

Health Benefits from Forests

Basic knowledge



This module will be of interest to the general public because it provides basic and more detailed information on the ways in which forests and trees influence human health and well-being. It also gives links to tools, case studies, websites and literature to further assist users in understanding the relationships between forests, trees and human health.

The dependence of a community on forests and trees for their health is likely to vary with the social, economic and cultural contexts, including whether the community is urban or rural. In urban centres, the presence of forests and trees helps citizens in adopting healthy lifestyles and improving their physical and mental health. Rural communities are more likely than urban centres to use forests and trees directly as sources of medicines, foods and nutrition.

Physical and mental health and well-being

There is increasing evidence that forests and trees contribute in many ways to people's physical, mental and social well-being. Forests and woodlands, including those in urban areas, provide *restorative environments* – places where people can relax, reduce stress and screen out noise; forests and woodlands have the ability to absorb large numbers of people without seeming crowded. They also offer opportunities for a wide variety of exercise and fitness activities, and they can be inexpensive to visit, which is important for reducing health inequalities and enabling social inclusion.

Undertaking physical activities in forests and woodlands can have short-term benefits in terms of fitness, as well as longer-term health benefits in reducing obesity, cardiovascular disease, the risk of type 2 diabetes and colon disease and in promoting mental health, enhancing and protecting brain function, helping in the management of painful conditions, and improving health-related quality of life.

Government agencies are increasingly acknowledging the role of forests and woodlands in healthy lifestyles (see, for example, [State of Europe's Forests 2015](#)).

Health benefits through pharmaceutical products

Traditional healthcare systems are based on significant local knowledge of medicinal plants. Traditional medicine is therefore often highly available and accessible to people in developing countries, and poor and marginalized people – especially those in rural areas – are often highly reliant on it.

Many pharmaceutical products are derived from tropical forest species; some of these products are now synthesized, but others are still collected in the wild. The economic value of traditional medicines derived from forest species (mainly plants) is considerable: the global

value of the annual market for these products [was estimated at US\\$60 billion in 2002](#).

Interest in traditional knowledge and medicine has grown in the last two decades, stimulated by the role of such knowledge in the development of new commercial products, including pharmaceuticals, herbal medicines, seeds, cosmetics, and [personal care and crop protection products](#). Traditional knowledge is used in screening plants for medically active compounds.

The commercial users of traditional medicines (“bioprospectors”) are often companies and scientists in technologically advanced countries. Concerns have arisen in recent years about “biopiracy” – the unauthorized commercial use of genetic resources and traditional knowledge and the lack of sharing of the benefits with the countries and communities of origin, as well as the patenting of spurious “inventions” based on such knowledge and resources. In the case of traditional medicine, pharmaceutical companies have sometimes been charged with reaping unacceptably and disproportionately large benefits from the knowledge of forest peoples, many of whom live in highly impoverished conditions. Other more general threats to traditional knowledge and forest-based medicines are those posed by deforestation, forest degradation and over-exploitation, and the consequent loss of genetic diversity among therapeutic species, and the loss of traditional knowledge under fast-changing social and environmental conditions.

Exposure to natural environments, including forests

There is evidence that exposure to natural environments or green spaces has positive health impacts. Exposure to forests specifically has stress-reducing effects – possibly due to the recovery effect of viewing attractive or aesthetic forest landscapes, as well as the forest climate, light conditions and air composition (including essential oils).

Forest environments may also pose risks to human health. For example, people with frequent interactions with forests [may be exposed to forest-related infectious diseases](#). Several *emerging infectious diseases* (EIDs), the incidence of which in humans has increased in recent decades and could increase further in the future, are associated with forests. The proximate causal factors in the emergence of EIDs include deforestation and other land-use changes, increased contact with forest pathogens among people lacking previous exposure, and pathogen adaptation. [EIDs may be transmitted via non-human primate hosts](#) or insect vectors, with a variety of intermediate hosts, including domestic animals.

The role of forests and forest management in the emergence of infectious diseases in humans appears to [involve three separate but interacting dynamics](#):

1. land-use change and the expansion of human populations into forest areas, resulting in the exposure of immunologically naïve human and domestic animal populations (i.e. those lacking previous experience with microparasitic fauna) to pathogens occurring naturally in wildlife;
2. forest clearing and alteration producing an increase in the abundance or dispersal of pathogens by influencing host and vector abundance and distribution; and
3. the alteration of ecohydrological functions such as water infiltration, peak discharge and runoff, thereby facilitating the survival and transport of water-borne pathogens in watersheds and catchment basins.

These changes are often linked to forest clearing and increased edge habitat, the fragmentation of the forest landscape, and disturbance of the vertical structure and diversity of forest stands.

The virus that causes yellow fever is maintained in a transmission cycle involving arboreal monkeys and sylvatic (jungle) mosquitoes, and a frequent cause of outbreaks is the expansion of human settlements into forests. In many areas, malaria – which causes the largest number of deaths and disabilities of any infectious disease, by far (300 million–500 million cases annually, with a death toll as high as 2.7 million) – [is transmitted by forest-associated mosquitoes](#).

Forests have other risks for human health, such as those posed by forest fires (and associated smoke hazes) and landslides. Forests may harbour dangerous wildlife and toxic plants and fungi. The stings and bites of forest insects, snakes and other animals may cause irritation, pain and, in some cases, deaths in humans. Some forest plants produce pollen, a major cause of allergies, pointing to a clear [need to identify non-allergenic or low-allergenic trees](#) and other plants when designing parks and managing urban forests.

The diversity of forest types, wildlife, disease vectors, human populations and cultures, and interactions among these factors, all affect human health. It has been projected that the incidence of [disease in forested areas and elsewhere will increase as the climate changes](#).

Health benefits from forests contributes to SDGs:

3 GOOD HEALTH AND WELL-BEING



11 SUSTAINABLE AND COMMUNITIES



15 LIFE ON LAND



Related modules

- [Forests, food security and nutrition](#)
- [Gender in forestry](#)
- [Protected areas](#)
- [Urban and peri-urban forestry](#)

In more depth

Health benefits of forests related to recreation and cultural and spiritual aspects

Studies in countries such as Australia, Japan, the Netherlands, Norway, Sweden, the United Kingdom and the United States indicate the significant benefits of trees, woodlands and green spaces to people's overall health and well-being. There are many ways in which to categorize such benefits, but primarily the categories are physical, psychological and social. Benefits can be gained from being active in nature (e.g. walking or cycling in forests), and by viewing nature, for example while in transit between or within urban areas. In the United Kingdom, for example, woodlands have been identified as places for promoting physiological, psychological and social well-being, specifically by helping in:

- tackling obesity and improving mental health and well-being;
- helping children and young people lead healthy lives; and
- promoting healthy and active living among older people.

In Europe, initiatives such as "Green Rooms" in residential care centres, "[Forest Schools](#)" for children with behavioural difficulties, and "[Inclusive Design](#)" aimed at encouraging people aged over 65 years to spend more time out of doors all promote the health benefits of forests and other green spaces. *Shinrin-yoku*, which means "taking in the forest atmosphere" or "[forest bathing](#)", is a common practice in Japan and the Republic of Korea.

In many developing countries, forests are central to cultures and ways of life; agricultural and forestry practices may be impossible to separate from beliefs and values. In Borneo, for example, rice cultivation in swidden systems is a central activity of Kenyah Dayak women. Without the forest (or access to it), this subsistence system, and the accompanying culture and way of life, would be endangered.

Forests are often also important for social well-being and the generation of social capital – that is, the social networks, norms and trust that facilitate cooperation among people for mutual benefit. Activities carried out in forests, woodlands and other green spaces that enable people to relax, be active and reduce stress provide opportunities to meet others and extend social networks.

The use of forest products in social, cultural and healing ceremonies in traditional societies is well documented. Specific natural features serve as cultural symbols, linking people to their ancestral pasts. Certain sacred trees are associated with burials and ancestors and others with birth cycles. Some trees are important for indigenous judicial processes, and sacred groves are often used for rituals and initiation ceremonies and for passing on social and political values, morals and secrets to the next generation. In some cultures, tree and forest medicines are believed to be vehicles through which people communicate with deities.

Forests provide a range of products for traditional ceremonies, from food and beverages to costumes and musical instruments. In many regions, forest products are used for healing. Traditional medicines and medical practices depend to a large extent on the mystical values associated with forest species.

Health benefits from forest foods

People residing in and near forests typically obtain a considerable, although variable, amount of nutritious foods from forests – with poor people generally most dependent on such food. Trees provide a variety of healthy foods – such as fruits, leafy vegetables, nuts, palms, roots and tubers, seeds and edible oils, mushrooms and insects – that can diversify diets and address seasonal food and nutritional gaps. Forest foods contain proteins, fats, carbohydrates, vitamins and minerals, as well as phytochemicals such as phenolics and carotenoids. However, forests may not always be able to provide balanced diets, and some forest foods contain toxic compounds.

Forests provide a food safety net in case of food shortages, and they can mitigate food insecurity and malnutrition. Forest foods may provide nutrients not otherwise available, and they can help people survive famine, wars and drought.

Forests are genetic reservoirs of plants and animals with the potential to contribute to food security and nutrition in the future. Forests also supply numerous goods (and environmental services) that indirectly support the provision of food, such as poles (for supporting fruit trees or fencing crops), beehives and fodder.

More knowledge is needed on the nutritional values of forest foods. Nutrition education can play an important role in empowering rural populations, with the potential to generate tangible benefits for households and communities in achieving food security and nutrition, sustainable forest and landscape management, and health. There is a need to develop or adapt forest management practices that can conserve and make efficient use of food species. It is difficult to overstate the importance of the traditional knowledge of indigenous peoples and local communities in gathering, hunting, managing and using forest foods and medicinal forest plant species.

Health benefits from medicinal plants in forests

Forests are important repositories of medicinal compounds in wild organisms, including some already-common foods, drinks and drugs (e.g. cocoa, cola nut and ginger). Forests are a rich reserve of compounds that can be used as pharmaceuticals and nutraceuticals.

Forest trees and other plants contain a wide variety of bioactive compounds with potential as anticancer drugs, antiatherogenic compounds, and antioxidants. Forest species contain alkaloids such as reserpine, quinine, quinidine, ipecac, ephedrine and caffeine, as well as antibacterial and antifertility compounds. Quinine and quindine, which derive from Andean forest trees in the genus *Cinchona*, have been the world's main defence against malaria for decades, saving countless lives. The Madagascar periwinkle (*Catharanthus roseus*) is used in the treatment of leukaemia, Hodgkin's disease and other diseases. Forest animals also provide a source of medicines, including toxins purified from venomous snakes, spiders, insects and scorpions.

There is a wealth of indigenous and local knowledge on forest medicines. Western science has confirmed the benefits of many such medicines, but the effectiveness of many other forest species, and their potential side-effects, are still unknown.

Demand for herbal medicines has increased in recent decades in both developing and developed countries; it has been reported that more than 4 billion people in developing countries use them, mostly the rural poor. An estimated 28 percent of plants on earth have been used medicinally, with the people of India and China the biggest users. For 65 percent of India's population, traditional medicine is the only available source of healthcare, and [it also accounts for about 40 percent of all healthcare](#) provided in China. It is estimated that 70–80 percent of Africans consult traditional [medical practitioners for healthcare](#). [A study in rural Burkina Faso](#) found that more than 50 percent of [ill people used traditional medicines](#) at some point in their treatment-seeking strategies.

The economic value of medicinal plants

It is difficult to determine the exact economic value of traditional medicines obtained from forests. The annual value of pharmaceuticals of natural origin has been [estimated at US\\$75 billion](#). The annual value of medicinal [plant exports from Nepal has been estimated at US\\$39 million–159 million](#), making it the country's fifth most valuable export. The bark of *Prunus africana* (nearly all of which is obtained from the wild) was reportedly [worth US\\$220 million](#) to the pharmaceutical industry in 1999.

Efficacy and dangers in the use of medicinal plants

Considerable controversy surrounds the use of medicinal plants and animals. Issues include:

- the appropriation of traditional knowledge and forest genetic material by Western pharmaceutical companies;
- the utility of traditional and local healthcare knowledge; and
- the possible dangers associated with the use of traditional medicines (e.g. due to improper traditional drug formulation, poor practitioner training, or misuse due to the lack of knowledge of individuals in their use).

The efficacy of traditional medicines (especially in comparison with other healthcare options) should be considered, as well as the relative expertise of their practitioners. In many (perhaps most) places, there is little "quality control", except where the medicines have become institutionalized, such as in formal ayurvedic colleges in India and similar traditional medicine centres in China. Many of the bioactive compounds in tropical forest plants are highly toxic if used in high doses.

Who benefits from medicinal plants

People living in or near forests, especially in developing countries, often benefit little from the commercial development of medicines derived from forest species. The Nagoya Protocol of the Convention on Biological Diversity addresses the issues of fair patents, the distribution of profits, and the recognition of traditional knowledge in the pharmaceutical and botanical industries. Pharmaceutical companies incur significant costs in the discovery, laboratory research, processing and distribution of, and legal requirements, for, medicines. Nevertheless, many observers are troubled by the divergence in wealth between pharmaceutical companies and the communities who live in or near the forests from which the genetic material for medicines is obtained. Although one of the aims of the Convention of Biological Diversity is to protect benefit-sharing rights, the mechanisms in place to ensure this are often inadequate, especially in developing countries. Determining how profits should be divided and who should receive them is difficult, but many people consider that current arrangements are inequitable. Contributing to the sense of injustice is the oft-cited importance of using indigenous medical knowledge to narrow down the pool of plants to investigate from the vast diversity of forest species.

Medicinal plants in imminent threat

The International Union for Conservation of Nature estimates that more than 20 000 species are used for medicine worldwide, and half of these are under threat of extinction. The use and sale of medicinal plants are often closely connected with threats to their survival.

Many medicinal plants were once harvested only by specialists; today, however, medicinal plants are an open-access resource, and many of the traditional restrictions that limited harvesting in the past are ignored. Traditional plants were protected in the past by taboos, seasonal and social restrictions on harvesting, the harvesting equipment, a lack of access to markets, and perceived toxicity; traditional practitioners also safeguarded medicinal resources by restricting the number of apprentices. Government regulations designed to prevent the overexploitation of medicinal plants tend to be less effective, however.

The traditional knowledge of local communities in gathering forest foods and medicinal forest plant species is not recorded to a sufficient extent. There is a need to balance the commercial exploitation of medicinal forest species for pharmaceuticals and the maintenance of local livelihoods. [Developments in biotechnology may help protect valuable plant species](#) from overharvesting. The rights of source countries and people need to be secured and adequate compensation systems developed. Accurate [data on the contributions of medicinal plants from forests to human welfare is needed](#), as well as more information on medicinal plant production, trade and consumption.

Women and health benefits from forests

It's undoubtedly fair and necessary to recognize the role of women when talking about the health benefits that forests provide. In developing countries, it is mainly women who rely constantly on natural resources for their household livelihood. They have expertise on local plants, grass, fruits and biodiversity in general, and they know how to transform these raw materials into edible and medical products.

Some among the most important gender issues regarding this topic are:

- **The recognition of the role of women in natural resource management.** It is recognized that women have a different relationship with nature than men. This is particularly true in the developing world, especially in rural areas where women depend on natural resources for daily subsistence. Women are traditionally appointed as caretakers of the family and the household. They collect water, fuel, provide food and medicine, among other things. Due to their close relationship with nature, women have a vast traditional ecological knowledge on local biodiversity and play a significant role in sustainably managing species that risk extinction. They also monitor the health of forests. Nevertheless, they don't play a significant and proportionate role when it comes to high level decision-making positions, they rarely participate in decisive discussions, they hold few land tenure and rights, and they are not involved in the policy and decision-making process. It is, thus, necessary to acknowledge the importance of women in forest management, for the sake of both forests and communities.
- **The protection of traditional knowledge.** Traditional knowledge about medicinal plants is held by communities and cultures over generations, and has deep cultural and economic significance. It is not static, but rather dynamic and it is usually transmitted orally. Such communication includes a variety of literary, artistic and scientific works, medical practices, agricultural techniques, etc. With regard to biodiversity, knowledge is transmitted about healing, agricultural and sacred properties of plants and animals, as well as about the quality of cultivation and processing methods. As noted above, women have a large role in keeping traditional knowledge alive, e.g. tribal women in India know and regularly use almost 300 forest species for medicinal purposes. It's this knowledge that ensures survival, especially during crisis, generating meals and medicines. As traditional knowledge is a valuable tool for forest dwelling communities, there is a need for widespread action that challenges gender bias and stereotypes at a local level, and challenges powerful stakeholders, such as pharmaceutical companies, at a more national and international level.

The role of women in markets.

Another issue affecting women is the disproportionate income generated by the exploitation of natural resources, especially in developing countries. At a local level, despite women being the ones to collect plants, grass and other species, and knowing how to transform them into precious resources, they have limited access to the main markets (e.g. national and export markets). Barriers that women face when trying to access the markets could be addressed in a twofold manner:

1. by contrasting the rigid gender stereotypes that prevent women's products having the same value as men's. and empowering women by creating women-held cooperatives; and
2. by involving women in policy-making decisions, both through reaching more gender balanced committees, and by including a gender perspective in the policies.

Further Learning

- Airhihenuwa, C.O. & Harrison, I.E.** 1993. Traditional medicine in Africa: past, present and Future in: Conrad, P. and Gallagher, EB (eds.) *Health and Health Care in Developing countries* 122 – 134 Temple university press, Philadelphia PA, USA.
- Ali, R.** 2008. Approaching Conservation through Health. In: Colfer, C.J.P. (ed.), *Human Health and Forests: A Global Overview of Issues, Practice and Policy*. London: Earthscan.
- Andel, T.V., Myren, B., & Onselen, S.V.** 2012. Ghana's herbal market. *Journal of Ethnopharmacology*, 140(2): 368-378.
- Akerele, O.** 1991. Preface in: Akerele, O. Heywood, V. & Syngé H. (eds.): *The Conservation of Medicinal Plants xv–xvi*. Cambridge University press.
- Anyinam, C.** 1995. Ecology and ethnomedicine: exploring links between current environmental crisis and indigenous medical practices. *Soc Sci & Medicine* 40 (3): 321- 329.
- Arman, S.** 2003. Diversity and trade of market fruits in west Kalimantan in: Padoch, C and Peluso, N.L. (eds.) *Borneo in transition: People, Forests, Conservation and Development*, 308 – 318 Oxford University Press, Oxford.
- Bhattarai, N.K. & Karki, M.B.** 2004. *Conservation and management of Himalayan medicinal plants in Nepal*. General Technical Report Pacific Northwest Research Station, USDA Forest Service, **604**: 45-50.
- Bodeker, G., Bhat, K.S.S., Burley, J., & Vantomme, P.** (eds.). 1997. *Medicinal plants for Forest Conservation and Health Care*. FAO, Rome.
- Burgener, M.** 2007. [Trade measures – tools to promote the sustainable use of NWFP](#). Non-Wood Forest Products Working Document No. 6. Rome, Italy: FAO.
- Chivian, E. & Bernstein, A.** (eds.). 2008. *Sustaining life: how human health depends on biodiversity*. Oxford University Press.
- Colfer, C.J.P., Sheil, D., Kaimowitz, D. & Kishi, M.** 2006. [Forest and human health in the tropics: some important connections](#). Unasylva 224 (57). Forests and Human Health.
- Colfer, C.J.P., Sheil, D. & Kishi, M.** 2006. [Forest and human health: Assessing the evidence](#). CIFOR Occasional Paper no 45.
- Colfer, C.J.P.** (ed.). 2008. [Human Health and Forests: A Global Overview of Issues, Practice and Policy](#). London: Earthscan/CIFOR.
- Cunningham, A.B., Shanley, P. & Laird, S.** 2008. Health, habitats and medicinal plant use. In: COLFER, C. J. P. (ed.) *Human Health and Forests: A global Overview of Issues, Practice and Policy*. London: Earthscan.
- FAO.** 1990. [The major significant of minor forest products: The local use and value of Forests in the West African Humid Forest Zone](#). Community Forestry Note 6
- Grifo, F. & Rosenthal, J.** 1997. *Biodiversity and human health*. Island Press.
- Hamilton A.C., ed.** 2008. *Medicinal plants in conservation and development: case studies and lessons learnt*. Salisbury, UK, Plantlife International.
- Karjalainen, E., Sarjala, T. & Raitio, H.** 2010. [Promoting human health through forests: overview and major challenges](#). *Environmental health and preventive medicine* 15(1), p. 1-8.
- Kate, K.T. & Laird, S.A.** 1999. *The commercial use of biodiversity: access to genetic resources and benefit sharing*. Earthscan, London.
- Kilham, C.** 2004. *Translating tribal plants: issues of sustainability*. *Acta Horticulturae*, 629: 17-21.
- Laird, S.A.** 1994. Natural Products and the Commercialization of Traditional Knowledge” in Greaves, T. (ed.), *Intellectual Property Rights for Indigenous Peoples: A Sourcebook*. Society for Applied Anthropology, Oklahoma City. pp. 145-149.
- Laird, S.A.** (ed). 2002. Biodiversity and Traditional Knowledge. Equitable Partnerships in Practice. People and Plants Conservation Series.

WWF -UNESCO - Kew Royal Botanical Gardens. Earthscan Publ. Ltd.

Lambert, J., Srivastava, J. & Vietmeyer, N. 1997. *Medicinal Plants – Rescuing a Global Heritage*. The International Bank for Reconstruction and Development/The World Bank, Washington, U.S.A.

Molteno, S., Morris, J. & O'Brien, L. 2012. Public access to woodlands and forests: a rapid evidence review. A report by Forest Research on behalf of the Independent Panel on Forestry. The Research Agency of the Forestry Commission, U.K.

Muriuki J., Franzel, F., Mowo, J., Kariuki, P. & Jamnadass, R. 2012. Formalisation of local herbal product markets has potential to stimulate cultivation of medicinal plants by smallholder farmers in Kenya. *Forests, Trees and Livelihoods* 21: 114–127.

Nilsson, K., Sangster, M., Gallis, C., Hartig, T., de Vires, S., Seeland K. & Schipperijn, J. (eds.). 2011. *Forests, Trees and Human Health*. Springer.

O'Brien, L. 2006. Strengthening heart and mind: using woodlands to improve mental and physical wellbeing. In: *Unasylva*, 224 (57). Forests and Human Health.

Olsen, C.S. & Helles, F. 2009. Market efficiency and benefit distribution in medicinal plant markets: empirical evidence from South Asia. *International Journal of Biodiversity Science and Management*, 5(2): 53-62.

Olsen, C.S. & Treue, T. 2003. Analysis of trade in non-timber forest products. (*Forestry Sciences Volume 74*). Helles, F. Strange, N. & Wichmann, L. Kluwer Academic Publishers, Dordrecht.

Olsen, C.S. 1998. [The trade in medicinal and aromatic plants from Central Nepal to Northern India](#). *Economic Botany*, 52(3): 279–292.

Pandey, M.M., Rastogi, S. & Rawat, A.K.S. 2013. [Indian Traditional Ayurvedic System of Medicine and Nutritional Supplementation](#). *Evidence-Based Complementary and Alternative Medicine*.

Parrotta, J.A. 2001. *Healing Plants of Peninsular India*. CAB International, Wallingford, UK & New York. 917 p.

Robinson, M.M. & Zhang, X. 2011. *Traditional Medicines: Global Situation. Issues and Challenges*, WHO, Geneva.

Scoones, I., Melynk, M. & Pretty, J.N. 1992. *The Hidden Harvest: Wild Foods and Agricultural Systems: A literature review and annotated bibliography*. IIED, London.

Seters, A.P.V. 1997. *Forest based medicines in traditional and cosmopolitan health care. Medicinal plants for forest conversation and health care*.

Smith-Hall, C. Overgaard Larsen, H. & Pouliot, M. 2012. People, plants and health: a conceptual framework for assessing changes in medicinal plant consumption. *Journal of Ethnobiology and Ethnomedicine* 8:43.

Suneetha, M.S. & Chandrakanth, M.G. 2010. [Establishing a multi-stakeholder value index in medicinal plants—an economic study on selected plants in Kerala and Tamilnadu States of India](#). *Ecological Economics, Volume 60, Issue 1*, Pages 36–48.

Swiderska, K. 2006. *Banishing the biopirates: a new approach to protecting traditional knowledge*. IIED. Gatekeeper Series 129.

Simpson, R.D., Sedjo, R.A. & Reid, J.W. 1996. Valuing biodiversity for use in pharmaceutical research. *Journal of Political Economy* 104 (11): 163 – 165.

Sunderland, T & Ndoye, O. (eds.). 2004. *Forest Products, Livelihoods and Conservation: case studies of non-timber forest product systems*. CIFOR, Bogor.

Tsunetsugu, Y., Lee, J., Park, B.J., Tyrvaainen, L., Kagawa, T. & Miyazaki, Y. 2013. Physiological and psychological effects of viewing urban forest landscapes assessed by multiple measurements. *Landscape and Urban Planning*, 113: 90–93.

UNIDO. 1987. *Better Utilization of Medicinal Plants: the Phytopharmaceutical Supply System in China*. Sectoral Studies Series No.35. Studies and Research Division.

Vira, B., Mansourian, S. & Wildburger, C. (eds.). 2015. [Forests, Trees and Landscapes for Food Security and Nutrition: A Global](#)

[Assessment Report](#). IUFRO World Series Volume 33. Vienna. 169 p.

Wan, M., Colfer, C.J.P. & Shanley, P. 2011. Forests, Women and Health: Opportunities and Challenges for Conservation. *International Forestry Review*, 13, 369-387.

WHO. 2002. *WHO Traditional Medicine Strategy 2002– 2005*. World Health Organization, Geneva.

WHO. 2003. [WHO guidelines on good agricultural and collection practices \(GACP\) for medicinal plants](#). World Health Organization, Geneva.

WHO. 2005. [National Policy on Traditional Medicine and Regulation of Herbal Medicines: Report of a WHO Global Survey](#). World Health Organization, Geneva, Switzerland.

Willcox, M., Bodeker, G., Rasoanaivo, P. & Addae-Kyereme, J. (eds.). 2004. *Traditional medicinal plants and malaria*. CRC Press.

Wilcox, B.A. & Ellis, B. 2006. [Forests and emerging infectious diseases of humans](#). *Unasylva* 224 (57). Forests and Human Health.

Credits

This module was developed with the kind collaboration of the following people and/or institutions:

Initiator(s): Christine Holding

Contributor(s): Cesar Sabogal - FAO, Forestry Department

Reviewer(s): Federica Urbani - FAO, Forestry Department; Ilias Animon; Mariève Pouliot - University of Copenhagen; Carol Colfer; John Parrotta - USFS

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Initiator(s): Gender Team in Forestry

Reviewer(s): Marta Gruca - FAO, Forestry Department

