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BIOLOGICAL DIVERSITY AND EDUCATION FOR SUSTAINABLE DEVELOPMENT

Key Topics and Starting Points for Educational Programmes

Produced by the Working Group on Biological Diversity

Biological Diversity and Education for Sustainable Development – Key Topics and Starting Points for Educational Programmes

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The German Commission for UNESCO is a mediator for Germany's cultural and educational policy abroad. On the basis of a unanimous decision in the Bundestag and with funding from the German Federal Ministry for Education and Research it coordinates implementation of the UN Decade of Education for Sustainable Development in Germany and has appointed a National Committee for this purpose.

The present paper has been produced by the Working Group on Biological Diversity that was set up in the course of German implementation of the UN Decade of Education for Sustainable Development.

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Summary

Striving for sustainable development is a key political task of the 21st century. Sustainable development is the answer to the challenges of global change – change that is driven by core problems that are ecological, economic and socio-cultural in nature. Predominant among these are the increasing interconnectedness of global environmental changes, economic globalisation, worldwide cultural change and a widening North-South divide. At present much discussion and negotiation focuses on climate change. Yet the overall process of global change also involves other core problems, including biodiversity loss, global water issues, soil degradation, population trends, world health and nutrition, the loss of cultural diversity and above all the interaction between these problems. This global change threatens the foundations of life for humankind and in varying degrees the quality of life of many people and many societies. It also endangers the foundations of life for many other species on this planet.

Tackling these challenges and shaping sustainable development processes requires comprehensive transformation of non-sustainable lifestyles. This transformation will need to be brought about in very different ways in different cultures and societies. Education is an important instrument for shaping sustainable development: this is reflected in the United Nations‘ decision to declare a World Decade of Education for Sustainable Development (2005 – 2014).

To organise this decade in Germany a National Committee and a Round Table were set up by the German Commission for UNESCO with funding from the Federal Ministry for Education and Research. As part of the work of the Round Table, the Working Group on Biological Diversity was set up in 2007; the group brings together some 20 stakeholders from scientific fields and educational practice, representing both state and private institutions. The aim of the Working Group is to increase the coverage of biodiversity issues in the UN Decade and, conversely, to link the objectives of the UN Decade with focal points of education of the National Biodiversity Strategy (NBS) (2007). Biological diversity encompasses species diversity, genetic diversity within species and habitat diversity. Attention to biodiversity involves not only conservation but also the sustainable use of biological resources, fair access to them and equitable sharing of the benefits and drawbacks arising from their use.

Transmitting understanding of the complex problems in an educational context and communicating possible solutions associated with the conservation and sustainable use of biological diversity as well as with equitable benefit-sharing poses a challenge. It involves establishing a deep-rooted awareness of the multifaceted phenomena involved, their causes and the links between them. Further, it is important to identify options for sustainable action and develop the necessary action competencies.

This position paper identifies four key topics of biological diversity in which there are specific links to people’s everyday environments and actions:

Habitat diversity

This key topic involves the various aspects of the conservation and use of biological diversity in natural landscapes – of which there are very few left in Europe – on which humans have had little impact. It also includes the cultivated landscapes that have been widely appropriated and transformed by humans, and the special features of urban areas. The role of different images of nature and the modern appeal of wilderness are also addressed, as is the increase in 'alien' (invasive) species.

Services of nature

Discussion of the services of nature often focuses on the monetary value of natural products and services. However, the various ecological functions that the biosphere provides for humans also need to be highlighted, as does the value of the natural environment for health and recreation. Lastly, the opportunities provided by biological diversity need to be preserved for future generations.

Climate change and biological diversity

An important complement to the current emphasis on climate change is provided by looking at biological diversity and their interdependence.

Consumption and biological diversity

The problem of conserving and using biological diversity can be approached in a way that relates closely to everyday life via the key topic of 'consumption', since in this area the everyday actions of individuals and organisations can be addressed in a very tangible fashion and can be framed as part of the educational task.

The selected key topics will be used to illustrate how 'learning sustainability' can take place at several levels and be considered from various perspectives. These key topics are relevant both to each and every individual and his/her actions and to a wide range of social groups, political organisations, administrative bodies, companies and business associations. Interactions between these levels provide many educationally valuable opportunities for examining individual issues, involving a range of third parties in the educational work, engaging in critical (self-) reflection and developing and implementing shared plans for the protection and maintenance of biological diversity. To illustrate individual issues, we quote examples and formulate questions that could be used in various educational contexts.

The aim is to provide a robustly underpinned guide for practitioners that highlights the risks to biological diversity and the links between these risks and other non-sustainable developments, while also suggesting ways of addressing these issues and reflecting on them in an educational context. The paper is addressed to practitioners in formal, non-formal and informal learning situations and to multipliers who wish to advance Education for Sustainable Development.

Didactic starting points for various learning contexts and areas of action are discussed at the end of the paper. This section also identifies issues and ideas that the Working Group intends to explore more fully in its next project.

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Biological Diversity and Education for Sustainable Development

Key Topics and Starting Points for Educational Programmes

Striving for sustainable development is a key political task of the 21st century. Sustainable development is the answer to the challenges of global change – change that is being driven by core problems which are ecological, economic and socio-cultural in nature. Predominant among these are the increasing interconnectedness of global environmental changes, economic globalisation, worldwide cultural change and a widening North-South divide. More than 20 years ago the Brundtland Report (1987) defined sustainable development as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED 1987: 43).

The German Advisory Council on Global Change (WBGU), too, has been warning of the global risks since 1993: 'For the first time in history, human activities are having impacts of planetary scale. The resultant changes in the global environment are reshaping the relationship between humankind and the natural basis on which its existence depends. This transformation process, called global change, is occurring at unprecedented speed and involves many risks. It can only be understood if Earth is conceived of holistically as a single system.' (WBGU 1997: 38)

At present much discussion and negotiation focuses on climate change. Yet the overall process of global change also involves other core problems, including the loss of biodiversity global water issues, soil degradation, population trends, world health and nutrition, the loss of cultural diversity and above all the interactions between these problems (Pretty et al. 2009). This global change threatens the foundations of life for humankind and in varying degrees the quality of life of many people and many societies (Smith 2001). It also endangers the foundations of life for many other species on this planet.

Various means and instruments are currently being discussed as ways of tackling these global challenges and shaping sustainable development processes. There is growing recognition and acknowledgement of the need for comprehensive transformation of non-sustainable lifestyles – transformation that will need to be brought about in very different ways in different cultures and societies. Although the idea was set out in the Agenda 21 document adopted at the 1992 Rio Earth Summit, it was not until the World Summit on Sustainable Development in Johannesburg (2002) that education was highlighted as an important instrument for shaping sustainable development. This concept was subsequently strengthened by the United Nations' decision to declare the World Decade of Education for Sustainable Development for the ten-year period 2005 – 2014 (German Commission for UNESCO 2008).

The international mid-term conference of the UN Decade of Education for Sustainable Development, held in Bonn in 2009, put the spotlight on the importance of biodiversity conservation as an educational task.

Preliminary note

This paper identifies key topics of biological diversity. It also suggests ways of addressing questions, issues and areas of action relating to biodiversity conservation in the context of educational programmes in a variety of learning settings and with different target groups. The aim is to provide a robustly underpinned guide for practitioners that highlights the threats to biological diversity and the links between these risks and other non-sustainable developments, while also suggesting ways of addressing these issues and reflecting on them in an educational context, as part of 'learning sustainability'. To make the discussion more engaging and tangible, brief summaries of educational projects and activities are inserted at various points in the text. These are intended only to suggest how questions and challenges of sustainable development, with biodiversity conservation in mind, can be addressed and actively implemented in various learning contexts; it does not imply that the projects and activities can automatically be regarded as having the credentials of model tools for use in Education for Sustainable Development. The position paper is addressed to practitioners in formal, non-formal and informal learning situations and to multipliers who wish to advance Education for Sustainable Development.

To organise the UN Decade of Education for Sustainable Development in Germany a National Committee and a Round Table were set up by the German Commission for UNESCO with funding from the Federal Ministry for Education and Research. As part of the work of the Round Table, the Biological Diversity Working Group was set up in 2007. This brings together some 20 stakeholders from scientific fields and educational practice, representing both state and private institutions. The aim of the Working Group is to increase the coverage of biodiversity issues in the UN Decade and, conversely, to link the objectives of the UN Decade with the education action areas of the National Biodiversity Strategy (NBS) (2007).

This paper is the first outcome of the Working Group. The group is planning to follow it up by publishing a collection of practical examples, with comments, from different areas of education. On the basis of selected quality criteria, educational practice will be described, evaluated and developed.

1 Introduction

The Convention on Biological Diversity (CBD) was adopted at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. In Germany this convention was implemented in November 2007 as the National Biodiversity Strategy (NBS). In this context biological diversity encompasses species diversity, genetic diversity within species and habitat diversity. In addition to the conservation of biodiversity, both documents also call for the sustainable use of biological resources, fair access to them and equitable sharing of the benefits and drawbacks arising from their use.

Education plays an important part in the implementation of these objectives. The importance of education was significantly boosted by the declaration of the UN Decade of Education for Sustainable Development (2005 – 2014), in which biological diversity is named as a priority issue. The international mid-term conference of the UN Decade, which was held in Bonn in 2009, emphasised the importance of safeguarding biological diversity as an educational task of the world community. In addition, biological diversity is quoted as a key issue in the Bonn Declaration produced by the participants of the world conference (2010): the decline in species diversity and the reduction in cultural diversity are mentioned as important problem areas (PO; stress is laid on the importance of protected areas, especially biosphere reserves, for the conservation of biological diversity and as places for Education for Sustainable Development (Espinosa 2009; Naughton-Treves et al. (2005). Biosphere Reserves are 'representative landscapes, designated for the purpose of ecosystem conservation, and as areas where sustainable economic use of the landscape should be combined with preservation of the population's cultural identity.' (EURO¬PARC Germany 2007: 5).

Recent studies of young people – a particularly important target group – show that safeguarding biological diversity is an educationally relevant issue not only from a scientific and academic perspective but also in socio-political terms. A representative survey in Germany and Austria entitled 'Youth and Sustainability' ('Bertelsmann Youth Study') in the summer of 2009 found that sustainability is an important issue for six out of ten young people: young people regard issues of climate change and environmental degradation, and of food and drinking water shortages in many parts of the world, as significantly more pressing than matters relating to the economic and financial crisis or to terrorism (Bundesministerium für europäische und internationale Angelegenheiten / tns emnid / Bertelsmann Stiftung 2009: 8). Young people in all socio-demographic groups ascribe great importance to the challenges that very concretely affect the majority of people worldwide. In addition, seven out of ten young people call for more Education for Sustainable Development. In training and education they would like to receive significantly more information about global problems and their responsibility for the world (ibid. 2009: 15).

Transmitting understanding in an educational context of the complex problems and possible solutions associated with the conservation and sustainable use of biological diversity and with equitable benefit-sharing is no easy task. It involves establishing a deep-rooted awareness of the multifaceted phenomena involved, their causes and the links between them. It is particularly important to encourage the development of values and attitudes relating to sustainable development and to promote the acquisition of the necessary skills and willingness to act. The starting point for greater willingness to take responsibility for the conservation and sustainable use of natural resources is the analysis of the relationship between humans and the natural environment (e.g. Berghoefer et al. 2010).

Info Box 1

Objective facts on biological diversity are important – but perceptions and evaluations (images of natures) have a decisive effect on human actions

As their environment changes, people change their perceptions and evaluations, without being aware that they are doing so. This provocative assertion was illustrated by Harald Welzer (2008) using research findings from Sáenz-Arroyo et al. (2005).

Fishermen in southern California were asked to estimate the decline in fish stocks in the Gulf of California. Three generations were surveyed. In the oldest group (aged 54+) the fishermen named 11 species that they considered were no longer present; fishermen in the middle group (aged 31-54) named 7 species while those in the youngest group (aged 15-30) named only 2 species that were no longer found in the fishing grounds. Welzer states that the youngest fishermen also had no idea that in relatively recent times there had been large numbers of white sharks, jewfish and pearl oysters in the places where they fished every day (Welzer 2008: 215). Their assessment of the fishing grounds was similarly affected: while the older fishermen still reported that they used to be able to make good catches very close to the coast, the younger ones unquestioningly regarded it as a matter of course that they must go far out to sea to catch similar quantities of fish. It would not even have occurred to them that there might be anything to be caught close to the coast.

The fact of declining species diversity is not perceived and evaluated as an ongoing process. Instead, the younger fishermen simply have different reference points and standards than the older ones. With the change in everyday reality they do not even miss the more extensive species diversity that used to exist – a phenomenon known as 'shifting baselines'.

Education for Sustainable Development engenders an understanding that nature and culture are not separate or even opposing realms and fosters an ability to understand and assess them as an interconnected whole.

Relationships between humans and the natural environment are manifested in people's concrete behaviour – that is, in the ways in which they relate to nature and how they change it, care for it, protect it and also destroy it. Further, Relationships between humans and the natural environment are manifested in images of nature that reveal cultural, societal and group-specific influences, in ideas, attitudes and values, and also in people's knowledge of nature (e.g. Corbett 2006; Krömker 2004; Umweltpsychologie 2005) (*Info Box 1*). The way in which people relate to nature and biological diversity is thus not only determined by the physical environment but also by social-cultural factors, which are subject to historical change (*Info Box 4, page 11*) and which vary widely (depending on age, social milieu, urban vs. rural background, ethnic origin; cf. Hunter & Brehm 2003). Empirical studies reveal that many people have an ambivalent and highly contradictory understanding of nature. For example, people's love of forests leads them to reject the felling of trees, but at the same time people buy furniture made of tropical hardwoods taken from the rainforest (Stoltenberg 2009: 34; Brämer 2006). It is with good reason that implementation of the National Biodiversity Strategy includes plans to asses the 'nature awareness' of the population (BMU 2010; Gallup Organization 2007, 2010), since the relevance of this awareness to the handling of biological diversity is beyond question.

Education for Sustainable Development should aim to promote an understanding of nature that sees nature as the foundation of human life, which needs to be both conserved and used. Nature and culture should not be perceived as separate or even opposing areas; instead, the fundamental ways in which they interlink and interact must be recognised and evaluated (UNESCO 2008). Culture arises through appropriation of nature (through managing, protecting and destroying, but also through naming and evaluating) (Kruse 2002). The beauty of nature and its diverse functions should, moreover, always be considered in relation to the possibilities of making economic, social and cultural use of nature, with 'use' being interpreted in a very broad sense. By building on such an understanding of relationships between humans and the natural environment, life on the planet can be shaped sustainably now and in the future. That involves heeding the natural coherence of life, using resources responsibly, observing human rights and striving for global fairness in our 'one world'.

Key questions for educational processes therefore include:

- What is the meaning/value of biological diversity for different social groups?
- How do such values arise?
- What ways of using biological diversity are people familiar with?
- To what extent do we feel responsible for the sustainable conservation of natural resources?

The significance of the conservation and use of biological diversity in shaping sustainable development can be particularly well illustrated by means of the key topics described below, which have tangible links with the world in which people live and their everyday actions. They can also be linked to the principles of the international Convention on Biological Diversity, the National Biodiversity Strategy and the UN Decade of Education for Sustainable Development (2004-2014). In future Education for Sustainable Development should focus more strongly on these key topics in order to make people more clearly aware of central global challenges relating to the management of biological diversity, identify conditions for sustainable action strategies and develop the necessary capabilities. In this context the following fact is always of fundamental importance: Humans are dependent upon the biosphere if they are to survive – however, the increasing overuse of the biosphere by a growing number of people on this planet means that a new way of managing its vital resources is now essential.

A useful means of structuring and evaluating action objectives is the system of 'differentiated intensities of use' proposed by W. Haber (1984, 1998; see also WBGU 2001); this moves away from a rigid separation of conservation and use, instead recommending integration of these two objectives. Each of the objectives is weighted differently in different situations. Under 'conservation before use' valuable areas would be designated as protected areas. 'Conservation through use' could involve use through low-impact or sustainable tourism, in which human usage interests are balanced against the conservation requirements of a landscape or resource. In the category 'conservation despite use' the emphasis would be on economic use. It should be borne in mind, though, that the basis of economic use (fertile soils, regions for mass tourism) also needs to be maintained and cared for.

2 Key topics

The main risks to biological diversity include the modification and overuse of habitats, general environmental pollution, the spread of 'alien' (invasive) species and climate change. In the light of this the Biological Diversity Working Group has identified the following four key topics as a basis for highlighting the challenges associated with the conservation of biological diversity in the context of Education for Sustainable Development:

- habitat diversity
- services of nature
- climate change and biological diversity
- consumption and biological diversity.

These key topics will be used to illustrate how 'learning sustainability' can take place at several levels and be considered from various perspectives. They are relevant both to each and every individual and his/her actions and to a wide range of social groups, political organisations, administrative bodies, companies and business associations. Interactions between these levels provide many educationally valuable opportunities for examining individual issues, involving a range of third parties in the educational work, engaging in critical (self-)reflection and developing and implementing shared plans for the protection and maintenance of biological diversity.

2.1 Habitat diversity

The term 'biological diversity' encompasses not only genetic diversity and species diversity but also habitat diversity, since the occurrence of plant and animal species is frequently linked to a particular ecosystem and thus to a particular habitat (*Info Box 2*).

Info Box 2

Points of view and constructs – What is an ecosystem?

Definition of an ecosystem in ecology (from Ellenberg et al. 1986): An ecosystem is a dynamic structure involving interrelationships between a habitat and the species community that occupies this habitat. A species community consists of producers (plants), consumers (herbivores and predators) and decomposers (bacteria and moulds). The properties of the habitat depend on abiotic factors such as relief, microclimate, soil conditions and water availability. To understand an ecosystem it is important to take account of the complex interactions between the species community and the habitat, for example through material and energy flows that typically occur in nature. As a result of these interactions the entire ecosystem can change if one of its components is modified.

Ecosystems are able to regulate themselves to some extent, thereby cushioning the effects of change to one or more components. However, both this self-regulation and the natural dynamics of an ecosystem are sensitive to disruption through outside intervention (e.g. through fertilisation, clearance or pollution). Anthropogenic impacts of this type on an ecosystem are often accompanied by change to the habitat and adverse consequences for the species community there.

'It should nevertheless be borne in mind, that the delineation of an ecosystem is not laid down in nature but is based on the point of view of researchers' (Reichholf 2008: 218f, translated). Ecosystems have no rigid, predefined state. Contrary to the assertions of much nature conservation literature, they can therefore not be 'stressed' or even experience 'collapse'. These terms reflect human expectations and points of view rather than objective circumstances of nature. Scientific concepts merely bring order and structure to the otherwise seemingly chaotic whole of 'nature' or 'biological diversity'.

Depending on the features of the habitat and the species community that is present, ecologists distinguish various ecosystem types (Haber 1991), such as mixed deciduous forest, mudflats, coral reefs and the areas of extensive grassland scattered with fruit trees that are found in some parts of Europe.

Biological diversity in cultural landscapes

Ever since the nomadic way of life was abandoned, people have made a significant impact on natural environments and altered them to meet their needs by establishing settlements, transport routes, fields and pastures. The term 'cultural landscape' describes this environment, containing both manmade and natural elements, that has been shaped by humans (Konold 1996). The majority of landscapes that are now commonly perceived as 'natural' are thus 'cultural landscapes' that have evolved over centuries or even millennia. Thus in Germany, for example, where the landscape would naturally consist of extensive, relatively species-poor deciduous forest (Jäger 2003: 83), one now finds a varied mosaic of forests, fields and meadows.

Many landscape elements created by humans – such as heaths and quarries, and also hedges and irrigation canals – provide habitats for a number of specialised species (Haber 1984) and are now very important for the conservation of nature and biological diversity. Securing habitat diversity always involves conserving a variegated cultural landscape and is thus a form of conservation through use (which should be as sustainable as possible). Agricultural use must, however, be regarded with ambivalence: while farming promotes biodiversity by creating varied, multi-faceted cultural landscapes, the increasing intensification of agriculture has numerous adverse consequences for the diversity of wild species and their habitats (FAO 1996, 2005).

Increasing attention is now being paid to the impact of 'alien' (invasive) species that have, in modern times, moved into areas in which they did not previously occur, either because they have been introduced through human activities (deliberate or otherwise) or because they have migrated of their own accord. This stimulates a worldwide exchange of fauna and flora elements on a previously unheard-of scale, which has led and is still leading to the transfer of organisms to regions far outside their natural territories. Considered on a global scale, the introduction of non-native species is a major threat to biological diversity, second only to habitat loss as a result of land-use change (WBGU 2001: 178, ibid. glossary). Recent estimates put the total economic damage at more than 1.4 trillion US dollars (Secretariat of the Convention on Biological Diversity 2010).

Over the centuries agriculture and livestock-rearing have given rise to extensive agricultural biological diversity

Info Box 3

Agrobiodiversity[1]

Is a loss of biological diversity in times of highly mechanised and industrialised agriculture likely to jeopardise the human food supply? In 'developed' countries the human food supply depends mainly on 12 plant species; agriculture worldwide has become focused on high-yield varieties of these. These crops are frequently grown in monocultures of enormous extent in which individual plants are genetically very similar. As a result the crops may be more susceptible to disease, which spreads rapidly over a large area.

One of the most important staple foods in Asia is rice; several billion people depend upon it for their daily nutrition. In the 1970s an insect-borne virus threatened the rice harvest in Asia. The virus prevented the rice flowering and producing seed.

When more than 6000 rice samples were tested at the International Rice Research Institute in the Philippines, it was found that a single and very rare rice line was immune to the virus. This resistant rice came from a valley at the foot of the Himalayas in India. By then the valley had been flooded for a hydropower plant; the resistant rice was lost beneath the water. In the 1970s, however, scientists at the Rice Research Institute succeeded in crossing the wild rice with high-yield rice. The result was a hybrid that was immune to the virus-borne disease and at the same time high-yielding. The most widely used rice varieties in Asia still come from this rice line.

1 Source used: http://abenteuerforschung.zdf.de/ZDFde/inhalt/12/0,1872,757306800.html Last viewed 31.03.2010 (ZDF documentation ‚Lebensversicherung Artenvielfalt')

– agrobiodiversity (Thrupp 200). This diversity of agriculturally used animals and plants is of great value in enabling agriculture to adapt to climate change, and it is essential for future global food security (*Info Box 3*). However, since the mid-19th century there has been a significant decline in the inter-species and intra-species (genetic) diversity of crops and domesticated animal breeds in central Europe as a result of the intensification of agriculture and modern plant-breeding methods (Scherr & McNeely 2008; Harper et al. 2008; TGRDEU 2010).

However, the cultural landscape is not only used for purposes of agriculture, forestry and fishing. It also provides important recreational space for the (local) population, opens up numerous opportunities for leisure use (sport, recreation) and hence boosts the regional economy (Vancura 2008). Furthermore, regionally specific features of the cultural landscape are closely linked with the history and regional identity of the population and with the feeling that an area is 'home'. Nevertheless, perception and evaluation of cultural landscapes undergoes constant change. In the course of history and within different cultures there have repeatedly emerged different concepts and values that can be regarded as the outcome of 'social constructions' (*Info Box 4*).

These socially and culturally conditioned constructions and value judgements of 'natural and cultural landscapes' (e.g. as revealed in 'images of nature') are crucial to attitudes and decisions relating to what is or is not worthy of conservation; they thus have a significant influence on the ways in which landscape and biological diversity are handled. This means that even so-called 'natural' landscapes (including 'wilderness areas') in a sense become 'cultural landscapes' through being culturally appropriated in a particular way through naming (designating) and evaluating.

The presence of different user groups in the cultural landscape means that conflicts between particular claims and wishes regarding the shaping of that landscape inevitably arise. While new forms of use – whether through agriculture, tourism or (nature-based) sport – frequently modify old elements of the cultural landscape, they also create new landscape structures and possible new habitats for animals and plants. Use of the cultural landscape for which humans are responsible thus 'treads a fine line between destruction and enrichment' (Bund Heimat und Umwelt 2003: 6, translated).

The subject of ‚biological diversity in cultural landscapes' provides numerous links and starting points for Education for Sustainable Development (Info Box 5). Suitable introductory questions include:

- What significance do cultural landscapes have for us – for our everyday lives, our consumption decisions and our leisure pursuits?
- How have particular cultural landscapes arisen? For what species do they provide habitats?
- How have particular cultural landscapes changed or developed, especially in the last 30 – 50 years?

Info Box 4

The influence of cultural and historical change on images of nature – the example of the Lüneburg Heath

In Europe it was not until the Romantic period that nature acquired significance as landscape and as an aesthetic experience. This is vividly illustrated by the ways in which people have perceived the Lüneburg Heath. The heath was declared a nature conservation park in 1921 but had acquired its special value with the development of the 'romantic view' at the start of the 19th century. Many literary witnesses testify that this area had for some 200 years been decried as 'wild, bad, desolate, evil, monotonous, sinister, miserable'. Caroline Schlegel, in a letter about her journey from Braunschweig to Harburg via Celle in 1801, wrote: 'The urgency was the best part of the journey – Heaven help such a land! I became seasick from the monotonous sight of the heath and the sky, and from Braunschweig to here it is like that for 18 miles, dry brown heather, sand, crippled trees coated with moss and mould ...' (Eichberg 1983: 198).

- What forms of use promote the greatest biological diversity in cultural landscapes?
- What is the effect of societal, group-specific and individual images of nature and culture on the shaping – i.e. modifying or conservation – of cultural landscapes?
- What role do cultural landscapes play in relation to our identity and sense of wellbeing?

Biological diversity in natural landscapes

The term 'natural landscapes' describes large-scale landscapes that are not primarily characterised by use but have retained their original character. Examples of natural landscapes in Central Europe are continuous areas of forest not used for forestry purposes, and the Wadden Sea (Wattenmeer) on the North Sea coast of the Netherlands, Germany and Denmark. In Germany natural landscapes are conserved as national parks under the slogan 'Let nature be nature'. Since these national parks are expressly intended to be used for tourism to promote education and enable people to encounter nature, they can also be regarded as a (special) form of cultural landscape.

Natural landscapes are sometimes closely associated with 'wilderness', which is often interpreted as the opposite of a cultural landscape – as nature untouched by humans, largely left to itself and shaped only by 'natural' processes (= without human involvement). The concept of wilderness is now used in a variety of contexts; the term is used both in connection with the large areas of wilderness on other continents and in references to the 'urban wilderness'. This highlights the fact that wilderness (like 'nature' or 'landscape') is experienced and evaluated subjectively and in different ways: it may evoke distaste and anxiety or romantic notions of freedom and self-determination. It is described as being unpredictable, threatening, untamed and lacking in culture, but it is also referred to as original, adventurous and paradisiacal. The ambivalence of the experience is reflected – as ambitendency – in behaviour (Manfredo 2008; Kruse 1983; Gerdes 2010; Heiland 1992).

The National Biodiversity Strategy defines wilderness areas as natural spaces with an intact habitat dynamic in which humans do not intervene. Such areas provide a habitat for many animal and plant species and represent an important resource for the study of natural processes (cf. Mittermeier et al. 2003). There are plans to increase

Info Box 5

Model training course – ‚the fruit growers – cultural landscape guide/traditional extensive orchards'

Through the LIFE+ project ‚Vogelschutz im Albvorland' (bird protection in the central Swabian Alb) the Stiftung Naturschutzfonds (Conservation Fund) in cooperation with the adult education centres of Esslingen and Göppingen and Cosmopolitan Services offers a qualification entitled ‚the fruit growers – cultural landscape guide/traditional extensive orchards'. The modular training course covers nature conservation issues and the ecology of traditional extensive orchards, provides information on traditional farming methods and opportunities for promoting alternative forms of marketing, addresses customs, art and culture, explores the importance of biological diversity in the context of Education for Sustainable Development and discusses the teaching aspects of experience-oriented educational work (*www.life-vogelschutz-streuobst.de*).

the percentage of wilderness in Germany from the current level of less than 1% to at least 2% of the country's surface area (BMU 2007). This is an indication of the particular value for the conservation of biological diversity that is ascribed to wilderness areas.

In Germany wilderness areas are usually integrated into national parks or 'developed' within them. According to Section 24 para. 2 of the Federal Nature Conservation Act (BNatSchG 2010) the aim of national parks is 'to safeguard undisturbed natural processes and their natural dynamics in a majority of their area'. Moreover, Biosphere Reserves also have a core area where nature is allowed to develop with as little human influence as possible; human intervention in these areas must be kept to a minimum (BfN 2007: no page number). 'Wilderness' is also a development objective for some areas covered by the 'National Nature Heritage' conservation programme under which, for example, semi-natural deciduous forests are being left to develop naturally as wilderness areas (DBU aktuell 2008).

The subject of natural landscapes and wilderness raises interesting and interlinked questions for Education for Sustainable Development (Info Box 6), including:

- What is wilderness – and what does it mean for me/us?
- What attraction does wilderness have for people and why?
- What is the importance of natural landscapes and wilderness in particular economic areas?
- To what extent should humans intervene in natural landscapes, change them and exploit them?

Info Box 6

Nature encounter areas by and for children and young people in protected areas[2]

Children and young people are the decision-makers of tomorrow: how can they be shown why Europe's natural heritage should be protected and conserved for future generations? How do today's young people relate to their natural environment? What do they want to experience in nature, what fascinates them about it and how can their wishes be met? How can plants, animals and their habitats be protected from harmful intervention?

In three model regions in Baden-Württemberg a project being carried out with children and young people from classes 3 -11 of various schools involves identifying visions and wishes, exploring their feasibility and implementing them with experts on the ground. This has given rise to a wide range of schemes in different nature encounter areas. Through discussions and work with shepherds, farmers and foresters the pupils discover why it is important to eat home-grown products. They also learn that farming and related activities involve hard work in the open air. This heightens their appreciation of the ways in which workers in these occupations contribute to conservation of the cultural landscape. At the same time they learn what is involved in producing high-quality food and what transport facilities are needed for food marketing. By undertaking practical maintenance work the pupils experience the hard work involved in nature conservation. And finally they acquire a wide range of skills in nature conservation and public relations work

2 Further details of activities in the three model regions are available at www.mobi-world.de; www.rohrhardsberg-life.de/Naturerlebnis; www.mlr.baden-wuerttemberg.de/Staatssekretaerin_ Friedlinde_Gurr_Hirsch_MdL_Der_Naturerlebnisraum_Schauinsland_ist_attraktives_Ausflugsziel_von_und_fuer_Kinder_und_Jugendliche_und_aktiver_Beitrag_zum_Naturschutz_zugleich/53911.html.

- How much ‚wilderness' do we require countries in other parts of the world – such as Africa, Asia and Latin America – to maintain for biodiversity conservation, perhaps forcing them to forego economic gain in the process? What compensation do they receive for this?

- How much wilderness are we prepared to permit in Germany or our own region?

Biological diversity in urban areas

People are frequently surprised to learn that the urban environment in Germany provides an important habitat for a wide range of plant and animal species. Many species (such as birds that nest in buildings, bats and stone martens) have discovered an alternative habitat in urban areas. In addition, 'alien' species are moving into new urban habitats (in Germany e.g. collared dove, rose-ringed parakeet and Egyptian goose) (cf. Reichholf 2007).

In fact, towns and cities often harbour a far greater number of species than the monotonous, polluted and industrially farmed landscape that surrounds them. They thus make a significant contribution to biodiversity conservation (Müller et al. 2010). On the 7th GEO Day of Species Diversity in 2005, more than 1,400 plant and animal species were found in Berlin's Tiergarten alone (www.geo.de/GEO/natur/Oekologie/Tag_der_ artenvielfalt/ 3942.html). This high level of species diversity in urban areas arises in part from small-scale land use and the resulting structures that include grass verges, gardens, parks, city forests, open waters, cemeteries and brownfield land; microclimate factors also play a part.

Towns and cities often harbour a far greater number of species than the monotonous, polluted and industrially farmed landscapes that surround them, thus making a significant contribution to biodiversity conservation.

However, this positive fact of high species numbers in urban areas must be juxtaposed in opposition to other factors that have a negative impact on the safeguarding of biological diversity. For example, arguments should not be based solely on species numbers, because quality as well as quantity must be considered. Many now rare plant and animal species depend on specific habitats: human influence often encourages the spread of species with less specific habitat requirements and leads to the loss of rare species (with lower tolerance of intervention in their habitat).

The spread of built-up areas, greater sealing of the landscape, increased use of non-native plant species and the planting of unvaried and easily maintained greenery in parks and public spaces often lead to a decline in native species diversity. Another drawback is the intensive use of land in urban areas, where many different uses compete for the limited space available for business, consumption, living space and recreation. Between 2004 and 2007 in Germany new land was taken for transport and housing purposes at an average rate of 113 hectares per day (BfN 2008a). The resulting surface sealing has far-reaching consequences, since it leads to the loss of important ecosystem functions – such as the buffer and storage function of the soil and groundwater recharge – and dissects, fragments or destroys important habitats.

To counteract the problems outlined above, the proposals of the National Biodiversity Strategy to 2020 include a significant increase in urban greenery (BMU 2007). Since in Germany the majority of the population lives in cities and conurbations this objective is at the same time of particular significance for the living environment of many people. Inner-city and suburban green spaces are important for recreational and sporting activities; at the same time they benefit the urban climate, improve air quality and improve the quality of life for children, young people and adults while also adding a new dimension of experience. The conservation of urban green spaces thus safeguards not only the habitats of many plant and animal species but also the environment and quality of life of the urban population.

Not least in importance is the fact that, because of their closeness and accessibility, urban green spaces provide an opportunity to introduce children and young people to natural phenomena as part of their everyday lives, to interest

them in observing and encountering nature and to increase their awareness of nature conservation issues. Many animals and the development of plants can be observed 'on the doorstep' throughout the year.

In addition to ecological issues, a wide range of other questions and opportunities for reflection arise in the context of Education for Sustainable Development:

- What plant and animal species can be observed on the way to school? What habitat do these species occupy in the town or city?
- What does biodiversity from the region or the town/city 'taste' like?
- How do we perceive biological diversity in the town/city and what significance does it have for our life there?
- In what ways do our 'images of nature' (or images of 'nature') differ in the town/city and in the countryside?
- What are the interactions between lifestyle, consumption behaviour and leisure requirements on the one hand and biological diversity in urban areas on the other?
- What services of nature, such as good air quality or a pleasant urban climate, do we make use of every day?
- What can we do/what can each one of us do to conserve biological diversity in the town, city or district we live in?

Since the direct living environment provides particularly extensive opportunities for participation and the shaping of political will, specific action options for shaping one's own environment can be discussed and implemented in authentic learning situations (school yard design, removal of sealed surface from certain areas, maintenance of neighbourhood parks, creation of neighbourhood gardens).

2.2 Services of nature

The importance of biodiversity for humans becomes apparent if one considers the services of nature, also referred to as ecosystem services by scientists. These are services that have a specific value to humans. Evaluation of the services provided by the biosphere – including those associated with biodiversity – involves a number of value categories. These make plain that biodiversity is valuable for human lives in a wide variety of ways – ecologically, economically and culturally (WBGU 2001).

The functional value of the biosphere includes the various ecological functions that the biosphere performs for humans – e.g. the breakdown of atmospheric pollutants, the self-cleansing capacity of bodies of water including the oceans, the provision of flood areas for flood protection, new soil formation and the carbon storage function of ecosystems such as moors, old forests and wetlands. These basic services provided by ecosystems and specific species form the basis of human existence and all economic activity (MA 2005).

Humans also depend upon a range of ecosystem services for purposes of production and consumption (e.g. food, wood, recreation, experiencing nature, health) that cannot be replaced by technical means (*Info Box 7*). For example, the economic value of ecosystem services in connection with farming, forestry and fishing is immediately apparent. In this context the genetic variability of crops also harbours potential for minimising risks, such as those associated with plant diseases and pest infestation (*Info Box 3, page 10*). To safeguard this service in the long term, it is essential to conserve wild forms and possibly 'uneconomic' varieties and strains.

Biodiversity is valuable for human lives in a wide variety of ways – ecologically, economically and culturally.

Info Box 7

Using genetic potential to develop medicinal products – the example of devil's claw (southern Africa)

Devil's claw *(Harpagophytum procumbens)* is traditionally used by the San, the indigenous bushmen of the Kalahari, as an aid to digestion, to treat headaches, fever and allergies, and as an ointment to reduce the pains of childbirth. Following initial tests in the 1950s, more recent clinical trials have found that devil's claw has anti-inflammatory and arthrosis-inhibiting properties for patients with degenerative diseases of the joints. The roots of devil's claw are now exported and used by many pharmaceutical companies in Europe and East Asia to treat diseases such as rheumatism and arthritis. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has supported sustainable wild collection of devil's claw and helped to enable initial processing to be carried out in the collectors' villages, thereby enabling collectors to obtain higher prices and hence increase their income.

Info Box 8

Bionics – ant colonies as models of human driving behaviour

Recent studies show that, even when ‚traffic volume' is high, ants do not overtake and avoid fluctuations in speed. Instead they adapt their speed to the situation and move steadily in columns without significantly slowing down or coming to a halt. This is made possible by a sophisticated communication system which involves ants marking their routes with pheromones. The stronger the marking, the more the ants use that route. If too many ants are on the route, diversions are found.

On the basis of these findings consideration is now being given to driver assistance schemes that communicate with each other and thus provide drivers with information on the current traffic situation and the driving behaviour that this calls for; alternatively, the system may directly influence the vehicle (e.g. automatic adjustment of speed).

There is a close correlation between economic value and functional value. For example, scientific studies have shown that farming land organically is an efficient way to promote a balanced water regime (e.g. via enhanced groundwater recharge).

In addition, nature provides information and models that can form the basis of innovation in the areas of technology, health and nutrition (*Info Boxes 7 and 8*). Thus, examples from bionics illustrate the potential of natural phenomena for technical developments.

Earth's biological diversity with its plant and animal species represents an extensive store of natural wealth. In national budgets and company balance sheets, however, nature conservation appears primarily as a cost factor and the role of the productivity of nature is systematically underestimated. In recent times there have therefore been growing attempts to monetise the value of nature (Secretariat of the Convention of Biological Diversity 2010; TEEB 2009). A study by Jessel et al. (2009) demonstrates that there are many good economic reasons, as well as ethical and emotional ones, for supporting nature conservation (*Info Box 9*).

Another ecosystem service is the symbolic value of aspects of nature, involving the ascription of meaning to natural phenomena in aesthetic, religious or other cultural contexts (e.g. heraldic animals or sacred trees). Symbolic value also includes biological diversity as a source of quality of life, for example through rest and relaxation or the encounter with nature as an elemental experience (*Info Box 10,*).

The category of existence value describes the utility that arises for humans from simply knowing of the existence or conservation of biological diversity. For example, natural landscapes have a utility for aesthetic reasons even if this is not directly experienced. The inclusion of natural sites in the UNESCO World Heritage List is also an acknowledgement of the existence value of biological diversity.

In the context of sustainable development the option value is of fundamental importance. It relates to the possibility of realising a value in one of the four other categories in the future, for example by using a genetic resource for medicinal purposes. Since a large part of the worldwide gene pool has not yet been tapped, the extinction of any species entails the irretrievable loss of potential resources that could be of inestimable value for future generations.

Every day plant species disappear forever from our planet – most of them before they have even been discovered. It is estimated that there are between 10 and 100 million species worldwide, of which only two million are known to scientists. The unknown species are concealed in the depths of the oceans, the desert floor, or the last inaccessible tropical rainforests. Biologists estimate that between one thousand and ten thousand times more species are now lost due to human intervention than through natural causes[3].

For a long time the services of nature appeared to be inexhaustible and they were therefore freely available to everyone. It is now known, however, that ecosystem services not only have limits but can fail completely if permanently overstretched. This can be observed in the destruction of the tropical rainforests, the overfishing of the oceans and the pollution of the atmosphere by emissions containing greenhouse compounds. The foundations of human life and the possibilities for development are affected not only by habitat change but also by species loss and the depletion of genetic diversity.

The key topic 'services of nature' can be used to identify and elaborate the direct importance of biological diversity for human wellbeing, economic activity and a sustainable world community. This will also reveal the central message, which is that the services of nature can only be used in the long

3 This and other data can be found online at www.br-on¬line.de/wissen/umwelt/artenschwund-und-artenschutz-DID1244192379926/index.xml.

Info Box 9

Putting a figure on the economic value of services of nature (Jessel et al. 2009)

The total value of the products and services provided by nature is estimated at 16–54 thousand billion (1012) US dollars per year. Mangrove forests, seagrass meadows and salt marshes provide effective flood protection; worldwide they prevent damage of more than 200 US dollars per household.

The economic value of avalanche-protection forests in Switzerland is put at more than 2.64 billion euros per year.

The value of insect pollination for our crops is put at up to 153 billion euros.

The recreational value of forests in Germany is estimated at around 2.5 billion euros. Approximately 50% of all licensed pharmaceuticals worldwide are of plant-based origin.

Info Box 10

Health – an important service of nature

It has long been assumed but only since the 1980s has it been proved through a growing number of scientific studies that landscapes and natural spaces affect human health and wellbeing: for example, landscapes that are perceived as attractive promote physical activity and impact positively on physical health. Natural spaces also contribute to mental health by evoking positive emotions, reducing stress and promoting concentration.

In addition, recent studies demonstrate the therapeutic benefits of the countryside and natural spaces, for example through the positive effects of recreation and sporting activities in the countryside on the cardiovascular system, heart disease, high blood pressure and diabetes.

term – and hence by future generations – within the carrying capacity of the ecosystems in question. In this context it must be made clear that many ecosystem services do not arise at the places where they are used and consumed but in the hotspots of biological diversity – the regions of the Earth that are rich in biological diversity and endemic species and whose natural habitats are threatened at the same time (Hanson et al. 2009; Myers et al. 2000). These hotspots comprise only around 2% of the Earth's terrestrial surface but contain more than 50% of its biological diversity. Many of them are situated in tropical developing countries (WBGU 2001: 431). By contrast it is the industrialised countries that have the necessary capacities for research, development and marketing. The countries in which genetic resources originate have, until now, profited very little from the immense profits generated by the utilisation of these resources (Rodriguez et al. 2007). However, despite the absence of binding rules on the fair sharing of benefits arising from the use of genetic resources (in accordance with the Convention on Biological Diversity, Articles 15 and 16) there are examples of successful attempts – as with Ethiopian teff and the South African hoodia plant – to share these benefits with the country of origin (*Info Boxes 11 and 12*).

There are many questions that might be asked in the course of reflection on the services of nature in the context of Education for Sustainable Development and awareness of comprehensive, long-term conservation of biological diversity, e.g.:

- In what ways are our lives affected by biodiversity as a source of quality of life and wellbeing?
- How do we impair the services of nature?
- To whom does nature belong? What opportunities are there for patenting nature or individual parts of nature, and what are the associated risks? Can the patenting of nature be ethically justified? What legal issues need to be resolved?
- How can the value of ecosystem services be measured?
- How much are we prepared to pay in order to experience wilderness directly, conserve traditional extensive orchards or reintroduce the bluethroat?

Info Box 11

Fairness payments between North and South – teff (dwarf millet) in Ethiopia

Teff, also known as dwarf millet, is an important food in Ethiopia. Teff flour is the basis of the dough used to make injera, a soft flatbread, which is the staple food of Ethiopia. Teff is high in iron and calcium and, moreover, it contains no gluten. Teff can therefore be used to make gluten-free baked goods and is particularly suitable for people who suffer from the metabolic disorder coeliac disease or the skin disorder Dermatitis herpetiformis.

Scientists in the Netherlands have spent many years studying the cultivation and development of teff. The resulting product has been registered by the Dutch company Health and Performance Food International as Eragrain®. In accordance with international guidelines the company has concluded an ABS agreement with the responsible Ethiopian institutions, as part of which it agrees to pay ten euros for every hectare of land worldwide on which Eragrain is grown plus five per cent of the profit from the sale of Eragrain products (e.g. flour).

2.3 Climate change and biological diversity

All over the world the effects of predicted climate change on ecosystems are likely to be severe (EEA 2010). The global rise in temperature has far-reaching consequences: the warming of the world's oceans not only leads to melting of the polar ice caps and rising sea levels but will also affect biocoenoses such as coral reefs, mangrove forests and mudflats. On land, increasing desertification threatens the livelihoods of millions of people, especially in Africa (Wright et al. 2009). In temperate latitudes changes in the rhythm of the seasons and increasingly extreme weather events (heavy rainfall, dry periods etc.) and their consequences (floods, soil erosion and displacement) and the spread of carrier-borne diseases (e.g. malaria) and pests pose major threats to the affected countries, their inhabitants and their economies (especially health services, farming and forestry, tourism).

It is now regarded as an established fact that, on a global scale, factors such as the use of fossil fuel, industrial and agricultural production, the destruction of forests and the draining of moors and wetlands make a significant contribution to climate change. The worldwide conservation of ecosystems that function as carbon sinks is therefore particularly important for preventing and mitigating the consequences of climate change.

There are many energy-saving measures – such as more efficient lighting systems, heating systems or vehicles – that are intended to counteract the effects of climate change. However, many of these measures are detrimental to biological diversity. In particular, the cultivation of energy crops (e.g. palm oil, soya and sugarcane in Latin America, maize and rape in Germany) often involves increased industrialisation of the agricultural landscape, an enormous land need and sometimes extensive pesticide use – factors which result in the destruction of natural ecosystems and a significant loss of biological diversity.

Info Box 12

Benefit-sharing after initial biopiracy: the hoodia plant in southern Africa

Hoodia gordonii, a cactus-like plant, has long been used by the San, the indigenous bushmen of the Kalahari, to suppress hunger and thirst. Descriptions of the use of hoodia by the Hottentots in the literature of the colonial era motivated the South African Council for Scientific and Industrial Research (CSIR) to initiate a research project in the 1960s. Twenty-five years later the CSIR succeeding in isolating the active ingredient in the plant that is responsible for appetite suppression; in 1995 this was finally patented.

Until 2001 the San were unaware that their knowledge of the uses of hoodia had commercial potential and that this knowledge had formed the basis of scientific studies and the registration of international patents by the CSIR. They were excluded from the lucrative agreements on the development of a commercial product concluded by the CSIR and the British company Phytopharm. It was only in 2003, after intensive negotiations between the San and the CSIR, that an agreement on benefit-sharing was reached: the CSIR agreed to pay the San eight per cent of all money that it receives or has received in the course of product development and six per cent of licence revenues from the sale of the commercial products.

Info Box 13

Regional electricity – helping to tackle climate change

The BUND regional electricity project in Baden-Württemberg offers an electricity tariff that goes beyond enabling customers to reduce their personal carbon footprint and support 'green' power plants in their region. The tariff also rewards plant operators for providing additional environmental services.

In the Allgäu-Oberschwaben region there is a particular emphasis on promoting agricultural biogas systems. However, systems do not qualify for support unless they provide additional benefits for nature and the environment. For example, to receive a subsidy farmers must include grass cuttings from water meadows and traditional extensive grassland/orchard systems in the fermenting process, grow their renewable feedstocks organically, use the heat produced during electricity generation for heating and drying systems and be prepared to show groups of visitors round their premises. Further information is available at *www.bund-regionalstrom.de*

In addition, other agricultural uses – occasioned by consumption patterns in industrialised countries – result in habitats being destroyed (e.g. forest clearance for meat production, conversion of peat forests into oil palm plantations, clearance of mangrove forests for shrimp production) and at the same time have an undesirable effect on the world's climate. To this it must be added the fact that many of these economic activities have adverse socio-economic consequences (e.g. working conditions in sugarcane plantations) and also threaten the livelihood of people living in those particular parts of the world.

The key topic 'climate change and biodiversity' can be used to identify and reflect on the effect of our own economic activities and consumption patterns on global climate changes and on biological diversity (Info Boxes 13 and 14). The topic does not only relate to the everyday actions of individuals but is also relevant to all groups within society, political organisations, administrative bodies, companies and associations.

Education for Sustainable Development can include a wide range of questions and opportunities for critical discussion, e.g.:

- Through which specific everyday actions and which consumption decisions do I/we contribute to climate change?
- What view do I/we/other people have of climate change?
- Have I noticed any consequences of climate change in my town/city or region?
- What is the likely effect of the predicted worldwide consequences of climate change on biological diversity?
- In what specific ways can I or particular groups within society counteract climate change and at the same time conserve biodiversity?
- What opportunities are there for changing consumption styles that are harmful to the climate, and what are the barriers to such change?

Info Box 14

Heat from wheat?! An energetic journey round the world

The 'Heat from wheat?!' project, which has been running since January 2009, is intended primarily for children in school years 3 – 6. Its aim is to raise awareness of the global, economic, ecological, social and cultural aspects of energy and nutrition and to identify opportunities for action. Participants are also encouraged to rethink their own lifestyle with regard to consumption, resource use and energy efficiency. There are a number of teaching modules for schools to use; farmers, one-world organisations and other partners are also involved. In addition, multipliers are being trained so that the project can be extended to the whole of Bavaria and the project results can be developed into a one-day project package for schools (*www.lbv.de/altmuehlsee*).

2.4 Consumption and biological diversity

For only a quarter of the human race does daily consumption go beyond the satisfaction of basic needs and represent a major element in their (consumption-oriented) lifestyle. In the USA 84% of the population belongs to the 'consumer class'; in Germany the figure is 92% and in Japan 95%. According to the Worldwatch Institute's 2010 report, the 65 high-income countries were responsible for 78% of expenditure on consumption in 2006 but represented only 16% of the world population (Assadourian 2010: 37) The unequal global distribution of consumption opportunities is at the same time an indicator for the difference in worldwide opportunities for realising individual life plans. Various methods of calculating the resource consumption of a group or individual have been devised. The 'ecological rucksack' quantifies the materials and energy consumed during manufacture and throughout the life cycle of a product or in the provision of a service (Schmidt-Bleek 2004; 2007). The 'ecological footprint' expresses these consumption figures in units of area (*Info Box 15)*.

The consumption of goods and services in our society has social and psychological functions in addition to the satisfaction of basic needs. For example, consumer goods serve as means of communication and signalise social position and status. They thus contribute to the formation of individual identity – not only among the peer groups of the young – and are of major importance for interpersonal relationships. Personal happiness and satisfaction can also be increased through consumer goods.

A particularly relevant example of the connection between consumption and biological diversity is the influence of social nutrition habits on global fauna trends. The growth in consumption of meat and fish in western industrialised countries – and increasingly in some Asian countries too – is having a decisive influence on land use in the tropical countries of Asia, Africa and Latin

Info Box 15

Ecological footprint

Our lives need space: space for our homes, space for the streets that take us from our home to school or to the sports ground. The cocoa and coffee on our breakfast table were grown in countries of the southern hemisphere – these fields also need space, as do those for fruit and vegetables or for the cotton for our jeans and T-shirts. Meeting our needs for food, shelter, clothing and transport requires areas of land and water – as does the need for storage and degradation of waste.

The 'ecological footprint' method can be used to calculate the area of land needed to produce a particular product. A kilo of vegetables requires approximately 0.95 square metres of farmland, plus 10 megajoules of energy. Generating this energy also requires land; this can be calculated and included. In this case an additional 1.41 square metres is required, so that a kilo of vegetables requires in total 2.36 square metres of land (Wackernagel & Rees 1996; *www.footprint.org*).

If the world's biologically productive land is divided between approximately 6 billion people, the result is approximately 1.8 hectares per person. In 1961 the ecological footprint of the entire world population amounted to around 70% of the Earth's biological capacity; in 1999 the figure was 120%, and by 2006 it had risen to 145%. It is clear from this that the human race is following a non-sustainable, non-viable pathway (Wuppertal Institut für Klima, Umwelt, Energie & Deutsche Bundesstiftung Umwelt 2005).

There are now a number of questionnaires and tables that individuals can use to calculate their ecological footprint for various everyday activities (transport, water consumption, clothing, leisure activities).

Info Box 16

Certification marks – diversity creates complexity and means that extensive knowledge is required for competent action

Environmental protection

Established in 1978, the 'Blue Angel' ecolabel is owned by the German Federal Environment Ministry (BMU). The label is awarded to products that are classed as having less environmental impact, better functional characteristics in use, and less human health impact than comparable goods or services. The Federal Environment Agency (UBA) operates and administers the scheme together with the RAL gGmbH company. UBA develops the scheme's technical criteria, while RAL is commissioned to conduct the label award process. The award criteria are adopted by an independent Environmental Label Jury (*www.blauer-engel.de*).

Organic

The state 'Bio-Siegel' is awarded to organically farmed products and is based on the criteria of the EU's organic regulations, which define minimum standards for organically grown crops, animal welfare and product processing. The EU regulations also require stringent monitoring to prevent unfair competition. Many organic farms and organic processing businesses in Germany are members of one of the organic farming associations and have therefore undertaken to comply with the more stringent criteria of their organic association (information on the associations is at www.oekolandbau.de) (*www.bio-siegel.de*).

Fair trade

The organisation TransFair e. V. is an independent label initiative that awards the Fairtrade seal for fairly traded products on the basis of licence agreements. Fair trade involves a trading partnership based on fairness, respect, dialogue and transparency. It supports producers, for example by paying minimum prices above world market levels and by setting up marketing structures. In addition, a 'fair trade premium' is paid, providing partners with planning security so that they can invest in a sustainable future (*www.transfair.org*).

Sustainability in the wood industry

The Forest Stewardship Council (FSC), founded in 1993, implements the objectives of sustainable development in forest ecosystems worldwide. It is supported by well-known environmental and social organisations as well as many companies. A responsible wood industry avoids uncontrolled felling, infringement of human rights and damage to the environment. With the aid of 10 principles and 56 criteria, forest management and wood processing and trade are certified by the FSC and monitored by independent bodies (*www.fsc.org*).

Sustainable fisheries

The MSC quality label of the Marine Stewardship Council (MSC), an independent organisation, is awarded to sustainably operating fisheries. The quantity of fish caught must not exceed the reproduction rate. The process of fishing must not harm the structure, diversity or productivity of the ecosystem concerned and of all the species present. A certified fishery must produce a management plan that details how the ecological, legal and socio-political criteria are being met. The aim is to secure a natural diversity of fish and seafood species for future generations. MSC-certified fish is already available in many shops and supermarkets (*www.msc.org*).

American and on fish stocks in the world's oceans. It can be seen from many examples in books, magazines and the Internet that fish- and meat-free dishes can be both flavoursome and healthy and at the same time can make an important contribution to climate change mitigation and biological diversity.

The purchase of a product takes place at the end of a chain of activities that have implications for sustainability; this chain includes the extraction of raw materials and the production, processing and transport of consumer products. The purchase of a product is therefore merely one aspect of the various dimensions of consumption. The use and disposal of the product are other factors that are important to the link between consumption and biological diversity. For example, for how long do we use particular items of clothing? How do we dispose of organic waste? In their present forms all the above-mentioned factors tend to impact adversely on the conservation and development of biological diversity, and also on the climate and other services of nature. According to a study by BMU (2008), at least 20% of greenhouse-relevant carbon emissions in Germany arise from private consumption.

The award of labels for products and services usually seeks to highlight particular product characteristics and provide consumers with the information needed to make an environmentally aware purchasing decision *(Info Box 16*). The most well-known label in Germany is probably the 'Blue Angel', a scheme launched in 1978. In 2001 a state 'Bio-Siegel' was introduced in Germany for use on organically farmed products. Other marks that provide important guidance for consumer decisions include the Fairtrade label and the FSC and MSC labels. However, the sheer number of quality seals and the different criteria employed make it difficult for consumers to obtain a rapid overview of the situation. At the same time the complexity and variety hold considerable educational potential which could give rise to interesting and informative educational programmes.

The key topic of 'consumption' provides excellent opportunities for illustrating the interconnectedness of the various dimensions of sustainability (ecological, economic, social and cultural) and highlighting the role of biodiversity conservation in sustainable development. At the same time it is easy to relate it to the everyday lives of individuals and link it directly to specific behaviours, thereby teaching the capabilities needed for a sustainable consumption style. Since much consumption behaviour is largely a matter of habit and hence 'unconscious' – i.e. is performed without close thought – it is necessary to consider the responsibility of the individual consumer more carefully, reflecting on established action patterns and if necessary breaking them down into their constituent parts. By this means it is possible to counter the popular argument that ecologically responsible consumption always involves additional financial outlay; it can also be shown that people are prepared to pay a lot of money for environmentally damaging, non-sustainable products and activities

It is also important to highlight the links between private consumption and production, trade, advertising, food legislation, purchasing conditions etc. The role of policy-makers, companies, organisations and local authorities in promoting sustainable development also needs to be addressed on an equal footing with private consumption (*Info Boxes 17 and 18*). And that means thinking about the conditions that underpin non-sustainable global production and consumption patterns and the impact of these conditions on biological diversity – because they are shaped by humans.

The links between individual consumption behaviour and local and global biological diversity are complex, but precisely on this account they have great potential for informal learning and learning from the study of examples. Opportunities for reflection are provided by questions such as:

- What points do I consider when buying food and durable goods?

According to the Worldwatch Institute's 2010 report, the 65 high-income countries were responsible for 78% of expenditure on consumption in 2006 but represented only 16% of the world population.

- What is in a sustainable shopping basket? Does this shopping basket take account of biodiversity issues?
- As a consumer, what food-related opportunities do I have to contribute to the conservation of biological diversity – for example to the conservation of seed varieties and rare domestic animal breeds?
- What quality marks are there that relate to sustainable consumption, and what do they mean?
- How big is my own ecological footprint? What changes can I/we make to reduce it?
- What portion of my consumption meets my ‚basic needs' and what could I easily do without for the sake of conserving biological diversity?
- What does quality of life involve for me?
- How can ‚bad' habits be changed?

3 Starting points and didactic challenges for educational programmes

It will be clear from the above remarks that the issue of biological diversity is a highly complex one involving varied and intricate interactions (cf. Gilbert et al. 2006). At the same time, however, the preceding discussion suggests areas – such as nutrition, transport, leisure – in which it is entirely feasible to elaborate specific suggestions for sustainable behaviour. Educational processes provide the basis for people to explore the complex problems inherent in the issue of biological diversity and acquire the knowledge and skills that will enable them to actively engage in sustainable development.

Education for Sustainable Development is a discovery and learning process for everyone involved. Education and information programmes relating to biological diversity therefore cannot be developed and implemented on the basis of a standard structure or an educational formula; they must be individually designed for different educational settings and age groups. The planning of educational programmes must take account of the intended age group(s), reflect the specific context (circumstances affecting the specific situation and specific physical and social environment) and relate

Info Box 17

Masters' course 'A sustainable service and food industry'

The four-semester course addresses the issue of ‚a sustainable service and food industry' at a number of levels. It looks at the difficult balance between market requirements on the one hand and ecological and economic factors on the other. The responsible use of resources and the social acceptability of methods of production, processing and transport are critically examined. In addition, students analyse the market situation in the food industry and associated services. The focus is on how the demands of consumers and of policy-makers and the general public change and how businesses should respond to these changes. Another key area of the course considers methods for positioning sustainable products and services on the market. Nine companies in the sector and three foundations are involved; they are funding a Foundation Professor for Sustainable Development at the Münster University of Applied Sciences (*www.fh-muenster.de/nibupev/index.php*).

to the action area under consideration. Relevant experts and stakeholders involved in different activities within society – such as culture, the church, sport, welfare and business – should also be involved in the planning and running of educational programmes as appropriate. In this way different forms of knowledge, different types of experience and different opinions can be brought together and new 'learning landscapes' can be developed; these may involve new learning situations such as the weekly market, the Sunday walk or a visit to a farm (*see Info Box 19)*.

According to the psychology of learning, the most effective learning programmes are those that enable students to engage actively and in a hands-on way with the material and that aim to strengthen the individual's problem-solving abilities. Teaching and learning processes will fail in their purpose if students do not accept the problems being described as their own learning problem, because they do not expect the learning outcomes to expand their action options and life opportunities in any way. This means, therefore, that the selected problem area should involve a central local or global key topic relating to the importance of biological diversity and should be relevant to the everyday life of the students. However, wherever possible the perspective from the local to the global and back again should be borne in mind and explored.

The acquisition of factual knowledge alone is of little or no value in changing attitudes and action patterns. While knowledge of the facts about biological diversity is a necessary condition, it is only understanding of the complex interactions and global connections (system knowledge) that provides a sufficient basis for future competent involvement in decisions. To this must be added the ability to reflect on (cultural) values and on ethical issues of (intra- and intergenerational) distributive justice (orientation knowledge). In addition, people need to be helped to acquire information about alternative forms of action at both personal and societal level (action knowledge), so that they can understand the implications for their own everyday behaviour (*Info Boxes 19, 20 and 21*). It is also useful to impart predictive knowledge, since the effects of one's own positive or negative actions are often regarded as insignificant or may be far removed in either space or time; they therefore cannot be experienced directly and via one's own senses. These facts have far-reaching implications for judgement formation and the perception and evaluation of risk in relation to the loss of biological diversity.

Over and above knowledge of the various types described above, there are other factors to be taken into account when supporting decisions and actions that relate to the conservation and sustainable use of biological diversity. These other factors include:

- the importance of cultural and group-specific norms and values (e.g. images of nature) for the acceptance of conservation conditions or changed conditions of consumption,

The acquisition of factual knowledge alone is of little or no value in changing attitudes and action patterns.

Info Box 18

The climate cookbook – buy, cook and enjoy in climate-friendly ways

Our food production contributes more to global warming than road transport. Anyone interested in saving the planet will find simple recipes to follow here. It is all spiced with knowledgeable articles by climate experts who explain how our diet is damaging the climate and how we can find a way out of the food jungle on the basis of climate protection and sustainability (BUNDjugend 2009).

- infrastructure elements (e.g. a school garden, good range of organic food) and incentives (e.g. for low-impact tourism), and also

- the general conditions and distribution of responsibilities in the various areas of politics, business, administration and institutions (e.g. legislation).

As quality criteria for Education for Sustainable Development, various questions and points of view have been formulated (Adomßent & Stoltenberg 2011; de Haan n.d., NBBW 2008) that are of importance for the formation of action and organisational skills in the context of sustainable development processes. They relate in particular to the following areas:

- **People's relationship to nature**

  The relationship between people and nature is relevant to the way in which nature is treated; it is manifested in behaviour, which may involve the conservation and use of nature or its destruction. Our ideas of nature, our perceptions, interpretations and evaluations – e.g. of nature as 'natural' in the sense of untouched and wild or simply 'left to nature' – also have a crucial influence on the way we relate to nature and are reflected in everyday actions. Creating awareness of images of nature (see above) – whether these images are held by whole cultures and societies, by specific (sub)groups and roles or by individuals – is therefore an important part of the education process.

  Since reshaping and consolidating the relationship between humans and nature is a large-scale social and cultural task, educational programmes should also help to develop skills that are at risk of being lost from the everyday lives of many people. These skills include the ability to perceive, to engage with nature and with a diverse flora and fauna and to feel for oneself. What do locally grown, freshly harvested fruit and vegetables taste like? How do I feel after a tasty meal made with a small number of ingredients from the region? What is the effect on quality of life of a school garden that we have planned and laid out together? What do I know about the attitudes and preferences of others in relating to nature? Such experiences provide new ways of approaching the relationship between humans and nature and that between people in nature.

- **Ethical issues and standards**

  Education processes should increase participants' awareness of the diversity of the natural foundations of life (biodiversity) and the carrying capacity of our planet and should encourage reflection on conservation and use. It is therefore

Info Box 19

Bachelors' and Masters' course in organic farming

This course, which has been run at the University of Kassel since 2005, aims to provide a holistic, systematic view of natural relationships and the ways in which humans intervene in nature. It is intended to encourage responsible practice and help students acquire the skills needed to bridge the gap between environmental knowledge and environmental action. These goals are achieved through the various modules of the course, which are taught by tutors from various subject backgrounds. There are also excursions, practical exercises, 13 weeks' experience before the course starts and a four-month placement. The course has regional and international links (cooperation with universities in Göttingen and Fulda (Germany) and Switzerland and an exchange programme with ten European universities). The topics covered vary: current projects include the environmentally friendly production of renewable feedstocks and healthy food production in the megacities of West Africa. The external activities of the course include assistance to other universities in setting up similar courses (in Poland, Slovenia, the USA, Mexico etc.), the website, fairs and conferences, the specialist press etc. (*www.uni-kassel.de/agrar/bsc*).

important to address not only ethical issues and standards relating to human responsibility but also questions of human dignity and human rights, issues of intra- and intergenerational fairness and the distribution of life opportunities and quality of life in different parts of the world. To whom does biological diversity belong? What does global fairness mean in relation to the conservation and use of biological diversity?

- **Understanding retinity: learning to think and act in terms of connections**

  Complexity is a hallmark of the core problems of global change and hence of the key topics of sustainable development; this must be described and explained in teaching and learning situations. At the same time the problems selected for teaching purposes must be made didactically 'manageable'

Info Box 20

McMöhre ('McCarrots') – pupils take over the tuck shop

A healthy snack at breaktime? Of course – and it's fairly traded and organically grown too!

This project, which is being operated at secondary schools in Baden-Württemberg, involves setting up student companies that take over the tuck shop and sell sustainable products (organically and locally grown or fairly traded food items). A McMöhre student company is not simply about imparting facts but about active and long-term engagement with the subjects of healthy eating, organic farming and sustainable business. Pupils are supported by the project office of BUNDjugend from the initial planning stages right through to implementation. They receive assistance through advice on legal and organisational matters, links to contacts with external partners (organic bakery, organic farmers), involvement in regional networks, provision of background information, organisation of networking meetings for student companies and courses run by chefs on the subject of healthy eating (*www.mcmoehre-bawue.de*).

Info Box 21

Young people support the conservation of traditional extensive orchards – integration of sustainability dimensions

At the Leibniz high school in Östringen a project has been under way since 2006 that is helping to improve pupils' diet, raise their awareness of healthy eating issues and conserve the cultural landscape. The work also has a social angle, since it helps older people. In 2009 the pupils harvested 3,400 kilos of apples from traditional orchards, for which they received more than 2,000 litres of apple juice. This was sold, and donations to charity are made from the profits (Africa benefit event). The project benefits biology teaching, and also the teaching of geography/economics/social studies. Other beneficiaries are elderly owners of traditional orchards who are no longer able to harvest the fruit themselves and have no interested or available relatives to do the work for them. The orchards would in all probability have been neglected.

Complexity is a hallmark of the core problems of global change and hence of the key topics of sustainable development.

and geared to the specific circumstances and expectations of the learning group. The 'sustainability square' (Stoltenberg & Michelsen 1999) can be used as an aid in helping people to understand complexity. The square divides the actions of society into four areas – ecological, economic, social and cultural – for analytic purposes. It provides a means of describing approaches to biological diversity in more detail and of identifying and reflecting on situations in which conflict plays a part (see also BMZ & KMK 2008). In this way the links between the conservation of biological diversity and its sustainable use can also be explored.

- **Global cause-and-effect relationships and global responsibility**

Following on from the central core problems of global change that affect and also endanger human life (see Section 1), one of the tasks of educational events should be to explore global aspects of the subject of biological diversity. What global developments and circumstances affect biodiversity? Are the general conditions in place for global action through international agreements? What regulations are there at national level? What political action should be taken in the light of global responsibility (cf. Overwien & Rathenow 2009)? Another task, though, is to explore the local situation with its global connections. In what ways are the global cause-and-effect relationships that involve the increasing loss of biological diversity noticeable at regional level? And also: How do we perceive the loss of biological diversity at regional and local level and how do we evaluate it? Do these evaluations affect our consumption and leisure decisions (e.g. tourism)?

- **Specific opportunities for action as a contribution to the conservation and sustainable use of biological diversity**

Since Education for Sustainable Development aims to encourage people to become actively and responsibly involved in sustainable processes, participants should reflect on how they themselves can work with others to influence particular issues. Education programmes should therefore promote initiative and create opportunities for participation.

There are many openings for concrete action with regard to the use and conservation of biological diversity. It is extremely important to help individuals and groups develop a realistic action outlook. Identifying opportunities for action that are relatively easy to implement and do not require an extensive input of time or money ('low-cost actions') can be a first step towards behavioural change. This can be particularly useful since it is commonly felt that in the area of political lobbying or individual consumption decisions individual actions achieve only a minimal impact and that even taken as a whole they are therefore inadequate. This feeling applies both to possible harm arising from an action and to efforts to make a positive contribution, e.g. to conservation of the habitat of an endangered species. Perceptions and judgements of this type must be taken seriously and worked on, and their important role in the adoption of more sustainable modes of action must be highlighted *(Info Box 1)*. With regard to realistic options for action it is also necessary to counter popular arguments. For example, lack of time and/or material resources is often quoted as a reason for non-sustainable consumption behaviour. There are, however, many opportunities for action that conserve resources without necessarily involving significant time and/or financial expense. People may be motivated by examples that show that individual consumer decisions and consumption preferences lead or have led to changes in production processes.

The fundamental aim must be to identify or develop solutions that are positive and encouraging. It is even more effective if opportunities for action are implemented and tested by a group of people working together. For example, a group of school students can, for one or two weeks, try out a diet that actively contributes to climate change mitigation and provides an experience of the varied tastes associated with biological diversity. This can lead to many surprises, new insights, the dismantling of prejudices and engagement with contradictory situations and information.

In the context of action opportunities as a contribution to the conservation and sustainable use of biological diversity it is also important to address individual (i.e. person-related) conditions, social conditions (e.g. group norms) and external conditions (e.g. existing or lacking openings for action, political and legal circumstances). These conditions must be incorporated into the education process and analysed, and students must become aware of their effects. These are key preconditions for the necessary modification of behaviour and for permanent lifestyle change conducive to sustainable development.

The chosen ways of working should, as far as possible, involve self-directed learning processes, as in student companies (*Info Box 20*). Similarly, events should arouse participants' interest in complex situations and encourage them to think through all the implications; they should not result in people being demotivated or deterred by intricate scenarios. Competitions, such as the 'Discover Diversity!' competition for schoolchildren and young people (www.entdecke-die-vielfalt.de), can also be motivating and encourage deeper involvement. It is useful to incorporate case studies and to follow up any work with a presentation of the results and the cause-and-effect relationships identified. This can be done by using posters, mind maps or role play. Real-life encounters at local/regional level through field trips and excursions also form part of the successful educational process. These might include visits to botanical gardens, zoos, research institutions or a weekly market; other opportunities are provided by (school) farms or guided city tours offering a critical perspective on consumption. A variety of approaches can be adopted using interviews, discussions between people of different generations and simulation and planning games. Changes in perspective can be brought about by drawing on the experience and stories of people in other parts of the world or through role play (see e.g. www.34plus.de/unterricht/rollenspiel-klimapolitik.html), drama (*Info Box 22*) and fantasy journeys.

Info Box 22

'Ice Bear, Dr Ping and the Friends of the Earth' – the climate musical for children

The story is a simple one: Lothar the polar bear and Dr Ping, professor of the South Pole University, have a problem – the Earth has a temperature and its house is melting. So they set out to encourage people to help the climate. Trying to cool off briefly during the journey, Ice Bear climbs into Paula and Paul's refrigerator and is discovered. The two children learn about the problems at the North and South poles and decide to help.

The musical is available as an audio CD and as a playback CD for schools and children's groups who wish to perform the musical themselves. The accompanying book contains the text of the play, together with tips on performing the musical, a climate lexicon, experiments and suggestions for helping the climate, teaching ideas and information and addresses relating to climate protection and climate change (*www.bund.net/?id=1175*).

Finally, for guidance purposes it is worth mentioning some of the key quality criteria that are of importance when addressing the issues and challenges of biological diversity in the context of Education for Sustainable Development and that clearly promote the formation of action and organisational skills (cf. de Haan 2008, Adomßent & Stoltenberg 2011). It should be noted that this checklist needs to be extended and sorted according to subject and target group:

- Does the issue represent a key local or global theme of (non-) sustainable use of biological diversity?
- Is the connection between the conservation of biological diversity and its use addressed?
- Are aspects of global fairness considered?
- Are global connections highlighted in connection with the chosen issue and are these global connections also linked to local aspects?
- Are relationships between humans and nature addressed and reflected on from the point of view of biological diversity?
- Are links between the selected issue and the everyday lives (both private and work-related) of the participants discussed and reflected on?
- Does the educational work involve methodological approaches that not only facilitate the acquisition of knowledge but also specifically address attitudes, values and opportunities for action?
- Is opportunity provided to explore cultural influences on ways of looking at and evaluating biological diversity (e.g. the Eurocentric perspective)? Are attempts made to understand the perspective of others (outside one's own sub-group or one's own country/nation) and to reflect on the significance and evaluation of biological diversity from this perspective?
- Are positive, encouraging solutions and promising options for action identified and where possible tried out?
- Does the education programme provide opportunities for initiative and participation?

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Biological diversity is a major subject area in Education for Sustainable Development, the aim of which is to impart the values, competencies, knowledge and skills needed to shape a liveable future. This publication sets out the key topics of biological diversity. It goes on to suggest ways of addressing the topics in the context of educational programmes in a variety of learning settings and with different target groups. It is hoped that the publication will provide guidance for practitioners and serve as a sourcebook for multipliers and educational policy-makers when formulating curricula and educational programmes. The text includes practical examples drawn from learning situations.

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