustainability, i.e., that the use of natural resources could be supported in the long term by the natural environment (Aronson *et al.*, 2007; Payraudeau and Van der Werf, 2005).

From the foregoing account, it may be reasonable to conclude that the advent of the NEMA EIA regulations in 2006 can only represent an improvement on an ignominious precedent. This may not be the case. Various explanations (e.g., CSIR, 1999; De Villiers and Turner, 2001; De Villiers, 2007) have been offered for weak enforcement of legal controls over changes in land-use in an agricultural context in the Cape Floristic Region. The section on “Implementation Challenges” seeks to explain some of the obstacles that appear to have inhibited the effective implementation of EIA on farms.

The NEMA EIA regulations: Post July 2006

The promulgation of the NEMA EIA regulations on 3 July 2006 marked a watershed in agri-environmental decision making (RSA, 2006a). Of direct relevance to the conservation of biodiversity on privately owned farmland was the listing of “the transformation or removal of indigenous vegetation of 3 ha or more” as an activity that has to undergo a Basic Assessment as a precondition for environmental authorisation (RSA, 2006b: Item 12). A Basic Assessment is required regardless of the condition, functional viability or disturbance history of the affected vegetation. Where the proposed development would be 20 ha or more, a full EIA is required (RSA, 2006c).

No threshold applies to the removal of "Critically Endangered" or "Endangered" indigenous vegetation listed as "threatened" in terms section 52 of the National Environmental Management Biodiversity Act 10 of 2004 (RSA, 2004). The protection extended to threatened ecosystems by the NEMA EIA regulations depends on these ecosystems being gazetted as "threatened", and until this is done surviving remnants of less than 3 ha will be exposed to transformation without any formal environmental safeguard (De Villiers, 2007).

Implementation Challenges for EIA in an Agricultural Context

This section outlines the challenges facing implementation of the 2006 NEMA EIA regulations in the context of the cultivation of virgin soil in farmland within threatened ecosystems in the Western Cape. The discussion is based on an analysis of information from two sources. Firstly, information was sourced from a workshop organised by the Fynbos Forum[2] in August 2006 which considered the implications of the NEMA EIA regulations for streamlined decision making pertaining to the cultivation of virgin soil and biodiversity conservation on farms (De Villiers and Manuel, 2006). The Fynbos Forum workshop included contributions by the DEADP, the Western Cape Department of Agriculture and CapeNature. The proceedings offer some insights into the difficulties facing mandatory EIA in rural and farming areas. Secondly, information was sourced from case material provided by the Conservation Unit of the Botanical Society of South Africa. This material (which includes official correspondence from, *inter alia*, CapeNature, the Western Cape Department of Agriculture, the NDA and the DEADP) focuses on procedural aspects relating to compliance with the NEMA EIA regulations, and questions arising from biodiversity considerations.

Logistical constraints in rural areas and farmers' perceptions of EIA

The Fynbos Forum workshop highlighted a number of factors that appear to be impeding the implementation (and acceptance) of the NEMA EIA regulations in the arena of commercial agricultural production.

[2]The Fynbos Forum is an annual gathering of scientists, conservation managers, officials and participants in bioregional programmes in the Fynbos Biome.

For example, attention was drawn to the low numbers of Environmental Assessment Practitioners (EAPs) outside the main centres in the Western Cape. There were reputedly no EAPs, for instance, in the western parts of the Northern Cape. Nonetheless, farmers in these areas were subject to the same environmental regulatory procedures as developers closer to the main urban centres. Long travelling distances added to the expenses incurred in undertaking EIAs. Farmers did not have ready access to information on their legal obligations and were especially ignorant of EIA procedures. There were language barriers in the rural areas of the Western Cape and public participation had to be repeated in both English and Afrikaans, at an increased cost. Also, there were perceptions that urban dwellers were obstructing rural development. Public participation in rural areas showed that job-creation and development were normally welcomed. There were seldom negative comments on development proposals. It was reported that farmers were not against following prescribed procedures; they just wanted concrete requirements on what to submit to the state for the process of authorisation. A major issue was that farmers acquired land for production to be told later that the land was of high conservation value and that no cultivation or grazing would be permitted. Such land was perceived as being useless to a farmer, who nonetheless still had to pay a municipal property tax.

None of these issues would *a priori* disqualify the legitimacy of EIA as a planning tool in an agricultural context. They do illustrate, though, the mixture of objective factors (access to environmental consultants, distance, additional costs, language and limited knowledge) and perceptions that would appear to contribute to a negative EIA "implementation climate". These factors are likely to inhibit ready public acceptance of a new system of resource planning in a sector where regulatory control over the physical conversion of land to cultivation has remained essentially unaltered for more than 20 years. Questions of relevance, affordability and practicality — let alone the sustainability value of EIA — come sharply to the fore.

Problems of praxis in biodiversity studies

A prevalent problem in the environmental application process is that of failing to adequately interpret the biodiversity conservation context of a proposed agricultural project, particularly where an applicant has not ensured that the terms of reference for a biodiversity assessment are sound. In one case, a "no objection" assessment by CapeNature extension staff was over-ridden by the agency's scientific services who predicted "high negative" impacts on the site in terms of the National Spatial Biodiversity Assessment (Driver *et al*., 2005) and instructed the applicant to commission a biodiversity assessment. There was an 11-month delay between the initial site assessment and the second opinion.

Applicants who elect not to be assisted by EA practitioners appear to be particularly vulnerable to challenges arising from procedural non-compliance with the EIA regulations. Case studies also show that these applications are most likely to run into difficulties relating to issues of biodiversity.

Another shortcoming entails the duplication of biodiversity specialist studies where each study assesses a similar suite of impacts in the same ecosystem, in close geographic proximity to each other. This situation arose in a valley where neighbouring wine farmers submitted separate applications to expand vineyards that would impinge on an ecological corridor linking a fragment of "Endangered" Breede Alluvium Fynbos to sandstone fynbos types. A fine-scale vegetation map described the Breede Alluvium Fynbos as having "very high conservation value". The conservation-worthy fragment is located on the one farm; both share the corridor. The respective environmental applications were submitted separately, would be processed separately, and would result in two separate official decisions.

Limitations of project-level, farm-by-farm EIAs

Shortcomings that inhibit project-level EIA's role as a tool for achieving sustainability assurance in planning procedures are widely documented. Some of the more prominent structural failings of EIA include reacting to, instead of informing, proposals and neglect of cumulative impacts (Thérivel *et al.*, 1994; Brown and Hill, 1995; Glasson *et al.*, 1999; Dalal-Clayton and Sadler, 2005). Inadequacies in the treatment of the ecological and biodiversity aspects of EIA are also well recorded (Krattiger *et al.*, 1994; Treweek, 1996; Le Maitre *et al.*, 1997; Brownlie *et al.*, 2006a and 2006b).

A chronic and widely encountered failing of a reactive and piecemeal approach to environmental regulation is that it fails to assess "big picture" impacts on threatened ecosystems (DEAT, 2006). The consideration of activity-based EIA applications, on a farm-by-farm basis, substantially frustrates the integrated assessment of long-term implications for biodiversity in ecosystems subject to repeated perturbations from virtually identical land-use pressures, such as vineyard expansion or the establishment of irrigated potato circles. In this context, biodiversity considerations should not be addressed in isolation but have to be viewed as fundamental to the delivery of sustainable development objectives (Treweek *et al.*, 2005; Slootweg *et al.*, 2006).

Systematic Conservation Planning and EA of Cultivation: A Shift in Perspective and Scale

For ecological effects to be adequately appraised and efficiently managed at an ecologically meaningful scale, the focus of agri-environmental planning and assessment has to be elevated above that of a particular development (and farm) to an ecosystem and sectoral level (cf. Treweek, 1996; Smith and McDonald, 1998; CBD, 2001; Ryskowski and Jankowiak, 2002; Payraudeau and Van der Werf, 2005). Far closer attention needs to be paid to assessing cumulative impacts, and the spatial and temporal boundaries of impact assessment have to be broadened to address long-term and delayed impacts and interrupted ecological processes (Cowling *et al.*, 1999a).

The principles and practices of Strategic Environmental Assessment (SEA) have a direct and positive bearing on the challenges of introducing sustainability prerogatives into the agricultural domain. Dalal-Clayton and Sadler (2005) provide a detailed inventory of how SEA can introduce "environmental quality" or "sustainability assurance" perspectives into project, sectoral and policy planning. Benefits of adopting a strategic approach to agri-environmental planning include:

— Providing a mechanism for public engagement in discussions relevant to sustainability at a strategic level;
— Reducing time, effort and cost in conducting reviews of projects;
— Including socio-economic assessments at scales larger than farm level (Cowling and Wilhelm-Reichmann, 2007); and,
— Compensating for unavoidable, irreplaceable loss of biodiversity, e.g., through biodiversity offsets.

Optimally, EA should steer development towards environmentally resilient locations and away from sensitive areas (Thérivel *et al.*, 1994). In order to do so, environmental policy objectives need to be set to both guide decisions towards more sustainable alternatives (or away from unsustainable ones) as well as to offer a yardstick against which the sustainability of a farm, agricultural region or sector can be assessed (Smith and McDonald, 1998; Glasson *et al.*, 1999; Payraudeau and Van der Werf, 2005). Systematic conservation planning provides a means for this assessment by identifying spatial priorities for conservation action on the basis of quantitative targets for species representation and ecological functioning in defined corridors or sub-regional "critical biodiversity areas" (Margules and Pressey, 2000; Cowling *et al.*, 2003; Pierce, 2003; Driver *et al.*, 2003). Agri-environmental land-use planning and decision making should be informed similarly by changes in environmental quality and function that result from cumulative, ecosystem-scale impacts of cultivation. Proposals to clear land for cultivation should ideally be adjudicated in terms of the aggregated loss of habitat measured against desired biodiversity objectives, thresholds or targets for specified agri-ecosystems (Payraudeau and Van der Werf, 2005).

Introducing Environmental Management Frameworks for Agri-Environmental Planning

In South Africa, recent developments in the biodiversity, agricultural and environmental planning fields have created unprecedented opportunities to streamline agri-environmental decision making by integrating mapped biodiversity priorities into agricultural plans that could be given regulatory effect as officially sanctioned Environmental Management Frameworks (hereafter "agri-EMFs"). Much of this work reflects key principles of SEA and the ecosystem approach. The remainder of the paper introduces the concept of an agri-EMF strategy that has been developed in partnership by an agricultural association, government departments and a non-governmental organisation for areas with a strong coincidence of farming potential and conservation importance in the Western Cape province.

The project was initiated at the Fynbos Forum in 2006 (De Villiers and Manuel, 2006) and has since been co-ordinated by the Western Cape Department of Agriculture's LandCare programme. The participants are Agri Western Cape (representing commercial farming interests in the Western Cape province), CapeNature, the NDA, the DEADP, the national DWAF, and the Botanical Society of South Africa (De Villiers and Hill, 2007). This initiative provided the conceptual underpinnings for an Environmental Management Framework that is to be developed for the Sandveld and Upper Breede River Valley (including Slanghoek) by the DEADP (Manuel, pers. comm.).

The agri-EMF strategy represents a fusion of systematic conservation planning products, agricultural LandCare area-wide plans, and EMFs. Each element is described below, and related to its function within the agri-EMF (Fig. 3).

Project screening and Environmental Management Frameworks

Screening frameworks based on mapped environmental features hold a number of advantages for environmental assessment. They can indicate whether or not an EIA would be required and, if so, what type and scope of assessment would be appropriate, thereby helping to focus an EIA on important environmental issues (The World Bank, 1993; Treweek *et al.*, 2005). In an agriculture context, a screening framework could be used proactively to guide agricultural planning in terms of environmental considerations or, alternatively, serve in the evaluation of specific cultivation proposals submitted for environmental authorisation. Environmental considerations in a farming context would translate into mapped biodiversity surrogates such as vegetation types or ecological corridors (Cowling and Heijnis, 2001; Rouget *et al.*, 2003), as well as agricultural informants such as slope, soil types, soil conservation works, watering points, encampments and fields (Department of Agriculture, 1984).

	Mechanism: Attributes and function with respect to 'agri-EMFs'		Status
Administrative effect	**Environmental Management Frameworks**		
	Attributes	**Function**	
	* Specify sensitivity and conservation status of environment in particular geographic area. * Indicate compatibility of proposed development/change in land use within specified areas. * Must be used by authorities when considering applications for environmental authorisation.	**Give official, environmental administrative effect to LandCare Area-wide Plans that have been prioritised and informed by fine-scale biodiversity plans.**	Adopted and enforced in terms of the 2006 EIA regulations by the Western Cape Department of Environmental Affairs and Development Planning.
Socio-economic aspects	**LandCare Area-wide Plans**		
	Attributes	**Function**	
	* Represents a participatory, multi-farm approach to planning and securing sustainable agricultural resource use. * Prioritise actions for land/river rehabilitation and social investment. * Map agricultural and environmental features, including critical biodiversity areas. * Set social objectives for use and management of agricultural land.	**Provide scientifically rigorous, spatially explicit and stakeholder-based mechanism for screening changes in land use in terms of agricultural and biodiversity criteria.**	Developed collaboratively by the LandCare Programme, Western Cape Department of Agriculture in partnership with land-users, farm workers, municipalities, conservation authorities and Dept of Environmental Affairs and Development Planning, CapeNature, National Dept of Agriculture, and Dept of Water Affairs and Forestry.
Biodiversity and natural environment	**Fine-scale Biodiversity Plans**		
	Attributes	**Function**	
	* Systematically-derived conservation plans that map most efficient means of securing integrated targets for biodiversity pattern and ecological processes. * At 1:10 000, maps are sufficiently accurate to inform land-use planning from farm to municipal scales.	**Identify 'hotspots' where potential conflict between agriculture and biodiversity priorities could be pre-empted by means of formalised environmental screening.**	Produced and curated by CapeNature. May be adopted as formal bioregional plans.

Fig. 3. The functional elements of "agri-EMFs": Biodiversity plans, LandCare Area-wide Plans and Environmental Management Frameworks.

EMFs drafted in terms of the NEMA EIA regulations (RSA, 2006a) are, in effect, a form of screening framework. Chapter 8 of the NEMA EIA regulations defines an EMF as a compilation of information and maps that specify the attributes of the environment in a particular geographic area. Once adopted by a provincial environmental Minister, an EMF must be taken into account in the consideration of applications for environmental authorisation in the area to which such a framework applies. An EMF must, *inter alia*, specify the sensitivity or conservation status of environmental attributes in a particular area, state the environmental management priorities of the area, and indicate which activities would be incompatible, or not, with specified areas.

One of the primary functions of EMFs is to provide applicants (i.e., proponents of projects that require environmental authorisation) with an early indication of the areas in which it would be potentially appropriate (or inappropriate) to undertake an activity listed in terms of the NEMA EIA regulations (DEAT, 2005b). EMFs can also be used as a basis for the national Minister of Environmental Affairs and Tourism to exempt specified activities from the requirement for environmental authorisation.

The agri-EMF strategy relies on systematic biodiversity plans to identify which agricultural areas would potentially benefit most from a formalised screening system (such as an EMF) due to the presence of important biodiversity features that could be in conflict with agricultural expansion.

Systematic conservation planning and project screening

Systematic conservation planning is a method for identifying priority areas for conservation action on the basis of spatially explicit, quantitative biodiversity targets (Margules and Pressey, 2000). In the agricultural context, systematic conservation plans can be used to identify areas where regionally important biodiversity overlaps with land with high agricultural potential, thus facilitating the prioritisation of agri-EMFs where they would have most benefit for sustainable development and streamlined decision making.

The principal objectives of systematic conservation planning are representivity (sampling the full variety of biodiversity) and persistence (promoting the long-term survival of biodiversity by maintaining natural processes and excluding threats) (Cowling *et al*., 2003). Conservation targets quantify how much of each biodiversity feature (such as a vegetation type) needs to be retained in order to meet the goals of representivity and persistence. A vegetation type will move towards a higher category of threat as it is reduced in extent and ecosystem functioning is progressively disrupted (Reyers *et al*., 2007). For example, the South African National Spatial Biodiversity Assessment categorised ecosystems as “Least Threatened”, “Vulnerable”, “Endangered” or “Critically Endangered” based on their degree of habitat loss, relative to the biodiversity targets for each ecosystem (Driver *et al.*, 2005).

Biodiversity targets can be used to assess cumulative effects of habitat loss in ecosystems where specific production sectors are dominant and result in numerous, largely homogenous impacts that are concentrated in a specific vegetation type such as the case of potato farming in Leipoldtville Sand Fynbos. However, systematic conservation plans need to be curated and updated to reflect changes in land cover over time as this will reflect changes in ecosystem status as habitat is lost or gained (Reyers *et al.*, 2007). In this regard, Cowling *et al.* (1999b) note that the ongoing and systematic calculation of biodiversity loss and gains against targets is a key requirement for maintaining biodiversity decision systems so as to ensure optimal and effective allocation of conservation resources.

Systematic conservation planning has been undertaken at various spatial scales to inform priorities for conservation actions in the Cape Floristic Region (the "C.A.P.E." programme), Succulent Karoo Biome ("SKEP") and Sub-tropical Thicket Biome ("STEP") (Sandwith *et al.*, 2005).

Fine-scale biodiversity plans

A new generation of "fine-scale" systematic biodiversity plans is being produced for a number of Western Cape municipalities with a high incidence of threatened biodiversity and land-use pressure. Land cover mapping varies in scale from 1:30 000 to 1:10 000 (Te Roller, pers. comm.). "Critical biodiversity areas" represent the most efficient set of land units that are needed to meet targets for biodiversity pattern and ecological processes and that should remain in a natural state. These products are sufficiently detailed to provide information on mapped biodiversity features at a cadastral scale.

Fine-scale biodiversity plans have both strategic and practical relevance to the development of effective agri-environmental screening frameworks in that they:

— Identify environmental features (biodiversity surrogates) and corridors that are deemed critical for the conservation of biodiversity from the broad municipal scale to the detailed farm scale;
— Can contribute to the identification of areas that are important for the maintenance and generation of ecosystem goods and services; and,
— Would assist with the strategic, municipal or sub-regional, identification of areas where there are pronounced overlaps between agricultural potential and high biodiversity value, and which would benefit most from a precautionary, pre-emptive approach to agri-environmental planning.

LandCare area-wide planning and the ecosystem approach

LandCare area-wide planning represents the second component of the agri-EMF strategy by introducing a participatory, stakeholder-based dimension to land-use planning and screening in agricultural settings with high biodiversity value.

There are strong similarities between the principles of the CBD's ecosystem approach and the LandCare area-wide planning methodology that has been developed by the Western Cape Department of Agriculture. The National Department of Agriculture defines LandCare as a multi-disciplinary, community-based programme that "encourages the sustainable utilisation of natural resources through management that is efficient, sustainable, equitable and consistent with the principles of ecologically sustainable development" (DEAT, 2006: p. 102).

The "grassroots", sustainability-orientated approach of LandCare closely resonates with a number of key precepts that define the ecosystem approach. These include the principles that (CBD, 2001):

- The objectives of management of land, water and living resources are a matter of societal choice;
- Management should be decentralised to the lowest appropriate level;
- Ecosystem managers should consider the effects of their activities on adjacent and other ecosystems;
- Ecosystems must be managed within the limits of their functioning; and,
- The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

In the Western Cape, LandCare area-wide planning has focused on addressing social, economic and environmental sustainability on various groups of farms in the Slanghoek and upper Breede River valleys about 100 km east of Cape Town (Röscher, pers. comm.). Area-wide plans complement and contextualise detailed, single-unit farm plans drafted in terms of the CARA.

The Slanghoek valley area-wide plan

In the case of the Slanghoek valley near Rawsonville, LandCare area-wide planning entailed undertaking a needs assessment with each of the farmers in the 75 000 ha valley, compiling an agricultural resources map for each farm, undertaking a botanical survey and developing a biodiversity conservation plan for the entire area, and identifying projects and funding to address community needs. Projects with a total value of ZAR973 000[3] were developed as part of this planning process. More than 70% of the funding was earmarked for river rehabilitation and the removal of

[3] South African Rand exchange rate 18 August 2008, 1EUR = ZAR11.36.

invasive alien plants. Local job creation and training were built into the respective restoration projects.

An agricultural resources map was produced at a scale of 1:10 000. It depicts areas that are potentially suitable for agricultural development, the location of infrastructure (e.g., dams and pumps), and distinguishes between "biodiversity hotspots", intensively developed areas and indigenous vegetation that is still largely natural but not prioritised for conservation. Remnant indigenous vegetation is divided into four categories of conservation importance: "low", "medium", "high" and "very high".

The Slanghoek area-wide plan falls short of a Strategic Environmental Assessment. It does not, for example, set environmental objectives, offer direction on desirable development, or provide for adaptive management. Neither does it spell out the implications of high conservation values for planning and decision making. The predictive value of the Slanghoek area-wide plan would be strengthened by integrating the Critical Biodiversity Areas identified by the draft fine-scale biodiversity plan for the Upper Breede River Valley (Te Roller, pers. comm.).

Notwithstanding its shortcomings, the Slanghoek area-wide plan has established a spatially explicit basis from which to start integrating agri-environmental sustainability objectives into agricultural and municipal planning for the valley and the "Endangered" remnants of the once-extensive Breede Alluvium Fynbos ecosystem that still occur there.

Implementing Agri-Environmental Management Frameworks

Agri-EMFs that are based on biodiversity-inclusive LandCare area-wide plans potentially hold significant benefits for sustainability assurance and streamlined decision making in the rural areas of the Western Cape. These instruments would primarily fulfil a screening function by helping individual farmers and agricultural and environmental officials to identify the most desirable agricultural land-use options in terms of agri-environmental criteria, such as soil suitability or Critical Biodiversity Areas.

Firstly, proposed activities on individual farms would be assessed for compliance with broader, ecosystem-level sustainability objectives. Proposed activities that complied with an EMF could be expedited, whereas those that did not would possibly require further investigation or be refused authorisation. Secondly, the cumulative impacts of proposed farming activities could be assessed with far greater confidence and accuracy due to an ecosystem-wide perspective and the means to measure habitat loss against spatially-explicit, quantitative biodiversity targets. The environmental implications of particular development options could be translated into impacts on landscape-scale ecological functioning as well as the extent to which an activity may compromise or support the achievement of a quantitative biodiversity target. Lastly, far greater certainty and efficiency would be introduced to agri-environmental planning because land-users would be fully appraised of the sustainability implications of particular development choices.

Three conditions need to be satisfied in order to operationalise agri-EMFs:

— They have to be developed at the level of affected ecosystems where the impacts of farming activities can be most effectively identified, assessed and managed in relation to the boundaries of such systems and in accordance with chosen indicators (Payraudeau and Van der Werf, 2005; CBD, 2001);
— Planning has to take place at the level of the affected farming-ecosystem interface, it must be inclusive and should engage directly with those persons and interests whose livelihood, security and economic well-being are most closely linked to the specified agri-environmental system; and,
— Where possible, agri-EMFs should be aligned with municipal spatial development frameworks and catchment management strategies.

Employed proactively (and, ideally, as an outcome of an SEA-type process), a well-informed and accurately mapped agri-EMF could be used to guide, by means of publicly-endorsed sustainability objectives, environmentally appropriate development in areas that are important for both farming and biodiversity conservation, or avoid environmentally inappropriate development in such areas. The EMF can further reduce or even obviate the need for site or activity-specific EIA, and give effect to the ecosystem approach to land management and protection of areas that are important for the maintenance and generation of ecosystem goods and services.

In summary, the proposed agri-EMF aims to address the major structural failings of activity and farm-specific impact assessment by elevating regulatory oversight to the ecosystem level. In this respect it holds clear advantages for "biodiversity mainstreaming" into planning and decision making in agricultural production landscapes (Cowling, 2005; DEAT, 2005a). Individual agricultural producers stand to benefit from greater certainty about the environmental and regulatory implications of different land use choices. Furthermore, agri-EMFs can contribute to more efficient decision making and, by implication, reduced transaction costs for farmers whose activities conform to an agri-environmental sustainability framework.

Conclusions

Agricultural and environmental policies and legislation have been in place for several decades in South Africa. Both forms of land-use regulation appear, however, to have been fettered by a tendency to analyse and respond to agriculture-related environmental change at the level of individual farms rather than that of agro-ecosystems.

In some ecosystems, uncoordinated, reactive and activity-specific regulation has resulted in impacts on indigenous vegetation best described as "death by a thousand cuts". The introduction of a mandatory environmental requirement to decision making has held spectacularly little benefit for threatened and highly stressed ecosystems such as those that have borne the brunt of the potato boom in the Western Cape Sandveld. As currently applied, the revised NEMA system of EIA perpetuates the major structural shortcomings of activity-based EIA: it is reactive, piecemeal and in practice does not promote the consideration of cumulative impacts or the strategic context.

In contrast, decision making that is guided by accurately mapped biodiversity and agricultural priorities potentially represents an efficient and attractive alternative to the current system of reactive environmental procedures based on the prescribed Basic Assessment and EIA processes. These plans may also counter the worrying tendency of agricultural producers not appointing consultants to assist them with applications for environmental authorisation which, in turn, holds significant risks of non-compliance with the EIA regulations. Inadequate environmental procedures can also result in otherwise avoidable adverse impacts on biodiversity.

LandCare area-wide planning that is prioritised and informed by fine-scale biodiversity plans elevates agricultural management to the ecosystem level and supports a strategic approach to planning and decision making. LandCare area-wide plans and fine-scale biodiversity plans can be given administrative authority if translated into statutory Environmental Management Frameworks. In such instances, regulatory authorities would have a shared, spatially explicit inventory of agri-environmental informants and desired development options against which to assess the merits of applications requiring environmental and agricultural authorisations. LandCare area-wide planning that is guided by systematically derived biodiversity priorities represents an effective, purpose-designed and progressive platform for achieving the objectives of sustainable agricultural development on the basis of informed and streamlined decision making.

Such a system cannot and should not supplant project-specific EIA. It can, however, assign EIA a more suitable role: that of assessing impact significance at a local (species and community) scale and evaluating whether proposed agricultural projects would comply with the biodiversity and socio-economic sustainability objectives for a farming region.

Acknowledgements

The first author is grateful to Dr Bruce McKenzie of the Botanical Society of South Africa for his support and encouragement. Gerhard Gerber, Paul Hardcastle, Jan

Vlok and two anonymous reviewers contributed valuable insights and criticism. Les Powrie is thanked for the maps.

References

Aronson, J, SJ Milton and JN Blignaut (eds.) (2007). *Restoring Natural Capital: Science, Business and Practice*. Washington DC: Island Press.

Beinart, W and P Coates (1995). *Environment and History: The Taming of Nature in the USA and South Africa.* London and New York: Routledge.

Brown, AL and RC Hill (1995). Decision-scoping: Making environmental assessment learn how the design process works. *Project Appraisal*, 10(4), 223–232.

Brownlie, S, C de Villiers, A Driver, N Job, A Von Hase and K Maze (2005). Systematic conservation planning in the Cape Floristic Region and Succulent Karoo, South Africa: Enabling sound spatial planning and improved environmental assessment. *Journal of Environmental Assessment Policy and Management*, 7(2), 201–228.

Brownlie, S, J Manuel and C de Villiers (2006a). Review of the effectiveness of the Botanical Society's input to environmental impact assessments in the Western Cape, South Africa. In *IAIAsa 2006 National Conference Proceedings*, 28–30 August 2006, Kwa-Maritane, Pilanesberg, Northwest Province.

Brownlie, S, B Walmsley and P Tarr (2006b). *Situation Assessment on the Integration of Biodiversity Issues in Impact Assessment and Decision Making in Southern Africa*. Windhoek and Fargo ND: Southern African Institute of Environmental Assessment and IAIA-CBBIA.

Cape Action for People and the Environment (C.A.P.E.) (2006). *The Dilemma of Unsustainable Development in the West Coast Sandveld*. Pamphlet produced for the C.A.P.E. Ministerial Visit to the Sandveld, 20 March 2006. Kirstenbosch: C.A.P.E. Co-ordination Unit.

Convention on Biodiversity (CBD) (2001). *Handbook of the Convention on Biological Diversity*. London: Earthscan Publications.

Council for Scientific and Industrial Research Consortium (CSIR) (1999). *An Assessment and Review of the Current Policy, Legal, Institutional, Socio-economic and Financial Situation Affecting the Conservation of Biodiversity in the Cape Floristic Kingdom – Summary Report*. Stellenbosch: CSIR/WWF (SA).

Cowling, RM (2005). The process of mainstreaming: Conditions, constraints and prospects. In *Mainstreaming Biodiversity in Production Landscapes*, C Petersen and BJ Huntley (eds.), pp. 18–25. Washington DC: Global Environment Facility.

Cowling, RM and A Wilhelm-Rechmann (2007). Four perspectives on conservation in Africa. *Oryx*, 41(2), 135–139.

Cowling, RM and CE Heijnis (2001). The identification of Broad Habitat Units as biodiversity entities for conservation planning in the Cape Floristic Region. *South African Journal of Botany*, 67, 15–38.

Cowling, RM and DM Richardson (1995). *Fynbos: South Africa's Unique Floral Kingdom.* Cape Town: Fernwood Press.

Cowling, RM, RL Pressey, AT Lombard, PG Desmet and AG Ellis (1999a). From representation to persistence: Requirements for a sustainable system of conservation areas in the species-rich Mediterranean-climate desert of southern Africa. *Diversity and Distributions*, 5, 51–71.

Cowling, RM, RL Pressey, AT Lombard, CE Heijnis, DM Richardson and N Cole (1999b). *Framework for a Conservation Plan for the Cape Floristic Region, South Africa*. IPC Report 9902, prepared for WWF-SA.

Cowling, RM, RL Pressey, M Rouget and AT Lombard (2003). A conservation plan for a global biodiversity hotspot – the Cape Floristic Region, South Africa. *Biological Conservation*, 112, 191–216.

Dalal-Clayton, B and B Sadler (2005). *Strategic Environmental Assessment: A Sourcebook and Reference Guide to International Experience.* London: Earthscan.

De Villiers, C and J Manuel (2006). The NEMA EIA Regulations, Agriculture and Biodiversity: New Challenges, New Opportunities? Unpublished workshop proceedings. Cape Town: Fynbos Forum and Botanical Society of South Africa.

De Villiers, CC (2007). Threatened biodiversity, the NEMA EIA regulations and cultivation of virgin land: More of the sorry same? *Potchefstroom Electronic Law Journal*, 3, 1–42.

De Villiers, CC and I Turner (2000). Managing agricultural land transformation in the Cape Floristic Region: An overview. In *IAIAsa 2000 National Conference Proceedings*, IAIAsa, September 30-October 4, Goudini Spa, Western Cape.

De Villiers, CC and RC Hill (2007). Evaluating EIA as tool for sustainable agriculture in a global biodiversity "hotspot" — Lessons from the Cape Floristic Region. In *IAIAsa 2007 Regional Conference Proceedings*, 5–7 November 2007, Lord Charles Hotel, Somerset West, Western Cape.

Department of Agriculture, Republic of South Africa (1984). *Handleiding vir Subsidieskemas*. Pretoria: Department of Agriculture.

Department of Environmental Affairs and Tourism (DEAT), Republic of South Africa (2005a). *South Africa's National Biodiversity Strategy and Action Plan.* Pretoria: DEAT.

Department of Environmental Affairs and Tourism (DEAT), Republic of South Africa (2005b). *Guideline 6: Environmental Management Frameworks in support of the EIA Regulations. Integrated Environmental Management Guideline Series*, Pretoria: DEAT.

Department of Environmental Affairs and Tourism (DEAT), Republic of South Africa (2006). *South Africa Environmental Outlook: A Report on the State of the Environment*. Pretoria: DEAT.

Department of Environmental Affairs and Tourism (DEAT), Republic of South Africa (2007). *National Environmental Management: Biodiversity Act (10/2004): National Biodiversity Framework for South Africa Published for Public Information and Comments – Final Draft. General Notice 801 of 2007.* Pretoria: DEAT.

Department of Water Affairs and Forestry (DWAF), Republic of South Africa (2005). *Olifants/Doorn Water Management Area: Internal Strategic Perspective*. Prepared by

Ninham Shand (Pty) Ltd in association with Jakoet and Associates, Umvoto Africa, FST and Tlou and Matji, on behalf of the Directorate: National Water Resource Planning. DWAF Report No P WMA 17/000/00/0305.

Donaldson, JS (2002). Biodiversity and conservation farming in the agricultural sector. In *Mainstreaming Biodiversity in Development: Case Studies from South Africa*, SM Pierce, RM Cowling, T Sandwith and K MacKinnon (eds.), pp 43–56. Washington DC: The World Bank Environment Department.

Driver, A, RM Cowling and K Maze (2003). *Planning for Living Landscapes: Perspectives and Lessons from South Africa*. Cape Town: Botanical Society of South Africa, and Washington DC: Center for Applied Biodiversity Science at Conservation International.

Driver, A, K Maze, M Rouget, AT Lombard, J Nel, JK Turpie, RM Cowling, P Desmet, P Goodman, J Harris, Z Jonas, B Reyers, K Sink and T Strauss (2005). National Spatial Biodiversity Assessment 2004: Priorities for biodiversity conservation in South Africa. *Strelitzia*, 17.

Giliomee, JH (1996). Agriculture. In *Environmental Management in South Africa*, RF Fuggle and MA Rabie (eds.), pp 739–747. Kenwyn: Juta.

Glasson, J, R Thérivel and A Chadwick (1999). *Introduction to Environmental Impact Assessment: Principles and Procedures, Process, Practice and Prospects*. London: UCL Press.

Glazewski, J (2000). *Environmental Law in South Africa*. Durban: Butterworths.

Hoffman, MT (1997). Human impacts on vegetation. In *Vegetation of Southern Africa*, RM Cowling, DM Richardson and SM Pierce (eds.), pp 507–534. Cambridge: Cambridge University Press.

Krattiger, AF, JA McNeely, WH Lesser, KR Miller, Y St Hill and R Senanayake (eds.) (1994). Editor's Introduction – Section 6: Biodiversity and Environmental Impact Assessment. In *Widening Perspectives on Biodiversity*, AF Krattiger *et al.* (eds.), pp. 315–318. Geneva, Switzerland: IUCN-The World Conservation Union and The International Academy of the Environment.

Le Maitre, DC, DIW Euston-Brown and CM Gelderblom (1997). Are the potential impacts on biodiversity adequately assessed in southern African environmental impact assessments? Paper presented at *IAIAsa'97 conference*, South Africa, September 1997.

Le Maitre, DC, SJ Milton, C Jarmain, CA Colvin, I Saayman and JHJ Vlok (2007). Linking ecosystem services and water resources: landscape-scale hydrology of the Little Karoo. *Frontiers in Ecology and the Environment*, 5(5), 261–270.

Love, V and J Burger (2004). Sandveld in Crisis. Poster presentation, *Fynbos Forum*, 10–13 August 2004, Club Mykonos, Langebaan.

Margules, CR and RL Pressey (2000). Systematic conservation planning. *Nature*, 405, 243–253.

Mattison, EHA and K Norris (2005). Bridging the gaps between agricultural policy, land-use and biodiversity. *Trends in Ecology and Evolution*, 20(11), 610–616.

Mittermeier, RA, PR Gil, M Hoffman, J Pilgrim, T Brooks, CG Mittermeier, J Lamoreux and GAB da Fonseca (2005). *Hotspots Revisited: Earth's Biologically Richest* *and Most Endangered Terrestrial Ecoregions*. Agrupación Serra Madre, SC, Mexico: CEMEX.

Payraudeau, S and HMG Van der Werf (2005). Environmental Impact Assessment for a farming region: A review of methods. *Agriculture, Ecosystems and Environment*, 107(1), 2–19.

Pierce, SM (2003). *The STEP Handbook: Integrating the Natural Environment into Land Use Decisions at the Municipal Level: Towards Sustainable Development*. Terrestrial Ecology Research Unit Report No. 47. University of Port Elizabeth, South Africa: UPE.

Ranger, S (2006). *The Sandveld Action Plan (Final draft)*. Porterville: CapeNature.

Reidsma, P, T Tekelenburg, M van den Berg and R Alkemade (2006). Impacts of land-use change on biodiversity: An assessment of agricultural biodiversity in the European Union. *Agriculture, Ecosystems and Environment*, 114(1), 86–102.

Republic of South Africa (1983). *The Conservation of Agricultural Resources Act* (No. 43 of 1983). Pretoria: Government Printer.

Republic of South Africa (1989). *The Environment Conservation Act* (No. 73 of 1989). Pretoria: Government Printer.

Republic of South Africa (1997a). The Identification Under Section 21 of Activities Which May Have a Substantial Detrimental Effect on the Environment. *Government Notice R. 1182*. Pretoria: Government Printer.

Republic of South Africa (1997b). Regulations Regarding Activities Identified Under Section 21 (1). *Government Notice R. 1183*. Pretoria: Government Printer.

Republic of South Africa (1998). *The National Environmental Management Act* (No. 107 of 1998). Pretoria: Government Printer.

Republic of South Africa (2002). Identification Under Section 21 of Activities Which May Have a Substantial Detrimental Effect on the Environment – Amendment Notice. *Government Notice R. 670*. Pretoria: Government Printer.

Republic of South Africa (2004). *The National Environmental Management: Biodiversity Act* (No. 10 of 2004). Pretoria: Government Printer.

Republic of South Africa (2006a). Regulations in Terms of Chapter 5 of the National Environmental Management Act, 1998. *Government Notice R. 385*. Pretoria: Government Printer.

Republic of South Africa (2006b). List of Activities and Competent Authorities Identified in Terms of Sections 24 and 24D of the National Environmental Management Act, 1998. *Government Notice R. 386*. Pretoria: Government Printer.

Republic of South Africa (2006c). List of Activities and Competent Authorities Identified in Terms of Sections 24 and 24D of the National Environmental Management Act, 1998. *Government Notice R. 387*, Pretoria: Government Printer.

Reyers, B, M Rouget, Z Jonas, RM Cowling, A Driver, K Maze and P Desmet (2007). Developing products for conservation decision-making: lessons from a spatial biodiversity assessment for South Africa. *Diversity and Distributions*, 1–11.

Rodrigues, GS, C Campanhola and PC Kitamura (2003). An Environmental Impact Assessment for agricultural research and development. *EIA Review*, 23(2), 219–244.

Rouget, M, RM Cowling, RL Pressey and DM Richardson (2003). Identifying spatial components of ecological and evolutionary processes for regional conservation planning in the Cape Floristic Region, South Africa. *Diversity and Distribution*, 9, 191–210.

Rouget, M, Z Jonas, RM Cowling, PG Desmet, A Driver, B Mohamed, L Mucina, MC Rutherford and LW Powrie (2006). Ecosystem status and protection level of vegetation types. In *The Vegetation of South Africa, Lesotho and Swaziland*, L Mucina and MC Rutherford (eds.), pp. 724–737. Pretoria: South African National Biodiversity Institute.

Ryskowski, L and J Jankowiak (2002). Development of agriculture and its impact on landscape functions. In L Ryskowski (ed.) *Landscape Ecology in Agroecosystems Management*. Boca Raton, Florida: CRC Press.

Sadler, B (1996). *Environmental Assessment in a Changing World: Evaluating Practice to Improve Performance*. Final report of the International Study of the Effectiveness of Environmental Assessment, Canadian Environmental Assessment Agency and International Association for Impact Assessment. Ottawa, Canada: Minister of Supply and Services.

Sandwith, T, K Maze, M Barnett, S Frazee and C Cadman (2005). Mainstreaming biodiversity through South Africa's bioregional conservation programs: Top-down and bottom-up. In *Mainstreaming Biodiversity in Production Landscapes*, C Petersen and BJ Huntley (eds.), pp. 78–90. Washington DC: Global Environment Facility.

Scholes, RJ and R Biggs (eds.) (2004). Ecosystem services in Southern Africa: A regional Assessment. A contribution to the *Millennium Ecosystem Assessment*, prepared by the regional-scale team of the Southern African Millennium Ecosystem Assessment. Pretoria: CSIR.

Slootweg, R, R Kolhoff, R Verheem and R Höft (2006). *Biodiversity in EIA and SEA – Background Document to CBD Decision VIII/28: Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment*. The Netherlands: Commission for Environmental Assessment.

Smith, CS and GT McDonald (1998). Assessing the sustainability of agriculture at the planning stage. *Journal of Environmental Management*, 52(1), 15–37.

The World Bank (1991). *Environmental Assessment Sourcebook – Volume II: Sectoral Guidelines*. Washington DC: The World Bank.

The World Bank (1993). *Environmental Screening: Environmental Assessment Sourcebook Update Number 2*. Washington DC: The World Bank Environment Department.

Thérivel, R, E Wilson, S Thompson, D Heaney and D Pritchard (1994). *Strategic Environmental Assessment*. London: Earthscan Publications.

Treweek, J (1996). Ecology and Environmental Impact Assessment. *Journal of Applied Ecology*, 33(2), 191–199.

Treweek, J, R Thérivel, S Thompson and M Slater (2005). Principles for the use of strategic environmental assessment as a tool for promoting the conservation and sustainable use of biodiversity. *Journal of Environmental Assessment Policy and Management*, 7(2), 173–199.

United Nations Environment Programme (UNEP) (1999). *Global Environment Outlook 2000*. London: Earthscan Publications.

Van Schalkwyk, M (2006). *Biodiversity Strategy Launched*, 23 May 2006. News24.com http://www.news24.com/News24/TechnologyNews/0,2-13-14431937126,00.html [7 June 2006]

Willis, CK (ed.) (2006). *Conserving South Africa's Plants: a South African Response to the Global Strategy for Plant Conservation: SANBI Biodiversity Series 1*. Pretoria: South African National Biodiversity Institute.

Personal communications

Burger, Johan – Greater Cederberg Biodiversity Corridor, CapeNature. 4 May 2005.

Manuel, Jeff – Specialist Advisor: Biodiversity and Land Use, Department of Environment Affairs and Development Planning. 17 July 2008.

Röscher, Rudolph – LandCare Programme, Western Cape Department of Agriculture. 18 September 2007.

Te Roller, Kerry – Co-ordinator, C.A.P.E. Fine-scale Biodiversity Planning Project, CapeNature. 18 September 2007.