Forests, Trees and Human Health

Kjell Nilsson • Marcus Sangster • Christos Gallis •
Terry Hartig • Sjerp de Vries • Klaus Seeland •
Jasper Schipperijn
Editors

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Editors
Kjell Nilsson
University of Copenhagen
Forest & Landscape Denmark
Department of Parks and Urban Landscapes
Rolighedsvej 23
1958 Frederiksberg C
Denmark
KJNI@life.ku.dk

Marcus Sangster
Forestry Commission
Land Use and Social Research
Corstorphine Road 231
EH12 7AT Edinburgh
United Kingdom
marcus.sangster@forestry.gsi.gov.uk

Christos Gallis
Forest Research Institute
National Agricultural Research Foundatio
57006 Thessaloniki
Greece
cgalis@fri.gr

Terry Hartig
Uppsala University
Institute for Housing and Urban Research
Radhustorget 1
80320 Gävle
Sweden
terry.hartig@ibf.uu.se

Sjerp de Vries
Wageningen UR
Alterra
6700 AA Wageningen
Netherlands
Sjerp.deVries@wur.nl

Klaus Seeland
Swiss Federal Institute of Technology
Group Society, Environment & Culture
Sonneggstrasse 33, SOL E
9092 Zurich
Switzerland
klaus.seeland@env.ethz.ch

Jasper Schipperijn
University of Southern Denmark
Institute for Sport Science and Clinical Biomechanics
Øster Farimagsgade 5 A
1353 Copenhagen K
Denmark
jschipperijn@health.sdu.dk

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Preface

The histories of European civilization and European forests are closely intertwined. Prior to industrialization wood, fodder and food from forests helped support our rural economies. Since then forest management has continuously adapted to meet the needs of industry and of urbanized society. Today cultural, amenity and environmental objectives inform all forest management, reflecting the concerns and requirements of contemporary society.

In the late twentieth Century lifestyle-related health problems emerged as an important new concern in all developed countries. Should this lead to a new objective for forestry in Europe? Can forests and forest management help in the promotion of healthier lifestyles and improved mental health?

This book summarizes research on these questions. Between 2004 and 2008 some 160 scientists from 24 European countries, with contributors from Asia, Australia, Canada and the United States, worked together in COST Action E39 'Forests, Trees and Human Health and Wellbeing' to promote our understanding of how forests contribute to health in Europe and elsewhere.

Funded by the EU through the European Science Foundation, COST is an intergovernmental framework for European Cooperation in Science and Technology. Its function is to encourage coordination of nationally funded research on a European level so that Europe will continue to hold a strong position in scientific and technical research.

In addition to this book, which has many contributors, the scientists and professionals in COST Action E39 prepared state-of-the-art reports on national research initiatives concerned with forests and health. National health policies and priorities of European countries have been described and the possibilities for forestry to help meet them have been analyzed.

A successful COST action leads to continuing collaboration. Members of the action continue to work together in new primary research and have produced individual and jointly authored peer-reviewed papers in international scientific journals. International co-operation continues between researchers from the USA, Australia and Asia through joint arrangements with IUFRO and ASEM.

Coordinating such a large group of participants has been a major task made possible by the professionalism, commitment and hard work of the COST secretariat

in Brussels. Particular thanks are due to Arne Been and Günter Siegel, and most recently to Melae Langbein.

We gratefully acknowledge the help of Cecil Konijnendijk and Chris Baines, who facilitated and edited our efforts towards identifying future research needs. Jasper Schipperijn played an invaluable role in coordinating the final text and liaising with our publishers.

This action not only encompassed many different countries it was also highly interdisciplinary. The leaders of the five working groups in E39 appear here as editors (Part I – Christos Gallis, Part II – Terry Hartig, Part III – Sjerp de Vries, Part IV – Klaus Seeland, Paul Mitchell-Banks/Fabio Sabitano) in cooperation with the Action's chairman and vice-chair. Over the slightly more than 4 years of the Action their leadership and inspiration has helped us navigate the rocks and shallows on which so many multi-disciplinary projects can founder.

Forests and woods occupy about 30% of the land area of Europe and extend from the centers of our towns to the most remote areas. Most forests are accessible at little or no cost. If by encouraging a new way of seeing forests, as a resource for health, we have made a difference in the quality of life of people in Europe then all participants of COST Action E39 have reason to take pride and find encouragement for future work in the field.

Kjell Nilsson
Chairman, COST E39

Marcus Sangster
Vice-chair, COST E39

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Forests, Trees and Human Health and Well-being: Introduction

Kjell Nilsson, Marcus Sangster, and Cecil C. Konijnendijk

1.1 Background

Traditional medical and public health approaches to illness and health are among the successes of modern science. However, society today is faced with the increasing incidence of various forms of poor health related to modern lifestyles. Contributing factors include an increasingly sedentary population, increasing levels of psychological stress related to urban living and contemporary work practices. In addition people with disabilities and chronic illness demand a transition from institutional care to care in society. These problems encourage thinking about alternative ways to prevent disease and promote health. Lack of physical activity and stress have led to increased occurrence of certain diseases where medication is perhaps only reducing the symptoms rather than combating the true cases of illness and reduced quality of life. Efforts to promote public health and well-being in Europe have thus become increasingly complex.

Natural outdoor areas and natural elements such as forests, parks, trees and gardens are known to provide opportunities to enhance public health and well-being (Photo 1.1). For example, activities in natural outdoor environments are intuitively known to be good for mental and physical health. But we lack knowledge on many aspects of this positive relationship between nature and health. What are the precise effects and mechanisms? Which outdoor environments or interactions with plants or animals work best for whom? The structured, empirical knowledge that exists has accumulated slowly, developed by research groups in disciplines as diverse as environmental psychology, landscape architecture, forestry and epidemiology, and without the wealth of resources so commonly made available to research in medical fields.

K. Nilsson (✉) and C.C. Konijnendijk
University of Copenhagen, Forest & Landscape Denmark, Frederiksberg, Denmark
e-mail: kjni@life.ku.dk; cck@life.ku.dk

M. Sangster
Forestry Commission, Land Use and Social Research, Edinburgh, United Kingdom
e-mail: marcus.sangster@forestry.gsi.gov.uk

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Photo 1.1 Natural elements such as big trees and access to the sea are known to be good for mental and physical health (Photo: Kjell Nilsson)

1.2 Fragmented Research

In 2001, Dr Karen Henwood at the School of Medicine, Health Policy and Practice, University of East Anglia reviewed the international literature for the UK Government. Her aim was to assess the evidence linking natural environments to human health. She found that there was a large body of literature supporting such links. However, the published literature had a strong US focus. The subject was less well covered in the European health and health policy literature.

However, in various European countries, including Sweden, Denmark, Norway, the UK and the Netherlands, substantial activity in the field was ongoing in 2001.

The research activities were spanning a wide range of culturally embedded practices such as the requirement for a proportion of formal education to be in an outdoor setting, as is found in Scandinavian countries; the use of forest environments as part of the therapy for children with behavioral difficulties in the UK; and, scientifically evaluated initiatives as pioneered in Sweden.

Much of this activity was related to domestic health policy, and was often empirical or with a practical emphasis. It tended to be circulated domestically and was not written up in the international literature or was scattered across journals from many disciplines. It did not fit easily with mainstream health journals that give emphasis to medical and theoretical writing or with the forestry and environmental literature. The fragmentation and national focus of ongoing research, as well as debates on health policy across Europe at start of this millennium, showed that this was an emerging scientific field that would clearly benefit from more trans-European cooperation and coordination.

Scientific evidence and understanding in this field requires crosscutting collaboration between researchers in health, environment and social science, and through close involvement of implementing agencies and practitioners. It seems that the reasons why the research on this area is limited, or research is not being fully recorded at present, include (a) that sector-based funding bodies do not feel mandated to support crosscutting research and (b) that environmental scientists have little profile in medical science.

1.3 COST Action E39 – Forests, Trees and Human Health and Well-Being

The European Cooperation in Science and Technology (COST) is one of the longest-running European instruments supporting cooperation among scientists and researchers across Europe. To bring together European researchers working with various aspects of the relation between nature and health, COST Action E39 'Forests, Trees, and Human Health and Well-being' started in 2004 and lasted until 2008.

The Action had a strong role in drawing attention to and acknowledging the importance of existing national activities, encouraging new research in this area. Many national activities are culturally embedded, so that practitioners might not realize that they are internationally relevant. For example, in Sweden there is a long-established network of therapeutic gardens, and in Finland, Norway and Sweden there are programs for taking children into forests and the natural environment as part of their normal schooling. Similar programs have been identified in Denmark, Estonia and in Germany. The UK has national programs promoting outdoor exercise, evaluated by Oxford Brookes University. This COST Action provided an important opportunity to bring such domestic activities into the international light, as well as giving researchers interested in more basic science of nature and an opportunity to gather together with practitioners.

1.3.1 Objectives

The main objective of the Action was to increase the knowledge about the contribution that forests, trees and natural places make, and might make, to the health and well-being of people in Europe. Secondary objectives were:

- To identify and record key lessons from national research and initiatives to promote forests and health
- To set out the key health priorities identified within European countries and the possibility for forestry to contribute to meeting them
- To gain experiences from good practice
- To join efforts to set up innovative, international research and development projects within this field
- To engage health policy interests in the identification of information gaps in this field
- To develop a network of researchers and research institutions in forestry, health, environment and the social sciences

1.3.2 Scientific Approach

Scientifically the Action covered quantitative and qualitative scientific approaches and economic analysis. In order to develop a broad evidence base the Action has drawn on numerate disciplines such as epidemiology and physiology and on phenomenological disciplines such as psychology and social geography. A description and evaluation of the institutional aspects of health and forestry has also been pursued.

In respect of spatial aspects, the Action has covered all forests, recognizing that there are likely to be differences in the contributions of forests in remote or wilderness areas and those close to and within urban areas, including urban forests. More than 75% of Europeans live in and around towns, so their regular access will be to forests close to urban areas. But a number of national surveys have shown that more remote forests are also highly valued by urban populations.

When looking at the direct contribution of forest products, e.g., pharmaceuticals from forest plants, process-related aspects such as the cultural and social aspects of gathering berries and fungi, have been included.

1.3.2.1 Crosscutting Approaches

Health and the environment each have their own professions and stakeholders and have distinctive research cultures. An important part of the Action therefore has been to explore opportunities and barriers to cross-disciplinary working. This was based on an exploration of how the different disciplines and research cultures might address research questions identified by the group, and identification of common ground.

The Action consisted of a network of approximately 160 researchers from 24 different countries, spanning health, environment, forestry and social science. The Action has encouraged crosscutting approaches not only across the environmental and health sectors but also within them. Within health research, for example, physical exercise is accepted as a vital contributor to physical health and prevention of illness. But it is increasingly recognized that there are psychosocial pathways to physical health and illness prevention. Within the social sciences there is an increasing interest in embodiment – the physical aspects of self. Mental and physical health are therefore increasingly recognized as interlinked.

There is considerable scope for engaging economists from across different sectors and countries. The economic implications of any positive contribution to health are likely to be substantial. For example, the Scottish Executive in the UK reports that typical medical treatments of one individual diagnosed as liable to heart attack costs approximately €21,000 over 5 years. On the other hand, inexpensive and enjoyable physical activity can be expected to reduce the risks of heart attack, stroke and diabetes by 50%, and colon and breast cancer by 30%. Economists in both the health and environmental sectors have to deal with complex valuations of social benefits. The Action has been an opportunity to draw such experience together.

1.4 A New Perspective on Human Health and Well-Being

Public health and modern medicine are continuously making progress in fighting diseases and ill health. However the majority of all causes of ill health, disease and premature death in Europe cannot be explained from simple relationships, such as proximity to pathogenic bacteria or genetic factors. An increasing number of future health hazards relate to our lifestyles, which are more sedentary, more stressful, and increasingly oriented indoors. A large part of the population is overweight and many diseases are related to this. Depression and pain are in greater focus, as they have a major impact on the number of years lived in good health.

There is a growing awareness of the multiple linkages between health and its various determinants, at individual as well as population level. The need for and value of intersectoral action between health and other sectors is increasingly recognized in Europe. It is also recognized that the complex nature of many health determinants and their interplay with social factors require more multi- and interdisciplinary efforts. Politicians and citizens seem to be increasingly attracted to a broader concept of health, which incorporates well-being and the quality of life.

Healthier societies offer potential long-term social and economic benefits and are therefore a main aim of international and national policy makers. Strategies for health-friendly decision making are led by organizations such as the World Health Organization (WHO). Apart from concentrating on special target groups, such as children, these strategies reflect more focus on prevention and thus take a more proactive stance. More attention is given to factors that determine health instead of diseases themselves. New health strategies look at the full magnitude of health

effects and their distribution across the population, contrasting this distribution with the allocation of benefits.

The positive (or salutogenic) effects of the relationships between nature and health are largely unexplored due to a focus on negative effects of environment on health. Yet there is a very long-established view that personal contact with plants, animals and natural green surroundings can benefit human health and well-being. The importance of this is being seen as increasingly important as the human habitat becomes more urbanized. These interactions may have been somewhat overlooked so far in the public health debate, perhaps partly because of lack of awareness and of hard evidence on effects and mechanisms at work. The range of different public health benefits is wide and varied and their full extent needs to be better understood and more effectively communicated.

Contact with the natural environment can provide an antidote to some of the unhealthy aspects of an urban lifestyle, and there is a growing realization that this should influence the way that our surroundings are planned and managed (Photo 1.2). Trees and other vegetation have been used in traditional, modern and alternative medicine as sources of pharmaceuticals and other chemicals. But they also help to moderate the effects of other physical environmental factors by acting as a biological buffer. They can filter potentially harmful air pollution and solar radiation, they provide natural shelter against the wind and they help to cool and moisten the air. Contact with nature and contacts with animals and plants can have a powerful therapeutic or preventative effect on many people, by reducing stress and helping to

Photo 1.2 Green spaces designed with nature like a Heempark in the Hague can provide antidote to some of the unhealthy aspects of an urban lifestyle (Photo: Kjell Nilsson)

Photo 1.3 Old ladies enjoying life in the Deer Park outside Copenhagen (Photo: Kjell Nilsson)

improve both mental and physical ability. Moreover, access to natural green spaces, particularly if they are conveniently close to work or home, may provide a supportive setting for physical exercise and restorative relaxation (Photo 1.3).

1.5 Health-Related Products from Natural Sources

Plants, including trees, have traditionally been used by conventional and alternative medicine as a source of many different pharmaceuticals, as well as a source of other chemical products. However, there is a great scope for using more advanced techniques in order to identify and extract a greater range of natural products beneficial to health.

Europe's sustainably managed forests and other green areas provide a wide range of products. Trees, besides timber, produce large quantities of wood residues, foliage, twigs, and bark produced during harvesting and manufacturing. Trees have through evolution developed unique chemical defense systems based on advanced functional molecules. Thus trees are exceptionally rich in bioactive, protective substances. Bioactive compounds found in trees include flavonoids, lignans, stilbenes, terpenoids, phytosterols, fatty acids and vitamins which are known to exert many beneficial effects, for example, antioxidant, anticarcinogenic, and estrogenic effects.

Some bioactive compounds can be used as nutraceuticals, that is, a combination of nutrition and pharmaceuticals. These can contribute to public health as ingredients in

dietary supplements and health-promoting 'functional' foods and as pharmaceuticals. In fact, such forest-derived health products have already been developed and marketed at a commercial scale. Xylitol products, for example, promote dental health, while sitosterol products lower cholesterol levels and consequently prevent cardiovascular diseases. Pycnogenol is the trade name for an extract from the bark of the maritime pine growing in France. It is a powerful antioxidant and its impacts on cardiovascular health, skincare, diabetes and inflammations, among others, are studied. In 2006 a new lignan product came on the dietary supplement market. The HMR lignan is extracted from knots (the place where a branch is attached to a tree) in spruce trees and can inhibit the development and growth of hormone-related cancer forms (breast, prostate and colon cancers). It is also a strong antioxidant with estrogenic properties. These three products are extracted from process waste streams in the forest industry and are thus contributing to a more efficient use of natural resources.

Although especially forests represent large natural pharmacies by virtue of their enormous source of tree and plant material with known or potential medicinal or nutritional value, more research is still needed to identify and develop the best applications and products. Nutritional supplements and functional foods are currently of high research interest and are recognized internationally as potential health-promoting agents if consumed on a regular basis and at effective levels. The polyphenols which are particularly abundant in knots and bark have potential not only as health-promoting substances but also as technical antioxidants and biocides. There is also potential in using natural, traditionally known extracts from trees as health-promoting products offered locally by enterprises in rural areas. Examples of such products are pine bark as an ingredient in bread and birch sap as a drink or syrup.

1.6 Therapeutic Interactions: Plants and Landscapes, Garden Therapy and Ecotherapy

As seen, the role of nature, gardens and plants in the improvement of ill health and the maintenance and fortification of good health is not a new phenomenon. Recent studies on these salutogenic effects of the green environment have shown that nature can lower stress levels, restore powers of concentration, and alleviate irritability, while correlations with strengthening of muscles and preventing aches and pain all over the body have also been noted.

Horticultural therapy can be defined as a process by which individuals may improve well-being using the garden environment by passive involvement, through stimulation of the senses, or by active involvement, through the practice of horticulture (Photo 1.4). Taking place in therapeutic gardens, horticultural therapy has its origins in the rehabilitation of British and American soldiers returning from the Second World War. It has a strong focus on healing effects of meaningful activities in the pleasant environment offered by a garden, such as weeding, raking and sowing. This shows its close links with occupational therapy. Distinct values of horticulture to support the healing process include people's physical dependency

Photo 1.4 The healing garden in Alnarp, Sweden. In horticultural therapy both the garden environment and the practice of horticulture are used for improving the individual's well-being (Photo: Kjell Nilsson)

on plants (related to harvesting crops for food and the like), observing beauty, nurturing of life, and social interaction. There is also growing attention to the key elements of ecotherapy or conservation therapy based on the active participation of all those involved in effective conservation or habitat development work, through the collaborative efforts of group participants. These meaningful activities carry a social value in terms of the participants' own community integration and in terms of social capital through public green space establishment.

A challenge is that there is still a need for a sound basis of evidence as to the health effects and mechanisms. Research must involve health outcomes related to therapy settings (for example, a garden or a forest) as compared to results from clinical therapeutic activities. Very few studies so far have reached a standard that can constitute a basis for evidence-based medicine.

Having said this, various relevant theories have been developed. One focus has been on restorative experiences, such as captured in the attention-restoration theory. This theory explains how natural environments can help people renew a depleted capacity for focusing attention. Good restorative environments should enable experiences such as being away, fascination, and compatibility. The aesthetic-affective theory looks at stress reducing effects of nature as a matter of unconscious processes initiated in the oldest, emotion-driven parts of the brain. The scope of meaning/scope of action theory studies how the surrounding environment communicates with visitor on many levels. Less known and still largely untested theories include that of phytoresonance, which looks at the influence of plant qualities on the human experience and the human

reaction to plants. This ranges from passive, merely being outside, to active participation, actively working with plants and soil. Active participation is thought to help develop self esteem, as well as practical, social and emotional skills.

1.7 Land Use, Accessibility to Green Areas and Health Effects

Although the general feeling is that nature is good for people's health, nature is not yet widely used for health promotion by public authorities. Green space nearby is often seen as a luxury rather than a necessity, especially in urban areas where the competition for land is intense. Current views on urban densification have led to even greater pressure on remaining open spaces.

Recent studies have looked into accessibility to and use of nature on (self-reported) human health and well-being (Photo 1.5). Studies that compared health indicators with access to green spaces in Denmark, The Netherlands and Sweden, for example, found that both health and well-being were better among people who regularly visited nearby nature and green spaces. A short distance to nearby green areas was associated with the number of visits, and subsequently with lower levels of stress. Moreover, people with a garden of their own were found to be less affected by stress.

Although links between green space and health are increasingly well established, little is known about whether nearby nature has an independent causal effect on

Photo 1.5 Accessibility for elderly and disabled people is an important factor in the design of green spaces (Photo: Kjell Nilsson)

Photo 1.6 Physical exercise is good for health, but does it make a difference if the activity is carried out in the open air or in a fitness centre? (Photo: Kjell Nilsson)

human health or not. Based on the available evidence such a causal effect is plausible. Suggested mechanisms are, amongst others, improving air quality, reducing stress, stimulating physical activity (Photos 1.6–1.8), and facilitating social cohesion within neighbourhoods. It is unclear which, if any, of the suggested mechanisms are the most important in terms of generating health benefits. However, it is already obvious that the way to optimise the health effects of local greenery depends strongly on the mechanism that is operative. Using natural elements to catch fine dust will lead to a different optimal green structure then using such elements to create a green oasis to relax and recover.

Past research mainly falls into one of two categories. The first is experimental research, especially on stress reduction and attention restoration. Many of these studies focus on short-term stress reduction, with stress being induced within the experimental setting. Furthermore, usually a crude distinction is made between a natural and a built-up environment, often represented by slides or videos.

Photo 1.7 The Common Park in Copenhagen is popular for jogging (Photo: Kjell Nilsson)

Photo 1.8 Volleyball is a perfect physical activity in the park as well as on the beach (Photo: Kjell Nilsson)

Based on this line of research it is difficult to say: (a) what the (size of) long-term health benefits of exposure to nearby nature in the residential or working environment will be, (b) what type of nature will work best, (c) how much of this type of nature is needed, and (d) whether there are additional requirements that should be fulfilled. With regard to the last aspect, the social safety of green areas comes to mind, especially in an urban setting. The second type of research is correlational in nature (surveys, epidemiological studies). It is better suited to give an impression of the size of long-term effects of nearby nature in a real-life situation. However, the causality of the observed relationships is usually difficult, if not impossible to establish. Furthermore, within this line of research there has been little theoretical development to date. Indicators for the local supply of green spaces tend to vary from study to study, without clear theoretical underpinning. A common quantification method is absent, not only in terms of local supply of greenery, but also regarding health outcomes, making comparisons between studies difficult.

As mentioned, more evidence is needed on (the size of) health-promoting and salutogenic effects of different natural outdoor settings in general. Only in this way can 'nature's health service' be properly understood and promoted, for example as part of new strategies for health promotion. The positive links between environment and health will provide a valuable addition to the rather extensive body of evidence of the harmful effects of the environment on human health. Obviously best possible use should be made of data that is already available.

1.8 Settlements and Localities: Health and Nature Where We Live

As mentioned in the previous section, nearby nature plays a very important role in the linkages between outdoor environments and human health and well-being (Photo 1.9). Nearby nature consists of the natural elements and features that people encounter in and around those settings of everyday life in which they spend much of their time, including residential settings, the workplace, and schools. Empirically we can see that people make most use of outdoor spaces that are nearby, in particular if they are close to home, engender a sense of security and ownership, and are attractive. Knowledge of the health benefits of nearby nature can support the design of interventions that serve multiple sustainability goals.

If we wish to deliver public benefit by encouraging activity in nearby natural settings and through contact with animals and greenery then we need to consider how to: compete with people's other interests and calls on their time; motivate and sustain particular behaviours; design and promote appropriate places; identify and target different groups (i.e. segmentation); and fit our activities into the context of wider health objectives.

There is considerable research to show that urban green space is frequently inaccessible. Reasons include physical barriers such as transport corridors, informational barriers where people do not know of areas or of the possibility of using them, disability,

Photo 1.9 During weekends people leave their apartments in St Petersburg, Russia, for an excursion to one of the state forests (Photo: Kjell Nilsson)

ownership issues, particular behavioural problems where the activities of one group exclude others, and barriers related to unattractive or inappropriate layout, location, design and infrastructure. Access requires infrastructure internally and also externally, leading into the area. Green spaces must be attractive to users and have facilities appropriate to the main objective. For example, if we wish to encourage socialising in towns, then small urban parks might be the best option. Differentiation applies both to spaces and activities and to the social groups for whom they are provided. We need research to understand the health benefits of different structures and infrastructures, to establish the scale and scope of benefits (including economic analysis when possible). There is a large body of social research from which it is possible to say that the distinction between rural and urban people is one of location, not of values. Nowadays, people in rural areas are likely to have very similar life-styles and attitudes to urban dwellers, at least in a European context.

Special attention in future research should be directed towards groups such as children, the elderly and ethnic minorities, who may have special needs that can be satisfied by nearby nature. Approaches need to be differentiated and tailored to the needs of these and other specific social groups. In the case of children, for example, there are concerns about the impact of a culture of safety and low risk that constrains children's access to outdoor environments, both urban and natural spaces. Across Europe there are considerable differences in the way that children are allowed to access the outdoors, in their 'mobility', and also cultural differences in the way that perceptions of danger and concerns about safety impact on children. Cultural diversity of Europe and the probability that immigrant groups are likely to have different perceptions and needs in respect to nature interactions also need study. More data is needed to take account of the needs of ethnic minority groups; this is related to issues of governance and social inclusion.

1.9 Health Policies and Economics

Public policies in many sectors have important health implications. These implications are not always properly assessed and considered. Given the importance of improving health and well-being and minimising adverse health effects, it is necessary that consequences are addressed when developing public policy. Gradually, the links between 'green' and 'health' are gaining more interest from international and national policy-makers. In several European countries, reviews have been carried out or are underway to describe the (research) state-of-art on nature and health, in order to provide a basis for policy. In these reviews, both the direct and indirect influences of nature on health and well-being are given attention.

Agriculture and forestry play important roles in linking outdoor environments and health. These roles have changed fundamentally in Europe in the last decades, and the multifunctional character of the agriculture and forestry sectors has become stressed. According to the Organization of Economic and Cooperation Development (OECD), multifunctionality refers to the fact that an economic activity may have multiple outputs, and, by virtue of this way, may contribute to several societal objectives at once. At present, however, mainstream discussions of multifunctionality in agriculture and forestry tend to neglect the health and sometimes also the social values of activities associated with nature. Yet, better opportunities for focusing on services such as those related to human health and well-being have emerged, for example due to increasing societal demands, higher awareness about alternative marketable outputs, and the 'crisis' of traditional agriculture. European policies in the framework of rural development have encouraged and supported diversification in agricultural enterprises. For example, the health and social services provided by care farms in The Netherlands and other countries are seen as a way to promote diversification and to escape from the impacts of globalisation on agricultural markets resulting in a constant demand for increased farm specialisation. Diversification refers to those situations in which, for example, an agricultural enterprise runs production activities in different economic sectors.

Another issue is how to assess the value of the benefits resulting from green care and other 'green-health' interactions. This requires the development of evaluative systems to quantify the costs and benefits of interventions. Presently public funds are still the main source of direct and indirect payments for green care services. As often in the case where non-market services are provided, payments which are made are mostly related to inputs rather than to outputs.

Decision-makers need to be supplied with sound evidence that provides further insight into the various effects, positive as well as negative, of nature on health. Most empirical research on positive linkages to date relates to the (short-term) effect on recovery from stress and attention fatigue. However, there has been very limited methodologically sound empirical research into links between nature and (generic) health indicators. More studies on these and other topics should be part of the development of a knowledge infrastructure which should consist of compilation research data and practical examples (good practices), a programme for further knowledge generation, as well as a coordination structure. The roles of the different actors involved should be made clear, for example in terms of responsibilities and financing.

As mentioned, there is a need for better evaluative frameworks for green care and other nature-health initiatives. Without an overview of the economic dimensions of these activities, it will be difficult to promote them in a policy setting. Better analysis of the economic dimensions should look at monetary as well as non-monetary aspects, issues of social responsibility, consider impacts on local level, and so forth. These assessments will need to be multidisciplinary and look at the relationship between nature and health in a wide range of contexts and under varying types of financing.

1.10 Future Research Needs

The Action found that nature-based approaches can contribute significantly to health objectives in Europe by ensuring that people have contact with nature in their everyday lives and that nature would be an integral feature of health care environments and approaches. More effective coordination and communication of existing knowledge and understanding, combined with increased investment in new research, is necessary to capitalise on the benefits of nature-based approaches.

The following key findings regarding future research needs have been identified:

1. There is suggestive evidence of *substantial economic benefits* arising from lower rates of illness and a reduced requirement for medical interventions. Because of the potential scale of the savings a concerted, Europe-wide effort to understand the costs and benefits is called for. The current scale of research is disproportionately small relative to the potential public benefit.
2. European *forests appear to be an important asset for health*, the economic value of which has not been understood in health policy or in forest policy. Forests are accessible to the public and can be used to benefit health at little or no cost to the individual or to the public purse.

3. Access to nature should be considered in *public health policy in Europe*. There are examples of national custom and national practice that could be adopted more widely.
4. There are strong, well recognized links between *social and environmental deprivation and poor health*. Urban forestry and urban green space is a means of rapid improvement to poor environments and thus is likely to improve health outcomes in deprived areas.
5. There are *highly positive differential benefits* where less mobile groups such as children, the elderly, disabled people and poor people are likely to gain particular benefit from policies that promote local green space and woodlands as a resource for health and fitness.
6. *Current policy* on health and the environment over-emphasizes environmental hazards and neglects the potential for natural environments to make very large positive contributions to health. In addition the emphasis on hazards creates behavioral barriers to public use of, and public benefit from green space.
7. Access to nature and natural places can be a central theme in promoting contemporary *lifestyle-based public health approaches*.
8. A more *persuasive evidence base* is needed on the links between natural outdoor environments and human health and wellbeing. Studies should investigate the mechanisms at work, and look at effects for different target groups.
9. Questions about health deriving from contact with nature should be incorporated into *national health surveys*.
10. Health should be a *central theme in urban and land-use planning*, for example, in debates about urban densification. Effort spent in developing tools and strategies that integrate healthy lifestyles into urban planning and green space management will be well repaid.
11. New research should be based on a more *comprehensive catalogue of existing studies*. Substantial research has been carried out, but it is widely dispersed. Findings need to be cross-referenced, for example, against other health care and epidemiological research.
12. Future research requires *common theoretical frameworks and more robust methodologies*. Some high quality studies now exist, but broader application of more rigorous methods will lead to greater acceptance in medical and related fields. Common frameworks, definitions and methodologies will enable cross-border comparisons.
13. More knowledge is needed about *health-related products and commodities from nature*. Multidisciplinary work should cover the process from identification of promising substances to their commercialization.
14. *Cross-sectoral, multidisciplinary research* is needed. Areas for future research include the health benefits of outdoor environments, as well as issues such as food security and quality, and environmental protection.
15. *European research* on nature and health is increasing rapidly but its multi-disciplinary nature reduces its visibility and impact. It is reported in several different areas of scientific literature and there is a case for establishing a high-quality journal to bring such research together in one place.

1.11 Structure of the Book, and the Action: Five Themes

The Action and this book are organized in five themes. Part I, *Forest Products and Environmental Services*, consists of three chapters and deals with the direct and in-direct effects and contribution of the forest derived pharmaceuticals, herbs, fruits, fungi, organic certified products, and other wood and non-wood forest products on human health and well-being, economical and social development, alternative medicine and industry. Their preventive, nutraceutical, therapeutic and healing values and benefits in relation to forest environment will be addressed. Negative and hazardous aspects of forest environment substances on human health will also be a subject for discussion.

Part II, *Physical and Mental Health and the Experience of Nature*, consists of three chapters and addresses the question 'how do forests and trees contribute to health and well-being?' The question has three aspects. One aspect of the question concerns the effects or outcomes of transactions between people and trees or forests. Work related to this aspect involves specifying the physical and mental health benefits of trees and forests for individuals and populations. The second aspect of the question concerns processes. Work related to this aspect involves describing the physical, behavioral, psychological and social processes through which trees and forests have physical and mental health effects on individuals and populations, as well as the characteristics of individuals and the contextual factors which modify those processes. The third aspect of the question concerns identifying those forms of variation in trees and forests that are relevant for processes related to health and well-being.

Part III, *Promoting Physical Activity*, contains three chapters and deals with the contributions that forests and other natural areas may make towards human health and wellbeing, related to the physical activities that are undertaken within (or travelling to) this type of environment. The beneficial effects of physical activity on human health are well documented. Much less is known about to what extent offering attractive and nearby natural settings will lead to people becoming more physically active, especially during leisure time (higher frequency, longer duration and/or higher intensity). Also it is not clear whether the same physical activity, when undertaken in a natural setting, has a larger effect on human health and wellbeing than when undertaken in an indoor setting, e.g. a treadmill in fitness centre. Finally, even if offering natural settings does not lead to more activity, and performing the activity by itself is not healthier when done so in a natural setting, then it may still be the case that it leads to spending more time in a natural environment.

Part IV, *Therapeutical and Educational Aspects*, holds two chapters and discusses the healing power and therapeutic aspects of forests, trees and related green spaces for human health and wellbeing are gaining momentum in the post-industrial societies of Europe as in other developed economies of the world. Forests and trees as representations of the natural world have often proved to be counterbalancing the negative effects of stress ridden societies whose lifestyles are dominated by high technology and virtual worlds. Daily life is predominantly lived indoors and outdoor

activities are performed in people's past time only. Outdoor recreation has become an important factor of a healthy living and a remedy against the deficiencies of a modern life world separated from nature.

And finally Part V, *Forest and Health Policies and Economics*, consists of one chapter that deals with the economic value of health benefits from forests and trees. Health issues are one of the largest expenditures in public budgets in any European country today. Thus there is a need to strive for the more efficient treatments, methods, etc. We need to know with certainty if costs and benefits in using the forest as basis for rehabilitation are favorable to the use of institutionalized procedures.

Finally, in a post script, the need for focus on a sixth theme, the cultural dimension in the landscape, is addressed.

Part I
Forest Products and Environmental Services

Chapter 2
Urban Forests and Their Ecosystem Services in Relation to Human Health

Giovanni Sanesi, Christos Gallis, and Hans Dieter Kasperidus

Abstract In this chapter we briefly discuss the concept of forest taking into account the provision of different goods and services. We provide some technical information on the forest classification systems adopted in Europe which are then reflected in the different roles and meanings that Europeans give to forests. We give a special emphasis to urban forests considering their origins, typologies and indicators. The importance of urban forests is analyzed including the role that forest areas and green spaces can play in contemporary (sustainable) cities. Different citizens' attitudes towards urban environment are also discussed considering the cultural differences existing at European level. The effects of urban forests on urban environments (i.e., hydrology climate, air quality, biodiversity) and human health are finally discussed. This chapter considers the social role of urban forest and the relationship existing between forests and communities through emerging approaches such as community forests.

2.1 Introduction

The concept of 'forest' has evolved considerably in the last few decades. Prior to the 1960s, it was seen principally as a productive land use, providing timber, wood and food. Other functions were seen as the protection of soils and to guard settlements

G. Sanesi (✉)
Department of Vegetal Production Science (DSPV), Università di Bari, Bari, Italy
e-mail: sanesi@agr.uniba.it

C. Gallis
Forest Research Institute, Thessaloniki, Greece
e-mail: cgalis@fri.gr

H.D. Kasperidus
Department of Conservation Biology, Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany
e-mail: hans.kasperidus@ufz.de

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against avalanches, rainfall, and torrents in mountain zones. Since then, the discourses on environment and environmentalism, the increasing role of urban culture as well as the critical assumption of degradation and huge loss of forested land (e.g., Amazon and Congo basins) drove towards the need of re-defining the concept of forest in use in contemporary societies. The forests currently are seen as an important source of non-wood products and of environmental, ecological, and social benefits. Several authors agree that in Western society the role of forests is changing rapidly from productive to consumptive (mainly recreation and landscape) and protective (biodiversity and erosion) functions (Glück and Weiss 1996; Koch and Rasmussen 1998; Eland and Wiersum 2001). These changing perceptions of forests mirror the wider perceptions of the rural environment typified in the changing European policy on rural development. More widely, the international forest policy process set in train by the United Nations Conference on Environment and Development (UNCED) in 1992 has established principles for sustainable forest management that emphasize social and economic factors as well as economics (Humphreys 1996). This different way of construing forests has led to changes in forest management in European countries. This is particularly valid for public owned forests where current management aims to conserve complex ecosystems and deliver social benefits at a landscape-scale. There is also a trend towards integration across different levels of administration (Kennedy et al. 2001). More difficult is the analysis of private forestry. The difficulty in generating income from non-timber products and from forest services is a major constraint for the owners and can require new knowledge and skills. It can also lead to conflicts where forest management impacts on scenic and recreational value, especially in forests near urban areas (Tahvanainen et al. 2001).

Forests not only are physical entities, they have strong symbolic and cultural value, and this leads to different perceptions of forests and woods within and between societies. This chapter has three main goals: (1) to illustrate the complexity of the term ‘forest’ within Europe; (2) to indicate current knowledge of the environmental functions and benefits of forest and trees especially at urban level; and (3) to introduce forests and trees as resources for human health.

2.2 Forest Classification Systems

Technically a forest can be classified on the basis of specific parameters such as frequency of forest cover on land use, tree canopy cover rate or species composition and forest structure. This approach belongs mainly to forestry inventory and statistics. But the way in which such data is applied varies, so that forests can be defined or classified in different ways in various European countries (European Commission 1997).

Recently, faced with a need for common definitions in international policy processes such as the Kyoto Protocol, organizations such as The Global Network for Forest Science Cooperation (IUFRO) and the Food and Agriculture Organization of the United Nations (FAO) have attempted to introduce an international standard