

# **BUFFER ZONES and their MANAGEMENT**

## **Policy and Best Practices for terrestrial ecosystems in developing countries**

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# CONTENTS

<b>PREFACE</b>	<b>5</b>
<b>SUMMARY</b>	<b>7</b>
<b>1 INTRODUCTION</b>	<b>9</b>
<b>2 THE BUFFER ZONE CONCEPT</b>	<b>11</b>
2.1 Evolution of the Buffer Zone Concept	11
2.2 Definitions and Terms	12
2.3 Approaches in Buffer Zone Management	13
<b>3 NATIONAL AND INTERNATIONAL POLICY ISSUES</b>	<b>17</b>
3.1 International Programmes, Conventions and Legislation	17
3.2 National Policies	17
3.3 Netherlands Policy and Buffer Zone Management	18
3.3.1 The Netherlands' Policy regarding Biodiversity Conservation	18
3.3.2 Other Policy Issues	19
3.3.3 Sustainability	19
<b>4 CONDITIONS, BENEFITS AND CRITERIA FOR BUFFER ZONES</b>	<b>21</b>
4.1 Characteristics of New Conservation Areas in Developing Countries	21
4.2 Buffer Zones and Jurisdiction	21
4.3 Conditions, Benefits and Criteria for Buffer Zones	22
4.3.1 Size	23
4.3.2 Ecological	23
4.3.3 Economic Aspects	24
4.3.4 Legal Aspects	26
4.3.5 Social aspects	27
4.4 Benefits of Buffer Zones	28
<b>5 TYPES OF BUFFER ZONES</b>	<b>31</b>
5.1 Traditional Use Zone	31
5.2 Forest Buffer Zone	31
5.3 Economic Buffer Zone	33
5.4 Physical Buffer Zone	33
5.5 Streamside Buffer Zone	36
5.6 Social Buffer Zone	36
5.7 Sanitary Buffer Zone	36
5.8 Fire Buffer Zone	36
5.9 Geo-political Buffer Zone	36
<b>6 SUCCESS and FAILURE in BUFFER ZONE MANAGEMENT</b>	<b>39</b>
6.1 Introduction	39
6.2 Causes of Failure	39
6.2.1 Ecological Causes	39
6.2.2 Social and Economic Causes	40
6.2.3 Institutional Causes	41
6.2.4 Other Causes	42

<b>7</b>	<b>GUIDELINES for ENHANCING BUFFER ZONE DEVELOPMENT</b>	<b>45</b>
7.1	Points of Attention	45
7.1.1	Ecological	45
7.1.2	Socio-economic	46
7.1.3	Institutional	47
7.1.4	Size and location	48
7.1.5	Other	48
7.2	Appraisal, Monitoring and Evaluation	48
<b>8</b>	<b>REFERENCES</b>	<b>57</b>
	Appendix 1: Netherlands policy on forests and forestry (objectives)	59
	Appendix 2: Netherlands Standard Appraisal Criteria	61
	Appendix 3: Some definitions of sustainability	63

## **PREFACE**

In recent years the concept of buffer zone management has emerged as a relatively new, integrated development approach to nature conservation. Buffer zones are seen as an important tool in conserving areas of ecological importance, while at the same time addressing the development issues of the people in the areas surrounding it. Despite its perceived potential, the concept has so far hardly been made explicit within international and national nature conservation and development policies. Nevertheless, in a growing number of locations valuable field experience is being gained which may provide important clues for the further development, application and management of buffer zones.

This report further explains the buffer zone concept and reviews its significance for nature conservation strategies in developing countries. Based on experiences so far, the authors discuss some 'do's and don'ts' of buffer zone management and suggest some points of attention and guidelines for enhancing buffer zone development. The authors emphasise the situation-specific character of buffer zone projects needing a participatory process approach and a long-term perspective as well as continuous monitoring and evaluation as tools for feed-back.

This document has been made at the request of the Directorate General for International Co-operation of the Netherlands Ministry of Foreign Affairs (DGIS). It is principally intended to provide some basic material for practical and problem-oriented planning and monitoring when establishing, developing and managing buffer zones, notably in developing countries. The target audience for such supporting material will mainly be Dutch government officers dealing with nature conservation and development programmes; it may however also be relevant for other professionals involved in buffer zone management.

It is hoped that this document, which does not claim to be complete, will contribute to a better understanding and a wider practice of the sustainable management of buffer zones and conservation areas.

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## SUMMARY

In recent years, buffer zones have become widely known as an operational approach in nature conservation, and are often applied in Integrated Conservation and Development Projects (ICDP). However, to the authors' knowledge, there has not yet been a thorough evaluation and analysis of the strengths and constraints of the buffer zone concept. One reason could be that, even though the concept has been known for quite some time, the systematic application of the buffer zone concept is rather recent.

A second reason, as it will be argued in this document, is that buffer zone projects should have a long-term perspective. Since it takes time to institutionalise the multi-disciplinary approach, buffer zone projects of five years or less are not realistic and are doomed to failure. Moreover, proper buffer zone management demands a participatory process approach, which also takes time.

Buffer zones are seen as important tools in both conserving areas of ecological importance and addressing development objectives. The latter are often rural objectives involving agricultural production, small-scale (cottage) industries and marketing. Various authors and experts have given their definition of buffer zones from different angles and perspectives. The Netherlands' policy context emphasises the buffer zones' dual function of serving both conservation and development goals. This dual goal is most appropriately reflected in Wild and Mutebi's definition (1996), which is used in this document. This definition of a buffer zone is:

***Any area, often peripheral to a protected area, inside or outside, in which activities are implemented or the area managed with the aim of enhancing the positive and reducing the negative impacts of conservation on neighbouring communities and neighbouring communities on conservation.***

Investments in nature conservation projects typically demand a long lead time before benefits start to materialise. By virtue of the classic economic view of time value, and since benefits only accrue in the distant (and for economists thus unattractive) future, appraisal of such projects through discounted measures of project worth often turns out to be rather unfavourable, with direct costs (capital investment) at establishment of the conservation programme weighing heavily (and negatively) in the analysis. Moreover, the benefits of nature conservation and management projects are often intangible or not easily quantified, let alone given a monetary value. If market prices for environmental services and amenities do prevail at all, they are often an imperfect reflection of value, i.e. market failure works to the detriment of nature conservation efforts. It is often difficult to integrate the direct and indirect benefits of nature conservation in an analytical framework, and the incremental costs and benefits of establishing buffer zones are even more difficult to assess. Unfortunately, the value and feasibility of buffer zones is indeed to be found in this incremental analysis. It is therefore difficult to establish the feasibility and sustainability of buffer zones from a purely economic point of view, using the available methodologies, even though it is acknowledged that such zones may have tremendous indirect (secondary, non-use and/or implicit) benefits.

The buffer zone approach is a long-term intervention for various reasons, the main ones being:

- It demands a participatory and process approach, which takes time. It also often demands a change of attitude and even cultural thinking, changes which cannot be achieved overnight;
- Buffer zones are crucial areas for both people and nature. Therefore, careful planning based on complete information of the natural resource base and socio-economic context is necessary;
- The multi-disciplinary planning process is complicated, as many stakeholders at different levels will be involved, ranging from indigenous people to government officials at the national level;
- It usually takes a long time to establish a stable institutional structure.

Identification and formulation of buffer zone projects is normally based on limited information. A blue-print approach does not work, nor is there a standard formula that can be applied. As a consequence, an inception phase is becoming standard procedure when Netherlands funding and assistance are involved.

It is important that buffer zone projects be well monitored and evaluated. Clear criteria and

indicators must be described before the actual implementation of the project starts. Stability, sustainability, equity and productivity (in relation to the development component) should be emphasised, in combination with protection, restoration and management of biodiversity. When appraising a buffer zone project technical, sustainability, and feasibility criteria should be applied, including the Netherlands development-assistance criteria of gender, poverty alleviation and environment. In practice this means that indicators will have to be developed in the following fields: ecology, socio-economics, institutional, policy and physical. These fields are further discussed in the document.

This document does not offer a ready-made formula for developing and managing buffer zones. Neither does it claim to be complete. On the contrary, we argue that no blue-print model exists for the development of buffer zones. Establishing buffer zones is highly situational and can only be achieved successfully through a process approach that includes all stakeholders and integrates ecological, social, economic and institutional aspects.



# 1 INTRODUCTION

The natural environment is still being destroyed at an alarming rate, all over the globe. However, increasing amounts of energy and money are being invested to arrest this spiral of degradation. The Netherlands play an active international role in biodiversity conservation and are financing many forest and biodiversity conservation initiatives. The overall Netherlands policy on development co-operation is specified and supported in a number of sectoral and topical policy documents. These include policy documents on Biological Diversity (1994) and on Forests and Forestry (1998). These two documents often serve as reference for policy and programme development related to buffer zone management.

In many of the conservation programmes and projects, the zoning principle is applied in order to allow protection to be combined with human use, whereby important areas (often conservation areas and/or core zones) are surrounded by so-called buffer zones<sup>1</sup>. In the early discussions about protecting valuable natural assets using buffer zones, these zones were primarily regarded as a means to minimise the negative impacts of human settlement and activities on the areas to be protected. Assessment of reciprocal beneficial consequences of buffers was often confined to merely functional issues such as reducing damage by wild animals. Gradually, however, the discussion on objectives and functions of buffer zones has increasingly shifted towards regarding such zones more as a socio-ecological concept than solely a geographically delineated area with imposed restrictions on resource use<sup>2</sup>.

The Netherlands and other donors are assisting many developing countries in conserving their natural resources through Integrated Conservation and Development Projects (ICDP), within which the concept of a buffer zone is often applied. Although the concept seems to be clear and logical, its appraisal, implementation, monitoring and evaluation is complex and unsatisfactory. Often, the foundation for failure has already been laid during the identification and formulation stage of the process.

The Netherlands Embassies have become increasingly involved in the appraisal and monitoring of buffer zone projects since 1997, when they were given the responsibility for decision making and management ('herijking') in development co-operation.

The primary purpose of this document is to assist the Netherlands embassies in better understanding the concept of buffer zones and its usefulness in sustainable conservation and development. The document will illustrate how buffer zones can be seen as part of a sustainable development strategy and process. Since buffer zones are a long-term process in the context of conserving natural resources, it will be important, if not crucial, to assess their feasibility and potential problems at the earliest stage possible. The document will also provide guidelines for better assessing and evaluating buffer zone projects in the identification and implementation stages.

The Netherlands' policy on development co-operation is based on sustainable development and overall well-being of the population (poverty alleviation)<sup>3</sup>. This policy determines the approach and starting point of this document. (Nature conservation should not be the only starting point when developing and managing buffer zones.) Consequently, the social and cultural settings and relationships of buffer zones are at least as important as environmental factors. Within this context, nature conservation and socio-economic development are not only complementary, but also strengthen each other's effectiveness and impact.

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<sup>1</sup> in French "zone tampon" ; in Spanish "zona de amortiguamiento", in Portuguese "zona tampão", and in Dutch "bufferzone".

<sup>2</sup> Shen, 1994; Jehoram, 1994

<sup>3</sup> A world of difference, 1990

This document will explain the principle of buffer zone management and will go on to describe the various issues to be addressed when a buffer zone is developed and managed, illustrated by a number of existing cases (chapter 2). In this chapter, we will choose the definition that corresponds best to the Netherlands' policy on sustainable development.

Chapter 3 begins with a short description of international conventions that relate to buffer zone management. National policies of recipient countries and of the Netherlands are briefly addressed in order to indicate the opportunities and constraints where the application of buffer zones is concerned.

Buffer zones are normally multi-functional and cover various disciplines, which are explained in chapter 4. Chapter 5 gives an overview of some possible buffer zone approaches.

In chapter 6, a short analysis is made of experiences in existing conservation efforts using buffer zones based on the literature, experiences from Netherlands-funded projects and input from the IAC/IKC-N Advisory Group on Forests, Forestry and Biodiversity.

Chapter 7 gives guidelines for identifying and appraising buffer zone management projects. The basis for these guidelines is the chosen definition of buffer zone, in which conservation and development are clearly combined. The guidelines can also be used during project implementation and project evaluation.

Attention will also be paid to external factors (e.g. market and policy failures) and other conditions and modalities of implementation which are fully or partly beyond the sphere of influence and which can negatively influence the appraisal process.

In general, the focus is on situations in developing countries, but for illustrative purposes examples from Europe are given as well.

This document will primarily focus on buffer zones in the context of biodiversity and landscape conservation. Some other applications will be discussed in chapter 5.

Wherever possible, we have avoided the use of the term 'core area' or 'core zone' in combination with 'buffer zone'. Instead, the word 'conservation area' is used, which may mean the whole classified protected area or in some cases the core zone.

## 2 THE BUFFER ZONE CONCEPT

The term buffer zone (sometimes also called ‘multiple use’ or ‘transitional zone’) is relatively new, although the principle has been in use for a long time. The concept of buffer zone management can be approached from various angles, which makes it difficult to give an overall definition. In this chapter the principles of buffer zone management and its various approaches will be discussed.

### 2.1 Evolution of the Buffer Zone Concept

The conceptual thinking about the underlying principles of buffer zoning is not new. The building blocks of the buffer zone concept were already integrated in policy thinking and programme planning of multi-lateral development organisations in the early 1970s. A more recent development is the introduction and spread of the term *buffer zone management* and the introduction of the integrated buffer zone concept in *Integrated Conservation and Development Projects (ICDP)* on a larger scale and among a wider group of development organisations, mainly in the public and informal sectors.

The concept evolved from the desire to better protect core areas of conservation areas or the conservation area as a whole by minimising the negative impacts of human activities on nature.

Before the buffer zone concept became widely known, its principle was already being applied, often in combination with production purposes. Forest plantations at the fringes of forest or other reserves, e.g. teak plantations around reserves in India, later turned out to be good buffers. Tea plantations around conservation areas in Kenya, Uganda and India turned out to be effective buffers against wildlife leaving the forest.

Conceptual thinking on buffer zone management has gone through three development stages:

1. At first, buffers were mainly defined as a means to protect people and their crops from animals leaving the conservation areas and forests;
2. Until 10-20 years ago the buffer zone principle was applied as a remedy to protect conservation areas from negative human influences;
3. Presently, buffer zones are more often applied to simultaneously minimise human impact on conservation areas and address the socio-economic needs and wants of the affected population (former resource users of the conservation area).

In the seventies, the buffer zone concept became widely applied in the wake of rising global awareness of biological values that resulted from increasing pressure on natural resources. Subsequently an increasing interest in stakeholders and traditional user rights gave buffer zone thinking a more socio-economic face and value. UNESCO's Man and Biosphere Programme (MAB) was begun to apply the concept of buffer zones<sup>4</sup> at a structural level.

In 1982 an Indian task force developed the ‘Core-Buffer-Multiple Use Zone’ strategy.<sup>5</sup> This strategy aimed at separating incompatible land uses, in particular in relation to wildlife. In this approach, the buffer zone would be under the park authorities’ administration. Sometimes controlled use of forest produce would be allowed. The multiple-use zone was located outside the park boundaries designated for rural development.

The buffer zone in the Indian context could refer to:

- A buffer entirely inside the park boundaries,
- A buffer with a sanctuary status adjoining the park, and

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<sup>4</sup> UNESCO, 1974

<sup>5</sup> Berkmüller and Mukherjee, 1998

- A buffer of reserved forest status adjoining a park or sanctuary.

The ICDP approach is in fact the result of the buffer zone approach, since the buffer zone principle is often applied in ICDPs.

## 2.2 Definitions and Terms

A buffer zone is an area lying between two or more others and serving to reduce the possibility of damaging interactions between them.<sup>6</sup> This approach is widely used in nature conservation, but is also applied in geo-politics (for example, the former East/West border in Europe and the zone between the two Koreas), in veterinary problem areas (swine fever) and in cases of contagious diseases (Ebola virus).

Nature conservationists distinguish two different ways of approaching the buffer zone issue. For the 'hard-core' conservationists, the buffer zone serves only to avoid negative human impact on the core area. The socio-conservationists see the buffer zone as a part of the socio-economic development of the entire area comprising conservation and non-conservation sub-areas.

### Box 2.1: Three definitions of buffer zones

From the Conservation point of view:

Wind and Prins (1989): Areas outside the protected area that are designed to protect parks;

Sayer (1991): A zone, peripheral to a national park or equivalent reserve, where restrictions are placed upon resource use or special development measures are undertaken to enhance the conservation value of the area;

From the Conservation and Communities point of view:

Wild and Mutebi (1996): Any area, often peripheral to a protected area, inside or outside, in which activities are implemented or the area managed with the aim of enhancing the positive and reducing the negative impacts of conservation on neighbouring communities and of neighbouring communities on conservation.

The Netherlands policy on development assistance is based on the principles of poverty alleviation and sustainable development. The third definition corresponds best with these basic principles and therefore, will be used in this document. Taking this into account, buffer zones can be seen as part of the sustainable development of people and countries (the bi-polar approach), and can be located inside as well as outside conservation areas.

Lack of international agreement and definitions on buffer zones has led to the use of different definitions and descriptions of buffer zones. In English, words such as 'support' and 'intervention' zone are often used as equivalents of buffer zone. However, a buffer zone is often seen as part of the conservation strategy, while support zone expresses a more people-oriented approach (e.g. CAMPFIRE in Zimbabwe).

Transitional zones are not buffer zones as such, but may serve the same purpose. They merely represent the interface between various ecosystems or different moments in the development of a vegetation ecosystem, and human activities. A mosaic of cultural landscapes around protected areas is also a transitional zone and could simultaneously function as a buffer<sup>7</sup>. The mosaic of cultural landscapes, interspersed with by natural vegetation, facilitates migration of animals and

<sup>6</sup> Shorter Oxford Dictionary

<sup>7</sup> Wu Zhaolu and Xiaokun Ou, 1995

plants.

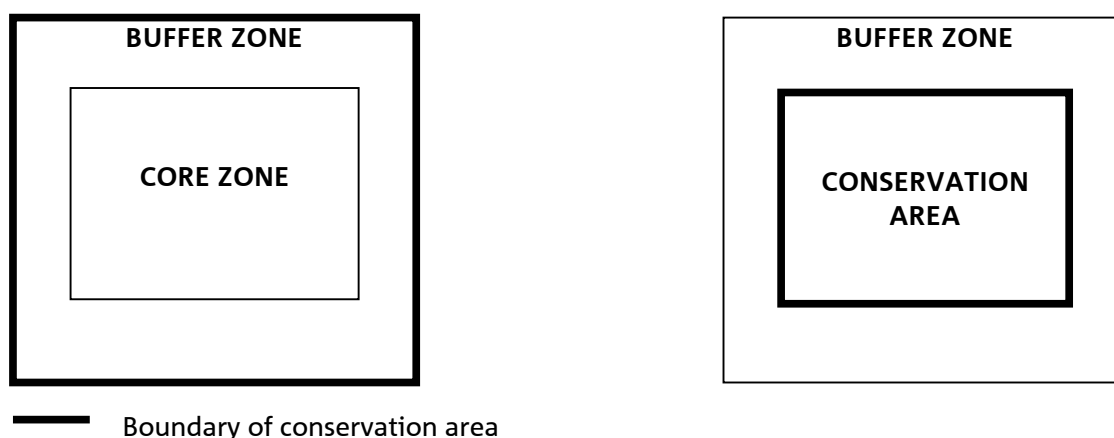
Multiple-use zones are areas that provide for the sustained production of water, timber, NTFP (non-timber forest products), wildlife, pasture and outdoor recreation, with the conservation of nature primarily oriented to the support of these activities<sup>8</sup>. Rubber plantations could well fall under this category.

## 2.3 Approaches in Buffer Zone Management

Buffer zones can be located inside a conservation/protected area (in which case there is a core zone), or outside it (so no core zone is needed). To avoid confusion, the word 'conservation' area will be used consistently in this document.

Figure 2.1 explains the situation.

*Figure 2.1. Two buffer zone situations*



There are various approaches in buffer zone management related to the specific approaches in and opportunities for nature conservation. The different nature conservation approaches, which are illustrated in figure 2.2, are Protected Areas (with and without buffer zones), Integrated Conservation and Development Projects (ICDP), Man and Biosphere (MAB) and Land Use Planning (LUP).

The bi-polar approach (2.2) is applied in the LUP, MAB programme and ICDP. In all three cases socio-economic development plays a crucial role, despite the fact that ICDP takes conservation as its starting point and covers smaller areas, while MAB focuses more on people and larger areas. Strictly protected areas (reserves) may have buffer zones around them, normally to minimise the impact of human activities on the protected area itself.

In general, the higher the population pressure is, the smaller the protected areas and the buffer zones, and the more intense the repression will be (figure 2.2). Even though this is often not seen as a sustainable solution, it is nevertheless applied on a large scale in Europe. The situation in Europe is such that people do not depend on protected areas for their livelihood and are highly aware of their recreational and ethical values.

Figure 2.2 clearly illustrates the position and the overlaps that exist between ICDP, MAB, and other types of conservation approaches. Box 2.2 provides some descriptions of ICDP and MAB.

In Western Europe the zoning principle, including buffer zones, is applied in LUP exercises. An example is the protection of wetlands, around which a zone with an artificially high water level is

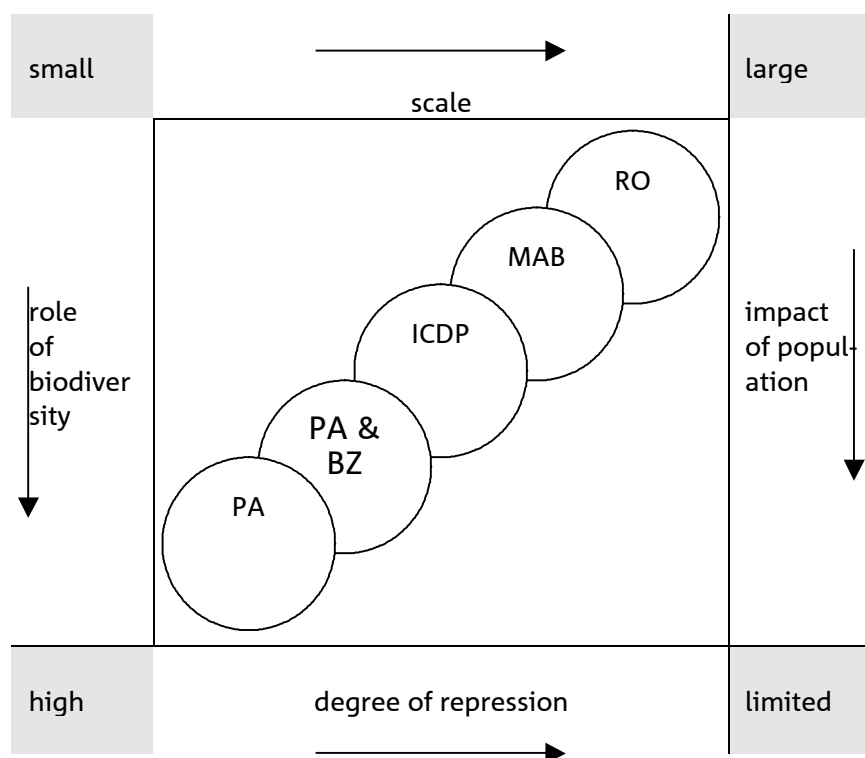
<sup>8</sup> Sayer, 1991

maintained in order to avoid drying out of the wetlands. This zone is in fact a buffer zone. The land use planning approach comes close to the MAB approach, however, in the MAB approach the protected area is the starting point, while the LUP has people and nature together as starting point.

In Western Europe, land use planning is accompanied by a number of legal instruments, which makes it possible to restrict certain activities, for example, the use of pesticides in wetland areas and large-scale 'factory farms' in sensitive areas. The European system of buffer zones around cronies is very old. These cronies are in fact small conservation/protected areas.

The type of conservation area with or without a buffer zone depends on a number of factors: population pressure, size of the area, quality and quantity of biodiversity, cultural situation, social organisation and way of life, legislation and economic development<sup>9</sup>. It is often important to start by examining the economic opportunities and hurdles, the legal context and the condition of the conservation area itself.

**Figure 2.2. Relations between various conservation approaches**



- PA      protected area approach
- PA+BZ    protected area and buffer zone approach
- ICDP    integrated conservation and development approach
- MAB    man and biosphere approach
- RO      land use planning approach

<sup>9</sup> IUCN, 1998

**Box 2.2: definitions of MAB and ICDP**

ICDP stands for Integrated Conservation and Development Project. This is an approach whereby conservation of the natural resources is achieved in combination with and through economic development of the population, and consequently demands for an integrated approach and participatory decision making process.

MAB stands for Man and Biosphere Reserve: An area chosen and managed as natural or largely undisturbed representative examples of the world's major ecosystem types. They are also selected to demonstrate the relationship between conservation and development. In most countries biosphere reserves are not classified as protected areas, but may include protected areas. In the MAB approach people are just as important as biodiversity, and economic development is the starting point.





## 3 NATIONAL AND INTERNATIONAL POLICY ISSUES

### 3.1 International Programmes, Conventions and Legislation

There are no international treaties and conventions specifically dealing with buffer zones, but in practice buffer zones are often applied as tools to implement those conventions.

International conventions and treaties ratified by the Dutch government are generally incorporated in Netherlands national policy documents.

The *Convention on Biological Diversity* (CBD) of 1992 does not explicitly mention buffer zones, but some chapters are relevant to buffer zone management. Article 8 deals with in-situ conservation, including the role of indigenous people:

- 8e) Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;
- 8j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the involvement of the holders of such knowledge, ...

Although not all buffer zones deal with indigenous people, buffer zones could facilitate the participation and protection of their traditional rights. Article 10 deals with the sustainable use of components of biological diversity, which often relates to buffer zone management, as the use of components of biodiversity is often allowed in buffer zones.

The recent developments in the CBD indicate a shift towards an ecosystem approach. The buffer zone concept responds well to this development in most cases; normally the ecosystem approach will need larger areas.

Of comparable importance for buffer zone management is Convention 107 of the International Labour Organisation, recognising the rights of tribal and indigenous people to ownership of their traditional lands.

The Man and Biosphere Programme of UNESCO started to use the buffer zone concept explicitly after 1974<sup>10</sup>.

As is clear from the above, the conservation of biodiversity and the respect for traditional land use rights do often go hand in hand in buffer zones. This makes the issue of buffer zone management an interesting, challenging and complex one.

### 3.2 National Policies

National policies on biodiversity and conservation may be elaborate, but they seldom address the issue of buffer zones. Definitions of buffer zones are not consistent, which explains the relatively wide range of applications and different interpretations. National legislation usually does not address or consider the creation of buffer zones outside conservation areas. The sectoral approach in legislation hampers the integrated approach of buffer zone management, particularly when buffer zones are located outside conservation areas.

Although many countries have National Forest Action Plans, Environmental Action Plans and even Biodiversity Action Plans, their national legislation often does not keep pace with new developments. Buffer zones are rarely mentioned in national policy and legislative documents. The institutionalisation of buffer zones thus is still difficult and sometimes even impossible.

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<sup>10</sup> UNESCO, 1974

So far, only a few countries have developed policies and legal instruments facilitating the development and implementation of the buffer zone approach through facilitating revenue sharing (e.g. Nepal), decentralisation of decision making and the creation of by-laws (e.g. Ghana).

Traditional land rights and land tenure are issues often raised in buffer zone management. These issues tend to be crucial for making investments in buffer zone management. National legislation in Asia and Africa is normally very conservative where allocating land rights and land titles is concerned, although in Latin America this is widely applied. In some countries national legislation supports traditional land use and customary rights. However, in situations where timber or minerals play a role, these laws are not strictly enforced or, even worse, are often overruled by economic interests.

National legislation, including the issue of buffer zone management, tends to trail behind reality. International conventions thus are not always adequately integrated into national legislation.

### **3.3 Netherlands Policy and Buffer Zone Management**

The overall objective of the Netherlands Development Assistance can be described as poverty alleviation through sustainable development for the overall well-being of the people (box 3.1). This means that conservation of biodiversity should be an integral part of this overall objective, and that it cannot be seen as an isolated and independent programme. Integrated conservation, therefore, is generally seen as the approach to achieve the general policy objectives. The buffer zone approach fits in perfectly well with this line of policy thinking.

#### **Box 3.1: Improved livelihood defined by Dutch Development Assistance (A world of difference, 1990)**

The two main pillars of the Netherlands Development Assistance are:

- The long-term fight against poverty, and
- Development by, for and of the people.

Spearhead programmes are:

- Environment,
- Women and development,
- Research, and
- Poverty alleviation

#### **3.3.1 The Netherlands' Policy regarding Biodiversity Conservation**

The Netherlands' policy regarding biodiversity conservation is described in the following policy documents:

- The Policy Document on Tropical Rainforests (1991),
- Biological Diversity (1995),
- Forests and Forestry (1997),
- International Nature Conservation Programme (PIN; 1996), and
- Strategic Plan for Implementation (Strategisch Plan van Aanpak or SPA)

These policy documents both address conservation issues and take into account the fact that biodiversity conservation is an integral part of sustainable development, along with poverty alleviation, gender and sustainability (see appendix 1).

Box 3.2 gives an overview of the most relevant objectives of the Netherlands Government policy document on tropical rainforests (Regeringsstandpunt Tropisch Regenwoud, or RTR) where buffer zone development is concerned. The use of buffer zones is clearly related to these objectives and is fully supported throughout the above-mentioned policy and sectoral documents.

**Box 3.2: Relevant RTR objectives in relation to buffer zones (RTR, 1991)**

- Active protection of surviving virgin rainforests.
- Encouraging planned land use and land management along with sustainable agriculture and forestry.
- Strengthening institutions and legislation; empowering local populations.
- Strengthening the political and social base in tropical nations.

### **3.3.2 Other Policy Issues**

Other relevant Netherlands policy issues and criteria are based on poverty alleviation, gender and environment. These issues are dealt with in appendix 2.

### **3.3.3 Sustainability**

A relevant issue to buffer zone management is sustainability. Buffer zone management is seen as a long-term intervention aimed at bringing about a transition to sustainability.

Four dimensions of sustainability can be distinguished<sup>11</sup>:

- **Ecological** sustainability, which concerns using natural resources in a way which does not reduce their future use potential, or impair the long-term viability of the species.
- **Social** sustainability, which concerns the ability of contracting communities to sustain their obligations as set out in collaborative agreements. Social acceptability is an important criterion in this aspect.
- **Institutional** sustainability, which concerns the managing authority's ability to meet conservation obligations, etc.
- **Financial and economic** sustainability: a state in which resources are managed so as to maintain productive opportunities for the future and whereby natural capital stock is non-declining through time<sup>12</sup>. The latter concept is interesting as it bridges the gap between ecology and economics by demanding minimum conditions of ecosystem stability and resilience through time as a prerequisite for sustainability.

Sustainability is promoted by institutionalisation of activities and programmes, and capacity building at the government, private sector and community level.

In order to create support and general awareness among the local population, whether indigenous or migrant, these people have to be involved in the process of buffer zone development and management. The population has to indicate what they expect and what they were or will be using the buffer zone for. Without their consent and understanding of the importance of a buffer zone, the approach will not be sustainable.

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<sup>11</sup> R.G. Wild and J. Mutebi, 1996

<sup>12</sup> Perman et. AL., 1996



## **4 CONDITIONS, BENEFITS AND CRITERIA FOR BUFFER ZONES**

### **4.1 Characteristics of New Conservation Areas in Developing Countries**

Areas with interesting values in terms of biodiversity, structure and productivity, which are identified and selected for gazettment as conservation areas, normally have some common features. These characteristics determine the conditions and restrictions under which interventions in the field of conservation and socio-economic development will take place.

A number of these characteristics can be distinguished (based on extensive field visits):

- Natural areas which are still intact and which harbour a high and/or interesting biodiversity are often located in areas with a low population pressure. This generally means that pressure on the natural resources is relatively low and infrastructure weakly developed;
- As the areas are normally isolated, people are living on the agricultural frontier, often more concerned with survival than with conservation. This is clearly expressed by land use systems such as 'slash and burn' agriculture, hunting and gathering. The population often consists of indigenous people;
- As most ecologically interesting areas are located in isolated places, government structures are generally less developed, or even lacking. This makes policy implementation, law enforcement and rural development difficult to implement;
- Nationally or regionally based NGOs are generally under-represented in these areas, with traditional organisations and institutions often playing an important role in community life;
- The remote location has a number of consequences, such as:
  - marketing problems, e.g. poor market infrastructure, few communication facilities (including telecommunications), poor transport facilities,
  - poorly motivated government personnel (including teaching personnel), limited or no access to financial services,
  - relatively high costs of living,
  - marginalisation of the population.
- Land rights and land titles are often not settled in conjunction with national legislation, or adequately secured and respected. Normally, traditional land ownership occurs alongside conflicting land claims by settlers. Land uses are often based on traditional user and property rights (customary rights). Some countries' national legislation does respect traditional land rights, but this is relatively rare, especially in those countries where natural resources are of strategic importance.

All of the characteristics mentioned above have one consequence in common: a functional and sustainable development for these areas, including buffer zone development, requires substantial investments in infra-structural and institutional development, among other things. Often these investments result in conflicting impacts: while investment is necessary for economically developing an area, it will add to the risk of intensified and possibly unsustainable use of the natural resource base. From the perspective of economic development, however, a trade-off between growth and environmental quality (for example, an 'optimal' level of pollution) is not uncommon and does not necessarily result in irreversible loss of environmental quality.

### **4.2 Buffer Zones and Jurisdiction**

In most countries, legislation with regard to conservation areas is fairly thorough, but quite often is not with regard to their zoning. As a result, conflicts may arise not only over their jurisdiction, but also with respect to the value and significance of buffer zones. Even in many international treaties buffer zones are not explicitly mentioned, let alone clearly defined.

A wide diversity can be observed in set-up, management and implementation of buffer zones, due to the lack of a well-defined legal concept of buffer zones. Consequently, situations are common where buffer zones are located within the conservation area. Apparently this is done in order to facilitate the management of *core* as well as buffer zones and to ensure a single responsible authority. As a matter of fact, wherever the buffer zone is situated within the boundaries of the declared conservation area (figure 2.1), jurisdiction over the buffer zone will be with the protected areas' authorities, unless defined otherwise by decree. In terms of serving the conservation objective, this is not a good approach if rural development and other social & economic activities are permitted in the buffer zone. It is often argued that conservation authorities should not be involved in rural development programmes.

Conversely, situating buffer zones outside the conservation area may also have its particular drawbacks. In such case, conservation authorities may have little or no say in the set-up and management of the buffer zone. From a socio-economic development point of view this may not be such critical issue, but the situation is certainly ineffectual in terms of overall resource planning and implementation.

Nepal and Cameroon are two countries where the buffer zone concept has in fact been laid out in legal terms. In Nepal the Buffer Zone Management Regulations (1996)<sup>13</sup> define the buffer zone as an area outside the protected area under the warden (assisted by a buffer zone development council). In Cameroon the law defines the buffer zone as area of 1km outside the boundaries of the nature park<sup>14</sup>.

In cases where a high population pressure requires a buffer zone with a clear socio-economic approach, it would be advisable to place the buffer zone under the jurisdiction of the local or national development authorities, which normally means that the buffer zone will be located outside the conservation area.

Buffer zones which are a continuation of the conservation area (natural buffer zone) need a completely different approach and are preferably managed by the same authorities as the conservation area.

The sectoral thinking in many developing countries may lead to contradictory objectives between the buffer zone and the conservation area, if under different authorities. Steering committees at the central and regional level and strong multi-sectoral thinking by local authorities can minimise these problems. If the possibility of creating by-laws arises, the vacuum in legislation concerning buffer zones can be filled.

In India<sup>15</sup> two simple but essential requirements are given for a functional buffer zone: it cannot have national park status (since this carries too many restrictions) and it should be under the park authorities' jurisdiction in order to have maximum control over its uses. However, it is clear that economic buffer zones do not have much in common with conservation area management. In those cases liaison between the various responsible authorities will be crucial.

#### **4.3 Conditions, Benefits and Criteria for Buffer Zones**

When discussing the possibility and/or need for the creation of a buffer zone, it will be necessary to first assess the added value of a buffer zone. Is a buffer zone necessary to better conserve or protect the value of the conservation area, or is the buffer zone needed in order to secure support from the surrounding communities, leading to greater respect for the values of the conservation area?

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<sup>13</sup> HMG, 1996

<sup>14</sup> van der Zon, 1999 (verb. comm.)

<sup>15</sup> Berkmüller and Mukherjee, 1989

The opportunities, focus and limitations for buffer zone development and management depend on a number of criteria and conditions. These are related to size, ecology, economy, legislation and social and institutional framework.

#### **4.3.1 Size**

The preferred size of a buffer zone is variable, depending on the objectives, availability of land, traditional land use systems, threats and opportunities. From an ecological point of view, the larger the buffer zone and the more it can be seen as an extension of the protected area, the better for the conservation area and its biodiversity, including natural processes.

From a social and economic point of view, however, this is not often possible. Economists will argue that there is an optimal size for any buffer zone whereby at the margin the incremental cost of enlarging the zone will no longer be compensated by the additional benefits generated by such enlargement. At best, there is still room for improved protection, but at a cost that exceeds the expected beneficial impact. Consequently there will always be a degree of environmental damage to protected areas that is - economically speaking - acceptable. Section 4.3.3 contains further discussion of the economic aspects. The social argument against enlargement of buffer zones is similar: in most cases it can only be done by curtailing the right of access to and use of natural resources in the affected areas. Moreover, not all individual members in a community, or for that matter within the households, will be equally affected by restrictions on resource use. Women quite often perform a greater variety of household tasks and might therefore be more severely affected by restrictions in resource use than men.

In areas traditionally used by the local population for NTFP (non-timber forest products) collection, buffer zones that include areas of shifting cultivation and timber extraction areas will have to be large enough to sustainably support these traditional use systems. A buffer zone that gradually degrades does not serve its purpose. Assessment and monitoring, therefore, will be very important in determining the effectiveness of a buffer zone.

Traditional use zones functioning as buffer zones can be located inside as well as outside the conservation area.

Economic buffer zones, such as tea, rubber, fruit and timber plantations, may be of any size. In many cases these were created long ago, and they are usually situated outside the conservation areas.

Cultural buffer zones can be any size. Culturally significant areas such as sacred places/groves and cemeteries are well protected and make excellent buffer zones. However, in many places, e.g. Ghana<sup>16</sup>, continuing degradation of traditional values is resulting in decreasing respect for these areas.

The real size of a buffer zone is often the result of negotiations between the various stakeholders and very much depends on the availability of land. However, in a stratified society, there is the danger that these negotiations are dominated by the most powerful inhabitants. It is therefore crucial that all stakeholders are fully involved in defining the buffer zone area.

Box 4.1 gives some indicative criteria for sizes.

#### **4.3.2 Ecological**

Buffer zones may focus on landscape, habitat and/or species conservation. All of these demand a different ecological approach. Before a buffer zone is established, it should be very clear what (or *what part* of the) ecosystem should be conserved. This also means that the local species ecology should be known.

These days, the ecosystem approach is common practice, as can be seen from the preparatory

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<sup>16</sup> Ebregt, 1995

document for the fifth Conference of Parties to the CBD to be held in Nairobi from 15 – 26 May 2000. This also has consequences for the buffer zone concept in terms of its functions as corridor or migration route.

#### **Box 4.1: Examples of sizes of buffer zones**

*Fauna:* migrating species normally demand large areas, e.g. an elephant herd's range can cover hundreds of miles. As a rule of thumb for amphibians the width of a buffer zone should be at least 5 times vegetation height. Cronies, a very old system of wild duck harvesting in Europe, has a core zone (a pond surrounded by dense vegetation) and around this core a buffer zone of 500 meters or more wide in which agriculture (mainly grazing) is allowed, but no people.

*Flora:* many species need very specific ecological conditions including seed dispersal by specific animal species. The larger the area, the better the chances for survival.

*People:* buffer zones in which shifting cultivation will be allowed, have to be large enough to support this rotational production system

*Economic:* optimal size when additional cost of a unit enlargement of the buffer zone will no longer be covered by the resulting incremental benefit

Factors that should be looked into are:

- Soil conditions. Some species may need particular soil conditions, e.g. valleys. Buffer zones which cannot protect these valleys do not serve their purpose;
- Habitat use of species. Some species are wide-ranging, due to the search for partners, minerals, water etc., or very specific food demands. For example, in Uganda's Kibale Forest it was found that chimpanzees were covering long distances to find specific fruit trees;
- The smaller a conservation area, the greater the chance that species in the conservation area may disappear, unless the buffer zone can compensate for the small size of the conservation area by simultaneously being an ecological extension of the conservation area itself;
- Crop-raiding animals have to be identified, since in those cases the buffer zone is important for mitigating crop damage outside the conservation area.

#### **4.3.3 Economic Aspects**

Conservation of protected areas is not a private commodity traded on the open market, but a public benefit. Therefore, there is no ready-to-use demand curve that conveys the marginal value society places on each additional unit of the benefit. The problem is that environmental quality is a public, non-marketable commodity<sup>17</sup>. The cost of the efforts to preserve this quality cannot easily be measured against their perceived benefits.

Establishing buffer zones to better preserve conservation areas is by all means an economic activity whereby productive resources are put to use with the aim of creating incremental value to the society. Ideally, the economic feasibility of a buffer zone must be deduced by appraising the incremental costs and benefits of establishing buffer zones and comparing the result to the situation in which such a zone was not established. The latter scenario would be one in which conservation areas simply bordered areas with no specific restrictions on development activities, other than those applied elsewhere in the area.

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<sup>17</sup> Callan and Thomas, 1996, page 225



This discussion will consider three aspects:

- Costs of buffer zones,
- Benefits of buffer zones, and
- Actual appraisal (cost-benefit analysis, time frame, discount rate).

Translating resource use into economic terms means establishing the cost of buffer zones, including both explicit and implicit costs. Explicit costs are the monetary expenses of establishing and managing buffer zones, such as the cost of:

- Infrastructure works,
- Conceptual development and (participatory) planning and management of the buffer zone,
- Monitoring buffer zones,
- Measures to compensate for enforced changes in productivity (price or income support to farmers),
- Enforcement of resource use restrictions and controls on implementation (banning hunting or timber collecting),
- Replacement for banned access to natural assets (e.g. bore holes instead of access to springs in core area),
- Ideally, compensation for and compliance by other sectors (restrictions on small-scale industrial activities, or on food-processing technologies requiring firewood),
- Other new or additional tasks performed by local government services,
- Administrative procedures and legislative measures (registration etc.),
- Implicit costs refer to the value of any associated non-monetary impacts of establishing buffer zones that negatively affect the well-being of society. Some examples are:
  - Time cost of searching for substitutes,
  - Inconvenience of specific measures such as having to use alternative technologies or losing access to certain environmental assets,
  - Inconvenience of enforced changes in social and cultural heritage (not being able to carry out certain traditional activities),
  - Time and energy required to acquire new skills and assimilate new technologies,
  - Trouble in accepting new non-traditional management procedures.

The literature shows that most analyses fail to fully capture the implicit costs of environmental policy interventions such as the establishment of buffer zones. The result is that the environmental cost assessment will be seriously understated.

Two situations<sup>18</sup> can be envisioned with respect to benefits of buffer zones:

1. Without a buffer zone, the threat to the conservation area is such that the intended conservation of the area becomes impossible over time, e.g. major protected species will disappear or the area will degrade completely and irreversibly. In such cases, the benefits of the buffer zone will include the total of user and non-user values of the conservation area plus incremental benefits of the buffer zone and possibly external benefits (if identifiable).
2. The buffer zone leads to improved management and sustainability of the conservation area, but is not a prerequisite for its long-term survival. The appraisal needs to weigh the benefits of establishing and maintaining a buffer zone against the incremental costs of doing so, in discounted terms. Major obstacles in this analysis would be (a) the description of the 'without' scenario (how bad would it be without a buffer?), (b) identification, quantification and value of the incremental benefits, and (c) setting the appropriate value of a social discount rate.

It is not the purpose of this document to discuss these issues in greater detail. Nevertheless,

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<sup>18</sup> Note: we have not considered a case where the relationship between buffer zone establishment and conservation of the protected area cannot be identified – in such case, there is no economic argument for establishing a buffer zone.

further research into experiences and best practices with respect to evaluation of buffer zone impacts is required to streamline and improve integration of economic arguments into the decision-making process in buffer zone establishment.

In both scenarios depicted above, two complementary categories of benefits can be distinguished: benefits generated in core zones, buffer zones or elsewhere<sup>19</sup>, and user and non-user values generated as a result of the establishment of a buffer zone.

A final note on environment versus economics: the disparity between ecological and economic time scales presents a great challenge because the economic system responds to change much faster than the ecological system; that is, biological systems are constrained by much slower time scales than economic systems. Furthermore, modern communication technologies allow economic decisions to be made far from the actual location of the conservation problem, and to be implemented rapidly, with no local community input. It is crucial to adopt analytical means and management institutions capable of ensuring that the rapid economic time scales do not overshadow the biological ones<sup>20</sup>.

#### **4.3.4 Legal Aspects**

Legal aspects are determined by various levels of legislation and agreements:

1. International treaties and conventions (e.g. CITES, CBD) will have, in the best case, an impact on national legislation. Strictly speaking, buffer zones are not addressed, except for indirect links to the buffer zone concept;
2. National legislation will be the principal factor in determining the impact of the buffer zone approach. In most countries, however, the concept of buffer zones is not addressed in the legislation, while often inconsistent definitions are used as well;
3. Local level legislation through by-laws and rules may have an important influence on the impact of buffer zones. If the by-laws are supported by local communities, the buffer zone approach may be successful.

Legal aspects and formal procedures of buffer zone planning and management are often poorly developed, if not entirely absent, in many countries, as is the aspect of ownership, notably when communal lands are included in a buffer zone. If a buffer zone is situated within the boundaries of a national park or other formally protected area, jurisdiction and ownership are usually clear. Even then, implementation and control may not always be easy to effect. For example, laws and legal procedures may be incomplete, unclear or inconsistent with traditional practices. Programme objectives or strategies (such as who is in charge, who monitors and controls compliance with laws, what legal power is vested in the park authority, etc.) may not be compatible with operational or institutional conditions dictated by the legal framework. Legal obstacles will usually be even more critical when the buffer zones are situated outside the conservation area (4.2) and thus (usually) fall under the institutional control and jurisdiction of authorities other than the management of the conservation area. (Nepal, whose Buffer Zone Management Regulations stipulate differently, is an exception.) Joint planning and implementation, shared policy objectives, co-ordination in procedures, and modifying legal procedures, laws and by-laws will be key issues here. Informal or management agreements between local people, the management staff of the protected area, and other government agencies have been shown to work well<sup>21</sup>. If the buffer zone grows in size, however, formalisation

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<sup>19</sup> i.e. externalities = spill-over effects associated with either production or consumption of goods or services that extends outside the market to some third party other than the producer or consumer (Callan, p.82). In this case, the service is the buffer zone's function in conservation of core area. Spill-over occurs in other areas, e.g. downstream of watershed.

<sup>20</sup> Mangel et. al. 1997, p.66

<sup>21</sup> Sayer, 1991

of such agreements may become necessary to allow effective control over its implementation. Generally speaking, a sound legal framework for protecting and managing a strictly protected area is a prerequisite for giving rationale and credibility to a buffer zone establishment around it. If a conservation area is not taken seriously, how can an adjacent buffer zone be of any value? As experiences with buffer zone legislation are still limited, lessons could be drawn from the more advanced field of jurisdiction with respect to industrial development and pollution abatement.

In other cases, such as the Qomolangma Nature Preserve (QNP) in Tibet, an institutional situation has emerged in which the park authorities have full control over core zone development, limited control over buffer zones, and basically no voice in the economic development zones. In a situation like Tibet's, where pockets of these different zones are geographically blended, joint planning and implementation of regional development programmes is nearly impossible, because of the multitude of institutional actors, most of whom have very limited (or no) knowledge or understanding about buffer zone functions and requirements.

When legislation is eventually reviewed and the law makes way for settlement of ownership claims, problems of a procedural nature may arise in the registration of land deeds. Quite often, these procedures have a rather negative impact on women, for example by creating formal threats to their traditionally accepted (but not formalised) rights of access to land resources. Problems with registration may also arise out of inconsistencies or gaps in the legal framework, or conflicts of interest arising between traditional users and others claiming ownership rights. Although participation is increasingly being seen and adopted as the obvious approach to land use planning (and establishment of buffer zone arrangements), apparently in far too many instances participation is less of an issue when legislation has to be formalised through registration of ownership rights.

In the Nepal case the buffer zone is situated outside the national park boundaries. By law the buffer zone is managed through the Buffer Zone Development Council (BZDC), of which the park warden is the secretary. It is this council that determines for what development activities/projects the revenues from the park are used – usually the communities in the buffer zone are entitled to around 40% of the revenues. The warden may use his/her power and position in this BZDC to direct the initiatives.

#### **4.3.5 Social aspects**

As indicated above, land tenure is a key issue in the success or failure of buffer zones. In general, it will usually be more difficult to manage conservation and buffer zones on privately owned land. Land-use restrictions may be difficult to enforce, especially as people become aware of potential alternative uses with apparently more favourable financial returns from investment. On the other hand, buffer zones on state-owned land, while allowing uniform management regimes, may also lead to the management problems usually associated with the 'tragedy of the commons'. In the latter case, informal management agreements would be a requirement for ensuring sustainable productive use by local communities (also see sections 4.3.3 and 4.3.4). Community tenure of land is difficult to manage in rapidly evolving societies having weak institutions and conflicting development objectives, as in the case of Tibet (see above).

For a buffer zone to succeed, there must be a recognition of the role of all stakeholders and why and how they interact, or ought to interact. Stakeholders must communicate intensely and participate in all stages of buffer zone establishment and management. In order to achieve true and meaningful participation, in particular from the local population, local users must appreciate the real benefits of buffer zones in order to adopt them as a long-term survival strategy. Although there will be obvious benefits from the appreciation of the value of nature conservation and preservation of the natural resource base for their own livelihood, planning must also include direct short-term economic benefits or a fair compensation for the lack of them (see 4.4). Collaborative management and co-management of the buffer zone is basically a process of

collaboration between local communities and state agencies over the use and management of natural resources or other assets, whether state or privately owned, through a negotiation process which includes all stakeholders, recognises the contribution of each, and results in a mutually acceptable and adaptable management agreement<sup>22</sup>. Conservation requires a transparent process of decision making that engenders public faith in the credibility of the process and thereby brings the public and decision makers to a better understanding, from all perspectives, of the desirability of maintaining the resource<sup>23</sup>.

#### 4.4 Benefits of Buffer Zones

Buffer zones may provide a variety of benefits, depending on the type of buffer zone, natural conditions, investments made and other factors. These benefits can be categorised as biological, social, economic, institutional or policy-related benefits <sup>24</sup>:

- Biological benefits:
  - ◊ Providing a filter or barrier against human access and undesirable use of the core zone or conservation area;
  - ◊ Protecting the core zone or conservation area from invasion by exotic plant and animal species;
  - ◊ Providing extra protection against storm damage, drought, erosion and other forms of damage;
  - ◊ Extending the habitat and thus increasing the population of large, wide-ranging species in the protected areas;
  - ◊ Enhancing environmental services provided by the reserve, e.g. watershed protection;
- Social benefits:
  - ◊ Providing a flexible mechanism for resolving conflicts between the interests of conservation and those of the inhabitants of adjacent lands;
  - ◊ Improving the earning potential and quality of the environment of local people;
  - ◊ Building local and regional support for conservation programmes;
  - ◊ Safeguarding traditional land rights and cultures of local people;
  - ◊ Providing a reserve of animal and plant species for human use and for restoring species, populations and ecological processes in degraded areas;
- Economic benefits<sup>25</sup>:
  - ◊ Compensation to people for loss of access to the strictly protected core zone or conservation area;
  - ◊ Increased benefits from protected area for direct users such as:
    - income from tourism,
    - research permit fees from scientists,
    - income of local people employed in area;
  - ◊ Increased value of protected area from indirect use:
    - watershed effects,
    - protective role of buffer;
  - ◊ Increased value of protected area for non-users:
    - existence value of wild life,
    - existence value of protected vegetation;

<sup>22</sup> Berkmuller & Mukerjee, 1989

<sup>23</sup> Mangel et.al., 1997

<sup>24</sup> Sayer, 1991; Poore and Sayer, 1987

<sup>25</sup> Caution is needed as some impacts of buffer zone establishment can be negative, e.g. change in productivity can be either positive or negative, qualifying respectively as benefits or costs.

- ◇ Direct benefits - income generated in buffer zone:
  - new employment opportunities,
  - change in productivity,
  - benefits of newly introduced crops or technologies,
  - income generation from transit movements to and from park (roadside stalls, resting places, food & drink establishments, hotels etc.);
- ◇ Indirect benefits from buffer zone:
  - new & improved infrastructure ,
  - new & improved market opportunities,
  - improved access to public services;
- ◇ Other benefits:
  - increased visitor flows (and income generation) at regional and national level,
  - the value from biodiversity and the conservation of habitat (i.e. future direct and indirect uses),
  - intra-household re-allocation of resource rights and returns;
- Institutional and policy-related benefits:
  - ◇ Introduction of participatory planning methodologies,
  - ◇ Direct and indirect users' awareness of value of natural areas and consequent willingness to contribute to their establishment,
  - ◇ Establishment of local level monitoring mechanisms involving local population,
  - ◇ Involvement of local population in management of conservation and buffer zones, and
  - ◇ Increased responsibility with local government for regional planning and implementation that includes nature conservation components.

The potential of eco-tourism and related services is debatable. Further research is needed to identify new and promising ways of tapping this potential without inflicting damage to the natural resource base that buffer zone development is trying to protect.



## 5 TYPES OF BUFFER ZONES

This chapter will describe a variety of buffer zones, all following the same principle, but applied under completely different conditions (biological, political, sanitary, economic, etc.).

### 5.1 Traditional Use Zone

In cases where a conservation area has been identified in which people live traditionally and exploit its natural resources, the basic needs of these people will still have to be met. The solution is usually to define a buffer zone in which these practices can be continued. However, these uses may be restricted and/or improved, depending on the situation. In most cases, this type of buffer zone is situated within the conservation area itself.

Traditional use zones are often low-intensity-use zones for subsistence purposes, generally allowing such activities as collection of NTFP, hunting and fishing. An important condition for continuing these activities may be that it does not lead to degradation of the buffer zone. An example of a difficult situation occurs where shifting cultivation is practised. The system as such may be useful in terms of biomass production, but can become harmful if the rotational cycle is shortened too much. Allowing shifting cultivation in a buffer zone automatically means that a vast area will be needed. In some situations, such as Central Africa, the forest areas are vast enough and the population pressure low enough to allow shifting cultivation to be continued. Close monitoring remains essential in these zones.

Box 5.1 gives an example of a multiple-use zone.

### 5.2 Forest Buffer Zone

Forest buffers, which can be planted or natural, are probably the oldest known buffer zone created for exploitation purposes. In most cases this involved converting natural forest into planted forest estates. The remainder (natural forests) were later often treated as core zones. The functional quality of a buffer zone is best when the buffer is an extension of the core zone habitat, in this case a natural forest buffer. Exploited natural forest buffers based on a sustainable system often have a surplus of biomass, which is advantageous for browsing species such as elephants and duikers. However, some timber-dependent species will be affected negatively. Cases of forest buffers are softwood plantations in Uganda's Mt. Elgon and Kibale National Parks, teak plantations in India and Sri Lanka, and softwood plantations in Vietnam's Vu Quang Nature Reserve.

**Box 5.1: Minkebe area in Gabon, a traditional use zone**

(source: WWF/DGIS Tropical Rainforest Portfolio, 1996)

The Minkebe area is a vast tropical rainforest area with virtually no infra-structure, known to be the home of Binga pygmies. The project there is focussed on the creation of a large protected area of around 500.000 ha with clearly defined management zones. In fact, the conservation area will be a multiple-use zone for the Binga population, as they will be allowed to continue their subsistence activities (hunting, NTFP collection). Regular review of their activities and impact will determine whether restrictions should be necessary. In fact close monitoring is needed, as it is said that the Binga population is largely responsible for elephant poaching.

Although traditional rights are relatively well respected and even the environmental legislation is relatively well developed, the political situation is such that in the recent past concessions were given out for logging or mining without careful consideration and without following official procedures.

Minkebe is an example of a conservation area surrounded by natural forests. The indigenous tribal people are allowed to continue their way of life. Their impact on the conservation area will be closely monitored and evaluated so that if intervention is needed it can be swift.

The dangers in terms of conservation are limited. The biggest risk will be mining, elephant poaching and logging. As the area is vast and located in isolation, patrolling and monitoring is only possible by foot and/or by air. Also, the area is not far from the border with Cameroon. The most effective monitors of biodiversity and resource would be the local population.

Strong points in relation to buffer zone development are:

- The total area is vast, isolated and inaccessible;
- The infra-structure is virtually absent. This and the natural conditions mean that logging operations will need high investments;
- The population pressure is low;
- The indigenous people and their traditional way of life is respected;
- The project is following a participatory approach;
- The buffer zone consists of natural forest.

Weak points in relation to buffer zone development are:

- Lack of proper legislation dealing with buffer zones;
- Weak government structure and representation in the field;
- Government staff lacks training, equipment and motivation;
- Lack of infra-structure limits control of illegal logging and poaching;
- The area is situated close to the international border, making control of illegal traffic and poaching difficult;
- Forest exploitation plays a dominant role in politics;
- Area is known to harbour minerals and timber;



It is important to apply a forest management system which has a minimal negative impact on the ecological conditions of the buffer zone. Examples are low-impact forest management, allowing other uses as well and taking the biological value of the forest into account. In a natural forest zone, it will be important to leave patches of natural forest untouched.

Advantages of forest buffers are relevant biodiversity in the case of natural forests, production of timber and NTFP, extension of habitat or deterring habitat for crop-raiding animals, depending on the species. However, they also have the following disadvantages: they can be a fire hazard (in the case of exotics), transformation of natural forest into softwood plantations, disturbance by logging and the risk of over-exploitation, primarily of wildlife.

### **5.3 Economic Buffer Zone**

This type of buffer zone is not always easy to define. Normally, economic buffers are located outside the conservation area, but in some situations this may not be the case (see box 5.2: Vu Quang Nature Reserve in Vietnam).

This type of buffer zone has a production function, which may be pure cash crops (low biodiversity) or adapted agricultural systems (relatively high biodiversity). Examples of cash crops are tea, cashew, rubber and sisal plantations, which are good buffers against crop-raiding animals. Fruit trees, wildlife utilisation and adapted agriculture are more 'true' buffer zones in the sense that they have a higher biodiversity.

Economic buffer zones carry a risk of attracting people from elsewhere. Since economic development is the priority, investments are made. The improved infra-structure and increased production which result are reasons for people from outlying areas to move into the buffer zone. Box 5.3 gives another example of an economic buffer zone in Cat Tien National Park in Vietnam.

### **5.4 Physical Buffer Zone**

In some cases, physical barriers are the only way to protect conservation areas from being degraded or destroyed. (In these cases the term buffer zone is not quite accurate, but as it performs some of the buffer zone functions it has been included here.) The best physical barriers are natural features such as rivers, cliffs and canyons. In densely populated areas in Western Europe, artificial barriers such as fences, walls and canals are often used.

Physical buffers have several purposes:

- Clear demarcation of the area,
- Preventing animals from leaving the area, and
- Preventing people from entering the area.

In principle, these physical buffer zones do not have a production function, except for rivers.

### Box 5.2 : Economic buffer zone in Vu Quang Nature Reserve (Vietnam)

(Source: project proposal of 1993)

The Vu Quang Nature Reserve has three zones, the core area (38,300 ha), reforestation area (17,650 ha) and the buffer zone (15,050 ha). The buffer zone comprises both valleys and surrounding slopes up to the ridge. The valleys are presently used for human settlement and agriculture, while the slopes are mainly used for grazing and fuel wood collection.

The valleys remain agricultural land, but their use and production will be intensified by improved irrigation systems. The idea is that the buffer zone will support seven communities and that the increase in agricultural production will lead to a surplus which can be sold on the market. This economic development should lead to a decrease in dependency on the conservation area.

The improved irrigation system can be achieved by constructing small dams, which can simultaneously be used for the production of electricity. The impact of these small dams, on in particular the ecosystem balance, will have to be determined by an EIA.

Another potential problem is that one of the agricultural cash crops is sugar cane, which is often processed locally. This requires large quantities of fuel wood and investments in re-forestation and fuel-efficient processing plants.

To enable people to market the agricultural surplus, the road to and inside the area will be improved. The fact that the buffer zone lies within the reserve's boundaries means that the park authorities can control the road and traffic. This has certainly some advantages: a road tax will pay for maintaining the road, and lorry loads can be better controlled (the area harbours rare species of mammals).

Strong points for buffer zone development are:

- The buffer zone is well defined and offers possibilities for socio-economic development;
- The buffer zone falls under the jurisdiction of the park, which makes control of access feasible (the park can be entered by two routes, but one is by ferry);
- The population pressure within the buffer zone is limited, making sustainable development possible;
- A limited infrastructure, including hospital, is already present;
- There is a re-forestation area , which could actually function as a real buffer.

Weak points in buffer zone development are:

- The buffer zone is not really a buffer zone according to the definition, but merely an economic development zone;
- The buffer zone is located in the valleys, originally the best sites for biodiversity;
- The old organisational structure of co-operatives is still present (top-down approaches);
- There is a tendency to introduce cash crops, such as sugar cane;
- Biodiversity in the valley is presently low;
- Extension of the buffer zone is not possible.

This project has put a lot of effort in creating support from the people's committee at the provincial level, in fact too much effort, as the process approach became too much of an objective of its own.

**Box 5.3: Cat Tien National Park (Vietnam)**  
(source: project proposal of 1995)

The project area consists of Cat Tien National Park ( around 43,000 ha) and Cat Loc Rhino Sanctuary (over 30,000 ha), separated by about 1 kilometre of paddy fields. Most of the surrounding areas are new economic development zones.

Most of Cat Tien National Park is bordered by a river, while another part is bordered by forest enterprises. The river floods the land between the two parks during the wet season, while the river is also a clear demarcation between the extremely densely populated and cultivated surroundings and the park. A buffer zone approach in the traditional sense is impossible, due to the high population pressure. A clear line of demarcation is crucial in this case.

Originally, a zone a few miles wide was identified as a buffer zone, but this was arbitrarily defined and without any true justification. This idea was abandoned as soon as it became clear that the creation of a buffer zone was not feasible. What was needed was a large-scale rural development project, including community forestry and re-forestation.

When the park was created two groups of indigenous people were living inside the park, making a living with rain-fed rice (slash and burn). They were resettled at the fringes of the park in 'good houses' with tin roofs and paddy fields. However, one group left and started the traditional way of life again in one of the forest enterprise areas. The remaining resettled group is renting out or selling the paddy fields, as they are not used to irrigated rice cultivation.

The forest enterprise areas can be viewed as buffer zones in the true sense, while the river is seen as an absolute boundary.

Cat Tien is a clear example of artificially selected buffer zones being neither effective nor functional. As far as the forest enterprises are concerned, it would be advisable to assist them in developing a sustainable system of natural forest management.

Cat Tien National Park is also a good example of failure to understand indigenous people's aspirations and way of life.

Strong points for buffer zone development:

- The forest enterprises could be excellent buffer zones, if properly managed;
- The river forms a clear boundary and simultaneously an obstacle to entering the park;
- The zone between Cat Tien and Cat Loc areas has been identified as a buffer zone, which makes socio-economic development feasible;
- The annual flooding could be controlled to a certain extent, which would create support among the population;
- The area has tourism potential in terms of wildlife viewing, Khmer temples and its proximity to Ho Chi Min City (Saigon).

Weak points for buffer zone development:

- National legislation does not deal with buffer zones;
- The protected areas are located in three provinces, making co-ordination and harmonisation very difficult;
- High population pressure;
- The buffer zone (not the forest enterprises) has a low biodiversity and is completely cultivated;
- The buffer zone concept could only be applied in a limited area.

## **5.5 Streamside Buffer Zone<sup>26</sup>**

Streamside buffer zones can be described as forest and vegetation strips along water courses and lakes. Often the width of these strips is determined by law in order to protect river systems from disturbances by logging operations and agriculture.

These strips are left to protect the banks from possible erosion and damage, and to preserve biodiversity.

The width of the streamside buffer zone is mainly determined by the slope, but also by the size of the river. In general different countries use different widths, but normally this is 20 – 50 meters depending on the size of the stream.

## **5.6 Social Buffer Zone**

Social buffer zones are probably the most sustainable kind of buffer. A social buffer zone approach uses the differences in culture and sense of identity of indigenous or other population groups, and local organisations, to form a barrier, control and monitoring system between a conservation area and its surroundings. Box 5.4 gives an example of such a buffer zone in Costa Rica. Other examples can be found in the Philippines (Sierra Madre), where the Agtas have legal rights to control and use 'their' land. However, this indigenous group is not well organised and very much marginalised, which makes them vulnerable to encroachment on their homeland. Indigenous territories may form good buffer zones around conservation areas. However, often the use of these areas is restricted and controlled in order to assure its effectiveness. Imposing too many restrictions may lead to a counterproductive situation.

## **5.7 Sanitary Buffer Zone**

These buffer zones are often created around areas with contagious diseases in order to prevent the disease from spreading. Examples are the no-go areas north of Mkokou in Gabon, where the Ebola virus emerged; in the Netherlands, where pig farms discovered to be infected with swine fever were isolated and no transport of pigs was allowed in a large area around these infected areas; and in potato farming, where other crops are planted around the field to avoid the spread of viral potato diseases.

## **5.8 Fire Buffer Zone**

In Ghana, fire buffer zones are created around forest reserves in fire-prone areas. These buffers normally are around 40 meters wide and consist of green fire breaks, although controlled burning around the reserve and bare-ground fire breaks serve the same purpose. Allowing agriculture in strips around fire-prone areas could serve the same purpose.

## **5.9 Geo-political Buffer Zone**

This type of buffer zone was created along the East-West border in Europe and between the two Koreas, to prevent contact between people and to facilitate military movements and decision making. The south of Lebanon, which was under the control of Israel-affiliated militias, was theoretically a buffer zone between the Bekaa Valley and Israel.

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<sup>26</sup> The sustainable forestry handbook (1999), Higman Sophie et al. IIED, London

These ‘no-man’s land’ areas between the East and West, later on turned out to harbour excellent conservation sites with an interesting biodiversity. They had also been well protected over a long period of time. On the other hand, extreme forms of natural resource management (forestry) in this ‘no man’s land’ led to disease-infested and degraded forests, as no effective control and management took place.

**Box 5.4: A social buffer in the Talamanca Mountain range**

‘La Amistad’ Biosphere Reserve is located in the Talamanca Mountain Range in the east of Costa Rica. To the north and south of the park are Indian reserves, of which the ‘Reserva Indígena Talamanca’ (66.419 ha) is one. This Indian territory is situated between the park and the mainly deforested lowland.

The Netherlands-assisted Namasöl Project is helping the Indians to develop sustainable alternatives to traditional methods of exploitation, to improve infra-structure (e.g. construction of water supply installations and small ponds) and to perform cultural activities, but also to physically demarcate their territory. The philosophy is that as long as migrants cannot invade Indian territory, they can neither invade nor exploit La Amistad Park. This way the Indian territory functions as an effective buffer zone between the park and the lowlands.

Strong points for buffer zone development are:

- The social buffer zone concept is sustainable despite high investments;
- Project ownership lies with the population;
- Cultural identity is strengthened this way.

Weak points for buffer zone development are:

- The project, given this approach (infra-structural development), is expensive;
- The project, through the buffer zone, covers only a part of the area around La Amistad which needs protection.



## 6 SUCCESS AND FAILURE IN BUFFER ZONE MANAGEMENT

### 6.1 Introduction

Even though in the previous chapter it was argued that the buffer zone concept can be used in different settings, in this chapter only the lessons learnt from use of buffer zones in conservation activities will be discussed.

Over the last fifteen years many conservation projects were under implementation in which the buffer zone concept played a crucial role. For most of the Netherlands-funded conservation projects, it is still too early to make a thorough analysis of the successes and failures. The WWF/DGIS Tropical Rainforest Portfolio and the IUCN/EU Biodiversity in Development programmes are presently analysing a number of ICDP projects encompassing buffer zones. The success of buffer zone management depends very much on the participation and support of the stakeholders. Ensuring public participation, co-management and capacity building, awareness raising and training are all issues to be addressed when developing a system of buffer zone management. One of the more frequent failures in buffer zone management occurs, when the link between the stakeholders and the authorities is weak or is missing altogether. Top-down approaches in buffer zone development are in most cases neither effective nor sustainable. In order to have legal support, buffer zone management should be included in the national (e.g. Buffer Zone Management Regulation of 1996 and the Guidelines of 1999 in Nepal) and international policies and strategies (e.g. Convention on Biological Diversity and Ramsar Convention). It is also evident that the definition of any buffer zone should be spelled out very clearly in national legislation (see 4.3.4). Finally, the general approach in conservation matters is changing. Within the context of the CBD more emphasis is put on the ecosystem approach, which also has far-reaching consequences for the application of buffer zones.

### 6.2 Causes of Failure

It is clear from the literature that in many cases the buffer zone approach failed because a blueprint model was applied. The following is a summary (although admittedly incomprehensive) of possible causes of failure in the implementation of the buffer zone<sup>27</sup> concept, based on this literature and experiences from Netherlands-funded projects.

#### 6.2.1 Ecological Causes

*Local environmental conditions were not sufficiently taken into account.* This is the case when core zones are identified without enough information on biodiversity. This also includes the interaction between species within ecosystems or even anthropogenous impact on for instance the vegetation (some ecosystems are dependent on grazing by cattle, e.g. Atlas Mountains in North Africa, Heath lands in Europe).

Also, in the case of flood plains, the environmental conditions should be well known, to minimise the risk from disastrous floods (e.g. Kaziranga National Park in India in 1998).

*Soil and climatic conditions were not taken into account.* New agricultural or forestry species were introduced in the buffer zone which were not adapted to the local soil and/or climatic conditions. The opposite has also happened: introduced species were doing so well that they

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<sup>27</sup> Based on Sayer, 1991; Wild and Mutebi, 1996; IUCN, 1998 and personal communication with authors

became a pest (e.g. *Cassia* spp, *Acacia* spp.)

*The role of the buffer zone in relation to specific species was not taken into account.* This is particularly the case with wide-ranging and crop-raiding species, which need special attention in order to prevent conflicts with local communities. Planting crops attractive to elephants, wild boar etc., e.g. sugarcane and tubers, in the buffer zone around a core zone is asking for trouble. This will inevitably lead to conflicts between the objectives of the buffer zone and the core area.

*If an ecosystem is divided between a core zone and buffer zone,* such as an economic development zone or commercial plantation there will be a risk of species disappearing due to specific measures in the buffer zone. The best approach is to include the whole ecosystem in the core zone and to use the buffer zone as an extension of the ecosystem in the core zone.

*The objectives of nature conservation were often conflicting with development objectives,* thus putting a strain on buffer zone development. Finding the right balance between the two depends on many factors. Too much emphasis on conservation (e.g. unique ecosystem, species) may lead to too many restrictions on the use of the buffer zone.

### **6.2.2 Social and Economic Causes**

*Social constraints were not sufficiently analysed.* The social structure and culture of people involved in buffer zone implementation, particularly the stakeholders and beneficiaries, should be fully integrated in the approach. Otherwise, the buffer zone approach may end up with counterproductive solutions lacking support from the key players.

*Changing a mentality takes a long time.* Conservation and buffer zone management require changes in mentality and attitude. This is closely related to culture and social organisation. Affecting and changing people's behaviour and attitudes require long-term approaches, which is why buffer zone projects need sufficiently long implementation periods (of over 5 years).

*Buffer zone objectives were not in line with local people's aspirations.* The objectives related to the creation of a buffer zone, will have to be agreed upon by the local population. If the objectives are not in line with, or even oppose, the aspirations of the people, the approach is doomed to failure.

*Socio-economic advantages were given too much emphasis, while they may not have materialised.* When buffer zones are developed, people (stakeholders as well as park staff) tend to over-emphasise the socio-economic advantages and benefits of a buffer zone without strong factual justification. This may at a later stage lead to frustrations among the stakeholders, in particular the natural resource users. A slow, steady, and in particular realistic start is important, based on information from the field. High expectations not made true will have a negative impact on people's motivation.

*Too little attention was given to intra-household aspects of natural resource use.* Within a household, there will be several users of the natural resource base for various purposes. Different members of a household will be affected in different ways by the establishment of a buffer zone. The multifunctional value of natural resources is often more recognised and exploited by women than by men. Establishing buffer zones (with new regulations and management rules) will affect women differently than men. Failure to recognise intra-household differences in this respect may have an adverse impact where benefits were anticipated.

*Difficulties arose from a half-hearted implementation of the concept of 'community representation'.* The term community is often used as if it represents an homogenous, clear and



defined structure. In actual fact it conceals a range of vested interests in terms of economic position, ethnic status, gender balance and age. If community participation does not access the full range of opinions and input within communities, e.g. clans in Papua New Guinea, it will not be truly representative and may result in 'tokenism'.

*Insufficient ownership of the buffer zone initiative by local communities.* Ownership of the buffer zone initiative and the investments to be made must reside with the local population at large. Lack of ownership transforms the project into a classic example of an open access resource: everyone will want to enjoy the direct benefits, no one will feel responsible for long-term maintenance and operations. In the end the project will fail.

*Wrongly balanced trade-offs took place between buffer zone impact and sustainability.* This may be linked with the issue of ownership, but not necessarily so. Even when ownership is well defined and internalised, generation of short term benefits to beneficiaries may prevail over long-term sustainability, especially when long-term objectives are poorly defined or future benefits difficult to determine. In other cases trade-offs occur between the institutional foundation and the cost of implementation (see 6.2.3).

*True participation in decision making* by the beneficiaries and stakeholders where the creation and management of buffer zones is concerned is not yet common practice in many countries. In fact this is one of the major failures in buffer zone development.

*Economic appraisal fails to incorporate environmental values into decision making on buffer zone establishment.* Economic appraisal techniques (cost-benefit analysis) are difficult to apply in making investment decisions with respect to nature conservation, in part because of market and policy failures. Nevertheless, progress has been made in this respect, and further applied research may lead to improved methodologies.

### **6.2.3 Institutional Causes**

*Subsidies and salaries were provided.* Many buffer zones have been implemented by heavily investing through subsidies (e.g. compensation schemes, incentives) and salaries for project staff. This is not sustainable in the long run. When the donor withdraws, the conservation area authorities and the local population are not able to continue the same level of investments, which may lead to loss of interest by some or all key stakeholders.

*Lack of consensus on objectives, location, shape and permitted uses.* Buffer zones have to be developed in collaboration with all stakeholders and all of them have to agree on the shape, location, limits, and the objectives of the buffer zone. The worst basis for buffer zone management is not starting from a common ground.

*Emphasis is on environmental protection while community benefits come second.* Although buffer zones are normally created around conservation areas, it should be clear that they simultaneously serve a development objective. Establishing conservation as the sole priority and making other issues dependent on conservation will not lead to an effective and sustainable buffer zone, as the management objectives will have to be supported by the stakeholders.

*Lack of legal authority to establish or manage buffer zones.* Buffer zones are normally not defined by law, so consequently it is rarely explicitly stated who is responsible for their management. If the legal foundation is missing, there is all the more reason to develop the buffer zone in a participatory way. In difficult situations it might be advisable to locate the buffer zone inside the conservation area, or to extend the conservation area in order to include the buffer zone, in which

cases the buffer zone can be under the park authorities' jurisdiction.

*The time factor makes the process a top-down exercise.* A participatory approach takes time, as does a process approach. With increasing population pressure and pressure on the natural resources, time becomes a constraint. Economic systems evolve much faster than biological ones, thus creating a bias towards short-term economic profits and against long-term environmental gains. Also, donor funding is normally for a limited period of time. Therefore some top-down planning is unavoidable. However, the negative impact of this can be mitigated by informing the population of the reasons why and by making the process flexible and transparent. The donor can also assist by committing its support for the long term – seven years is a recommended minimum.

*Technical plans for buffer zone development are too detailed.* Buffer zone development is mainly carried out by the stakeholders. Technical and detailed plans are good documents for park management and technical staff, but for most of the stakeholders, strategic concepts and logical frameworks based on participatory problem analysis may be of more use.

*Buffer zone initiatives have often by-passed the authorities responsible for rural development.* In most cases, this problem occurs as a result of a poor legal basis for buffer zone management. Consequently, buffer zones are located inside the conservation area under the park authority. A lack of cross-sectoral thinking and working hampers collaboration with the authorities responsible for rural development outside the area. It is important that these authorities get involved from the very start, even when their functioning is clearly less than optimal, in order to assure their support and assistance in the field. At the very least, rural development authorities often have a good network of extension workers. This network can be used and upgraded, notably with respect to fostering a better understanding and appreciation of the functions and tasks of buffer zones.

*Poor policy development and implementation capacity at the local level.* To get institutional support, establishment of a buffer zone must be part of the policy thinking at the national and local government level. Often, however, policies and subsequent regulations are subject to frequent changes, mostly for political reasons. Such an unstable policy environment is detrimental to establishing popular support among local resource users for innovative approaches towards long-term management of the natural resource base. In such an institutional environment, people distrust any initiative that originates from government, irrespective of the soundness and feasibility of the initiative.

#### **6.2.4 Other Causes**

*Local knowledge was not sufficiently used.* Many failures can be avoided if the store of local knowledge is explored and used. Often the local population knows best what can and cannot be done.

*New technologies were not acceptable or too sophisticated.* As with subsidies and salaries, new technologies also have to be maintained after a project ends. If external assistance stops, this often poses a problem. Technically and socially adapted systems are more sustainable than sophisticated ones.

*Buffer zones were not well defined.* It is important that all parties involved agree on the boundaries of the conservation area and buffer zone, and that this agreement is clearly visible in the field. This is also important for monitoring purposes. An ill-defined buffer zone remains a potential conflict.

*Uncertainties regarding sustainability of resource use.* Any uncertainties have to be spelled out and looked into. It is important not to make any commitments or promises which cannot be met. A gradual development of a management system will be the ultimate solution. Starting a management system without knowing the resource base is a bad thing to do: it may raise expectations, but will fail to meet them later on.

*Buffer zones were developed based on insufficient information.* In principle, buffer zones are zones in which different functions and activities can take place. Before defining the buffer zone, it is important to know what is needed to protect the conservation area (the size of which depends on the species and ecosystems to be protected, but also on conditions and biodiversity of the buffer zone), and what uses the population can make of the buffer zone. In any situation the resource base should be well known before a definite decision on a buffer zone can be taken.

*Dialogue with people is often not followed by action on the ground.* In many community development projects, not just those with buffer zones, good intentions articulated in participatory planning exercises do not get the anticipated operational follow-up, for various reasons. These days, PRAs, logical frameworks, process approach, village and community involvement, emphasis on ownership and so forth are normal steps in project preparation and implementation. All these activities create hope and are seen as signs of commitment. If this commitment fails to materialise in terms of action, people may get disappointed and turn against the project.

*Last but not least, time is often a constraint.* As already noted before, the establishment of a buffer zone which involves many disciplines, institutional arrangements, social adaptation etc. is a lengthy process. The period of five years, often seen as a guideline by donor agencies, is certainly not enough.

Even if a buffer zone looks well established after five years, consolidating the achievements (sustainability) needs more time.



## 7 GUIDELINES FOR ENHANCING BUFFER ZONE DEVELOPMENT

There is no single boiler-plate formula for implementing a buffer zone management approach. Any conservation area needs a tailor-made buffer zone, which will have a specific size, format, management, land use pattern, etc. which works best for that area. The development of such a buffer zone should follow the process approach, which is a slow process. It is perhaps for this reason that few conservation areas having fully operational and effective buffer zones have been identified.

Due to the complexity and long duration of buffer zone establishment, many of these buffer zone initiatives have not, or have not yet, succeeded in achieving their ultimate goals (or perhaps these goals were too ambitious). A buffer zone approach demands solving the conflict between nature conservation and rural development, while taking a participatory approach. Buffer zones with a clear community-based view need a holistic approach, using four indices for performance<sup>28</sup>:

- Stability,
- Sustainability,
- Equity, and
- Productivity.

All four indices have a clear relation to development and are important when buffer zone management has a central focus on community development. In section 7.1, these have been worked out along ecological, socio-economic, institutional, size and location and other guidelines. Section 7.2 discusses monitoring to assess impact and sustainability.

### 7.1 Points of Attention

The following is a list of steps and considerations to be taken into account when developing a buffer zone and its management. This can be done during the process of identification and formulation, but also during the inception phase of the implementation.

Before developing a buffer zone it is necessary to have a clear overview of all stakeholders, beneficiaries, ecological values, economical potentials etc. The next step will be to define clear objectives that respond as much as possible to the wishes of the stakeholders and relevant legislation.

Points of attention and consideration<sup>29</sup> include (see table 7.1 for more details):

#### 7.1.1 Ecological

- The conditions and structure of the vegetation and landscape of the buffer zone should preferably be as similar as possible to that of the conservation area, as if the buffer zone is an extension of the core zone;
- An ecosystem approach should be followed as much as possible, whereby the buffer zone could be an extension of the ecosystem or could have a corridor function for migrating species (e.g. Project Elephant in India);
- The biological diversity of the buffer zone (number of local species) should be as high as possible. This also means that LEISA and adapted agriculture is preferable to modern large-scale agriculture and cash crops;

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<sup>28</sup> Conway, 1986

<sup>29</sup> Kiss, 1990; Orsdol, 1987; IUCN, 1998; Cunningham, 1996; Poore and Sayer, 1987; Wild, 1992

- Buffer zone activities should not have a negative impact on the soil and water conditions. Large plantations of exotic species such as eucalyptus and pines should be avoided;
- In order to avoid abrupt changes, utilisation of buffer zones should be as close as possible to the traditional uses (and only if the traditional uses are sustainable);
- Possibility of extending the conservation area;
- When developing and managing buffer zones, specifics on flora and fauna should be taken into account (species, migration, pests, crop raiders, species that are endangered, vulnerable, rare etc., distribution, mineral licks etc.). Different species require different interventions;
- Sensitive areas must be recognised.

### **7.1.2 Socio-economic**

- It is important to assess the social and cultural situation of the local population, both indigenous and migrant;
- However, base line surveys are necessary only up to a certain level of comprehensiveness beyond which additional data collection may not yield sufficient new information to warrant the incremental effort. Besides, data (especially on socio-economic features) may become obsolete by the time over-ambitious surveys are finalised, rendering such exercises more or less worthless;
- There should be clear consensus on objectives, location, shape and permitted uses of buffer zones. To meet this goal, conservationists, local and national authorities and the local population have to agree on these aspects. This can only be done through a participatory approach, since the key to success is involvement of all stakeholders in project planning and implementation;
- Already in the beginning of developing the buffer zone the question of ownership must be addressed. In most cases the best option is to give the direct beneficiaries and stakeholders the ownership, but under clearly described conditions (e.g. by use of by-laws);
- It is necessary to identify and address the multiple factors that may affect rural peoples' income. This means that primary social and economic problems have to be identified and tackled;
- It is important, where possible, to insure long-term land rights and land titles in order to stimulate investments in those areas, including buffer zones;
- Be aware of intra-household differences towards multi-functional values of nature;
- In wildlife areas, control of access to and use of land is as critical to wildlife management as to agriculture;
- Consider agriculture the main engine of growth, especially in remote rural areas;
- Establishing an enabling economic environment for growth and diversification in the agricultural sector is more sustainable than providing direct (mostly financial) incentives for production;
- Consider support at different levels of the agricultural chain from production to consumption;
- Applying appropriate technology when improving agriculture must be done in such a way that sustainability is guaranteed;
- Look into potential of off-farm income generation that is compatible with buffer zone establishment;
- Take advantage of economic opportunities that arise indirectly from buffer zone establishment (roadside stalls, service functions, photo opportunities, rest & recreation spots, etc.);
- Isolated operation of community-based projects is not advisable;
- Local people must be given a guarantee that they can meet basic needs, have economic safety and enjoy upward social mobility - if this is not insured, the buffer zone arrangement will collapse from inevitable non-compliance with unrealistic procedures and conditions;
- The key to feasibility is local people's lasting interest in establishing the buffer zone because of identified long-term benefits in combination with necessary short-term assurances of economic viability and improved livelihood;

- Three types of income-generating opportunities from NTFP by the local population are:
  - open access to specialist users (beekeepers, medicinal plants);
  - seasonal access to popular plant resources (e.g. Marantaceae);
  - seasonal and rotational management by specialist harvesters (e.g. bamboo);
- Distinguish each type of use and develop specific interventions where appropriate;
- Agro-forestry can be highly appropriate in buffer zones, as it is a multi-purpose system with various economic opportunities and a relatively high intrinsic biodiversity level;
- Existing knowledge and use of trees/plants should be fully exploited. Local people may know the local situation and species much better than outsiders;
- Apply economic decision-making models where and when possible, notably for assessing possible investments in production-related activities (agriculture, off-farm income generation, eco-tourism, non-traditional products, etc.);
- Favourable conditions for acceptance of new technologies are that the technology:
  - has a low risk,
  - is easy to adopt,
  - uses locally available inputs,
  - is similar to well-known or traditional technologies,
  - does not cause time constraints for any member of the farming household,
  - preserves or improves equity situation for household members, and
  - has benefits that become rapidly visible.

Unfortunately most of the potentially interesting technologies only partially fulfil these requirements (compared with present technologies, they all have costs as well as benefits) Buffer zones provide an opportunity to preserve traditional crop varieties and tree crops, fruit trees and multi-purpose trees.

### **7.1.3 Institutional**

- If decentralisation is in progress, it is important to use this development down to the lowest level possible;
- It is important to build on local institutions and traditional organisations. NGOs from outside the area may be important, if local organisations are failing or absent and as an intermediary between government and local people and organisations;
- The ownership of buffer zone management should be at the lowest level possible, unless the law determines otherwise (in Ghana for instance forests are seen as strategic natural resources and therefore managed from the central level);
- The legal status of the buffer zone should be clearly spelled out. So far not many countries do have legislative instruments covering buffer zones. In this case the use of by-laws could be very useful and applicable;
- The capacity of government personnel is important. Attention should be paid to level of training, knowledge of contemporary developments, flexible personnel management, incentive structures, etc.;
- It is necessary to have various government authorities working together, notably the forest/parks department and the agricultural department;
- When the emphasis is on conservation, it is advisable that the park authorities have a clear say in the management of the buffer zone or to put it under their jurisdiction;
- Legislation will have to be reviewed to assess use in relation to buffer zone management;
- Local groups must be given secure rights to use and control access to natural resources as a condition for long-term sustainability;
- Local or regional by-laws must be examined for their potential to help or hinder;
- Depending on the legislation regarding buffer zones, they should be under the same jurisdiction as the conservation area (i.e., located inside it). If not, legislation should make this possible.

#### **7.1.4 Size and location**

- Buffer zones should be made as effective as possible (but in a feasible way , i.e. considering economic arguments as well), in order to guarantee maximum flexibility in management of both core and buffer zones;
- Solicit participation of the local population in defining the buffer zone (joint management, co-management);
- Clear demarcation of boundaries;

#### **7.1.5 Other**

- The management plan objectives for the buffer zone should be compatible with those for the core zone and the population involved (beneficiaries and stakeholders);
- A long preparatory phase: project focus should be well defined, and community participation and decision making should be guaranteed;
- Project should have a long duration, therefore buffer zone initiatives need a long-term commitment from the national government or donor;
- Detailed management and technical plans are not useful. Flexibility in combination with a process approach is more important;
- Gradual phasing in of project activities;
- A flexible and adaptable approach in community participation;
- Economic gains should not be over-emphasised;
- Monitoring and evaluation (M&E) is important as a key instrument for guiding implementation;
- If there is no legal framework, use informal or management agreements between local users, park management and local government. The latter are expected to control both conservation area management and local users on fulfilment of agreement.

### **7.2 Appraisal, Monitoring and Evaluation**

The following criteria should be carefully considered when appraising a project or programme:

- Technical criteria,
- Netherlands development assistance criteria,
- Feasibility criteria,
- Sustainability criteria, and
- Management criteria.

Monitoring and evaluation is very important in buffer zone projects, particularly as the investments made yield few direct or short-term benefits. Because these projects are typically long-term exercises, it is important to be able to prove the usefulness and effectiveness of buffer zones from various angles (ecological, social, economic, institutional, etc).

Clear criteria have to be set for monitoring and evaluation.

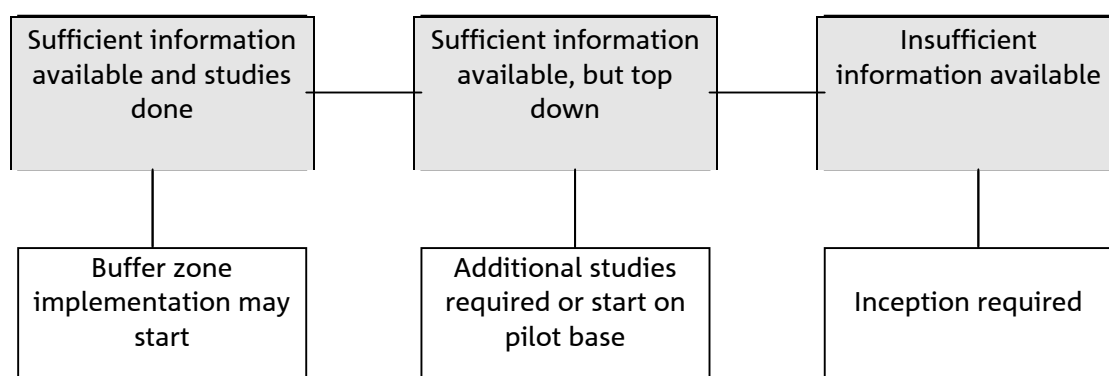
Figure 7.1 gives an indication of steps to be taken when beginning a buffer zone management initiative. The steps in this figure are particularly important in buffer zone projects such as ICDPs. As projects are normally formulated in a minimum of time, information is often not complete. For that reason Netherlands-funded ICDPs more and more often include an inception phase, in order to collect additional information for better justifying and elaborating the project.

Table 7.1 is an attempt to summarise some guidelines and points of attention when developing or appraising a buffer zone initiative. It should be borne in mind that this list is incomplete. General criteria and points of attention at the macro level, such as good governance, are not included. These issues will have to be looked into whenever a project is identified, formulated and



implemented.

**Figure 7.1 Phases in project preparation and implementation**



**Table 7.1 Possible points of attention for buffer zone development and management**

Aspect	Points of Attention	Remarks
Ecological	General	It is crucial to know exactly what should be conserved and protected. This will require inventories. A system of conservation areas should be flexible, based on recent information and data. It is important to collect data from the earmarked buffer zone and conservation area.
	Flora	Inventories have to be made and species lists prepared. It is not necessary to have all species covered, but definitely the most important species and vegetation types.
		An assessment of the species composition and classification by rare, endangered, vulnerable etc. categories will have to be made.
		Spatial distribution by species and by vegetation type will have to be prepared.
		Identify exotic species that could behave as pests.
		Identify fire hazard areas and vegetation types.
		Does the vegetation consist of natural vegetation or plantations or degraded and secondary vegetation as well?
		It is important to know if the vegetation resources are exploited and if so, by what means.
		For zoning purposes vulnerable (sensitive) areas should be identified.
	Fauna	Inventories have to be made and species lists prepared. It is not necessary to have all species covered, but definitely the most important ones.
		An assessment of the species composition and classification by rare, vulnerable, endangered etc. categories will have to be made (red data book).
		Spatial distribution per species will have to be prepared.
		The ecology, habitat use, migration patterns etc. of the most important species should be known (this includes spawning and breeding areas, nesting areas, feeding areas, refuge areas).
		Identify species (crop raiders, livestock predators etc) harmful to the surroundings, but also threats to wildlife from domesticated species such as cattle.
		Using the information on flora as well, identify the most important and vulnerable habitats.
		Areas of utmost importance to wildlife, such as salt licks, have to be identified.
	Ecosystem	The ecosystem approach in buffer zone management is essential.
	Constraints	The basic reason for creating a buffer zone is to mitigate threats and constraints. To be able to assess the need for a buffer zone, threats to the ecology of an area must be clearly identified (also with participation from local people).
	Opportunities	Measures taken in order to mitigate constraints are based on opportunities created by these measures. The creation of a buffer zone does not always create the opportunities foreseen.

Aspect	Points of Attention	Remarks
Physical	Landscape	The landscape, in particular the differences in altitude, may have an important impact on the environment and the people. Zoning of an area should take into account sensitive areas such as steep slopes, river valleys and cliffs.
		Natural barriers which could be of use as a demarcation line or physical buffer should be identified.
	Soil	Good, bad and erosion-prone soils have to be identified. If agriculture is accepted as an activity, the quality of the soil is crucial.
		Presence of minerals will have to be known, in order to calculate the chances of mining in the future.
	Hydrology	River systems and hydrology should be identified and mapped, as these are important features in zoning.
		The hydrology, in combination with soil type, texture and vegetation cover, determines the sensitivity of a site in relation to erosion, etc.
		Natural mineral licks and sources should be mapped (crucial areas for wildlife).
		The hydrology of an area also determines the limitations and opportunities for various land use systems, including agriculture and infra-structural works.
		Water sources are also important for human habitation.
	Constraints	These have to be clearly identified, in particular in relation to land use, infra-structure and erosion.
	Opportunities	Zoning could mitigate a number of constraints already identified. A complete overview will make it possible to identify sites for multiple use, agriculture, game hunting, etc.
Socio-economic	Indigenous people	It is crucial to use local knowledge available from the indigenous people.
		Establish feasible size of buffer zone that will allow indigenous people to maintain reasonable extraction levels (if access to core area is restricted).
	Migration	Economic incentives may attract unwanted migration into buffer zone. Incentive schemes need strict targeting of existing resource users.
		Monitor immigration/emigration and possible causal links with the nature conservation programme and buffer zone development.
	Population pressure	A high population pressure may lead to over-exploitation of the natural resources.
		An increase in population might require other approaches in the future.

Aspect	Points of Attention	Remarks
Socio-economic	Land use systems	Assessment of existing and potential land use systems and practices must be made, notably slash-and-burn agriculture.
		Establish feasible size of buffer zone to support specific land use systems.
		Use locally available inputs – economic feasibility of and access to substitutes.
		Land use systems under communal ownership in buffer zones require informal management arrangements between local users and park authorities – if not, the tragedy of the commons directly threatens the nature preserve.
		Access to resources, such as water, is major critical issue.
		Analysis (including economic) of different land use systems and technologies (diversification, product choice, mixed vs. monoculture, plantation, agro-forestry).
		Invest in establishing an enabling environment for investment in new technology (streamline credit, input supply, marketing infrastructure, etc.) rather than unsustainable direct financial incentives (price supports, subsidies).
	Land rights	Where possible, long-term land rights and title deeds must be established to stimulate long-term investment by land users.
		Streamline land registration procedures – favour local users over claims of absentees.
		Investigate intra-household consequences of transition to new land use and land access regulations and approaches.
	Local organisations	SWOT analysis of existing local institutional set-up and organisations can be useful.
		Local resource user groups should be at the cradle of buffer zone development (become buffer zone groups).
		NGOs can play a very useful role in establishing (informal) management arrangements for buffer zones.
	Gender aspects – emancipation	Consider intra-household differences in access to and use of natural resource base.
		Integrate different social groups (e.g. nomads, landless) into the process of buffer zone development.
		Integrate gender issues into policy development and implementation.
		Mainstream gender issues within project organisation, local government and NGOs.
		Provide economic incentives and support programme for different social groups and strata.
		Ensure equal participation by women in decision making.
		Consider gender aspects in land legislation and registration.
	Benefits	More analysis is needed on different functions of buffer zones. Economic values can be derived from functions – use and non-use value of nature is a key factor in economic resource allocation.

Aspect	Points of Attention	Remarks
Socio-economic	Marketing aspects	First, analyse existing marketing arrangements, identifying strengths and weaknesses.
		Next, carry out market research to look for new opportunities in terms of products, processing, market niches, distribution channels, etc.
		Look into possibilities of alternative sources of income generation that are compatible with buffer zone development: eco-tourism, non-traditional natural products, services for park management, etc.
		Invest in marketing infrastructure instead of providing direct price support.
	Infrastructure	See above – same as for marketing aspects.
	Constraints	A strict and heavy emphasis on nature conservation could be a major constraint in economic development, leading to loss of traditional rights of access and use of the resource base. If such restrictions cannot sufficiently be compensated in a feasible and sustainable way, quality of livelihood of local population may decline.
		Other constraints related to remoteness of valuable nature preserves from economic development areas, resulting in poor access to markets, to educational, health, and financial services; high cost of living; unattractive duty stations; social remoteness; etc.
		Market constraints, both in input and output marketing.
	Opportunities	See above: marketing aspects / land use systems.
		Eco-tourism.
Institutional	International Conventions and treaties	Although international conventions rarely address the issue of buffer zones, these conventions can be helpful when developing proper national legislation.
	National legislation	It is important to identify the shortcomings in national legislation where it addresses protected areas and buffer zones. If buffer zones cannot be supported by legal instruments, it will be advisable to include the buffer zone within the conservation area boundaries.
		Assessment of National Action Plans and Programmes in order to identify gaps in relation to buffer zone management.
		Identify legal instruments through which buffer zone management could be optimised and legalised, in particular in relation to biodiversity conservation and rural development.
		National legislation dealing with land rights and decentralisation will have to be scrutinised.
		Identification of gaps in legislation and the preparation of new legislation should be taken up as an activity in the project.
		When a well-defined legal basis for buffer zone development is lacking, much can be achieved through management agreements.
		If the country has guidelines for sustainable exploitation of natural resources, they could be an asset.

Aspect	Points of Attention	Remarks
	National legislation	It is of vital importance to assess the capability and dedication of the responsible authorities.
	Local legislation	In countries where decentralisation has progressed, local laws and by-laws often fill the gaps in national legislation.
		It is important to know the mechanisms and key players in the process of preparing and approving by-laws.
		Identify partners and key players dealing with conservation and rural development.
	Decentralisation	To what level has decentralisation progressed?
		Identification of the most appropriate level to deal with in terms of buffer zone management (conservation and rural development!).
	Monitoring	Has a monitoring system been developed, preferably at grass-roots and stakeholder level (participatory monitoring)?
		Implementation, enforcement and control of informal management arrangements.
		Participatory monitoring mechanisms.
	Collaboration	Identification of authorities involved.
		Determine the feasibility of collaboration between various authorities, notably park and rural development authorities.
	Staffing	How are the responsible government authorities dealing with nature conservation and rural development organised?
		What is the level of training and capacity of these authorities?
		Are park staff trained in participatory approaches?
		Assessments of constraints in staffing, and how to solve them, have to be made.
	Infra-structure	Park infra-structure (such as roads and buildings) has to be developed in most cases.
	NGOs	Identification and qualification of NGOs active in the field of nature conservation and rural development.
	Training institutes	Assess number, quality and curriculum of training institutes that are relevant to buffer zone management.
Size and location	Availability of land	Generally, land availability depends very much on the population density and pressure on the natural resources.
		The bigger the buffer zone, the better, up to the point where marginal cost of further enlargement equals its marginal benefit.
		Stakeholders have to agree on size and location of the buffer zone.
		Link between land use systems and possible size of buffer zone – look for acceptable alternative land use systems.

Aspect	Points of Attention	Remarks
Size and location	Location	The size of the protected area, the population pressure and national and/or local legislation may determine the location of the buffer zone: inside or outside the boundaries of the conservation area.
		If it is necessary to have the buffer zone under the same jurisdiction as the conservation area, preference should be given to have the buffer zone located inside the conservation area. This is the case when buffer zones outside conservation areas do not have a special status.
Management	Structure	It is important that the stakeholders be directly involved in the management of the buffer zone.
		Can the management structure continue after termination of external assistance (creation of a foundation)?
		Position and role of project management vis-à-vis the established institutional actors (notably of local government).
		Policy development and implementation – who is in charge of what aspect – how to achieve consistent policies for different user zones? How to monitor implementation?
		Complications that arise when management of buffer zones is under another authority (or authorities) than the core zone – what are workable management frameworks in those cases?
		Development and set-up of necessary management information systems (different from but related to monitoring system).
		Communication between stakeholders for monitoring and management purposes.
	Financial aspects	Has a system been developed to sustain the management system?
		Impact of foreign capital investments from public and private sources in nature conservation – conditions and implementation.
		Under what circumstances will financial incentives still be needed for buffer zone development – who is paying, what must their purpose be, how is it organised, who is eligible, how long can and should direct financial support be maintained, how can it be phased out and by what will it be replaced (if at all)?
		Is there a legal basis for retaining funds from tourism, for instance?
		Ascertain financial feasibility of economic components of the buffer zone development programme.





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## **Appendix 1: Netherlands policy on forests and forestry<sup>30</sup> (objectives)**

### **Ecological**

Conserving forests, tree stands and trees for global environmental functions. Promoting the ecological and regulatory functions of forests.

Protecting and regenerating forests which are important for hydrology and river basins, and preventing erosion and excessive drainage of rainwater.

Curbing deforestation and forest degradation and regenerating secondary forests.

Conserving forests, including production forests, as a pool of biological diversity. Protecting valuable forest ecosystems, especially primary forests, by introducing a system of protected areas and fitting such ecosystems into an ecological infrastructure.

Preserving the genetic diversity of forests and tree species.

### **Socio-economic**

Developing and using sustainable forest and agroforestry production systems. The participation of the local population is an important factor in this respect.

Achieving sustainable forest management in production forests by the year 2000 (ITTO target for the year 2000).

Re-forestation and expanding the areas of forests used for providing forest products. Promoting the plantation and management of trees and ensuring at the same time that, where possible, this is not at the expense of natural forests. Expansion should preferably be achieved by natural rejuvenation or by planting native species.

Adopting an integrated approach of the use of firewood to satisfy energy needs, particularly for the urban population.

Promoting the transfer of technology geared to the sustainable management and use of forests and trees, and promoting the use, processing and marketing of forest products.

Improving the socio-economic security of and securing an acceptable socio-economic status for those members of the local population who are dependent on the forests; promoting an equitable distribution of the revenues earned from and the obligations stemming from the management of the forests.

Promoting sales on the Dutch and European markets of forest products originating from forests which are located in countries with which the Dutch government has development co-operation links and which are managed in accordance with the principle of sustainable development.

### **Socio-cultural**

Strengthening the role played by the local population in the decision-making process and in implementing decisions.

Conserving the forests as a home to local population groups, with special attention for indigenous peoples and the preservation of their cultural identity; strengthening their involvement in decisions on the future management of forests which are vital to their own survival; promoting forest ownership rights for the local population.

Enhancing the position of women. Policy will be aimed at strengthening women's negotiating position and the role played by women in traditional management systems.

Increasing the level of public support for forest conservation and sustainable forest management, and promoting participation in decisions on forest management by population groups which depend on the forests; achieving an equitable distribution of the benefits and responsibilities following from this.

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<sup>30</sup> Ministry of Foreign Affairs, 1998, Forests and Forestry



## **Appendix 2: Netherlands Standard Appraisal Criteria<sup>31</sup>**

### **Poverty Alleviation**

Anti-poverty policy is aimed at helping create a more hopeful outlook for the poor. At the heart of the policy are three strategic choices:

- Investment in people, particularly the poor, in order to increase their productive capacity,
- An improvement in the provision for basic needs, and
- Greater participation by the poor in the process of political decision making, for example by strengthening local organisations.

These three choices have in common the fact that they all accord special weight to the distribution within society, not only of the results of the economic processes (i.e. the distribution of income) , but also of the factors of production in the broadest sense: the distribution of land and capital, and access to education, health care and other basic amenities.

### **Gender**

The main policy goal is to promote structural and institutional equality between men and women in all aspects of international co-operation. Policy focuses on the concept of autonomy, the most important elements of this concept being:

- Physical autonomy: full control over one's own sexuality and fertility,
- Economic autonomy: equal access to and control over means of production,
- Political autonomy: self-determination pursuing freely chosen directions, and
- Socio-cultural autonomy: right to an independent identity and self-respect.

Development co-operation based on this concept means endorsing a vision of distribution in all its manifestations. A second key element is the involvement of women in programme and project preparation, implementation and management. Empowerment of international co-operation activities and mainstreaming of gender at all levels of civil and public society are new and powerful objectives of the Netherlands policy.

### **Environment**

No project having a detrimental impact on the environment will be financed. In principle, buffer zone management has a positive impact on the environment, since its objective is to conserve the environment. However, some buffer zone management activities may have a limited negative impact on the environment, for instance the construction of small irrigation dams. In these cases environmental impact assessments are necessary before any decision can be taken.

Infra-structural investments, sometimes necessary for socio-economic development, will always require an EIA.

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<sup>31</sup> Gender and Poverty Alleviation: A World of Difference, 1990



### Appendix 3: Some definitions of sustainability<sup>32</sup>

**Definition 1:** *Every generation should leave water, air and soil resources as pure and unpolluted as when it came on earth. Each generation should leave undiminished all the species of animals it found on earth.*

**Source:** **Unesco Document**

**Comment:** Robert Solow's (1991) comment on this definition succinctly sums up the problem with this and other similar interpretations of sustainability. He writes, 'If you define sustainability as an obligation to leave the world as we found it in detail, I think that's glib but essentially unfeasible. It is, when you think about it, not even desirable.'

**Definition 2:** *Sustainability is defined as non-declining utility of a representative member of society for millennia into the future.*

**Source:** **Pezzey (1992)**

**Comment:** Pezzey notes that his criterion is actually one of 'sustainedness' as it refers to actual achievement rather than just a potential for this. His definition is built around an explicit goal of human well-being. This definition relates to final outcomes, and if one were confident about the likelihood of continuing technological progress, this would imply a reduced need to bequeath some forms of capital inputs to future generations.

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<sup>32</sup> Perman R., Yue Ma & McGilvray, Natural Resource & Environmental Economics, Longman, New York, 1996