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World Health Organization

Chapter 8.
Nature and health

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unicef for every child

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Contents

8.1 Protection of nature, biodiversity and ecosystems for health

Many interventions that protect nature, biodiversity and ecosystems such as interventions for mitigating climate change are not included here but in many of the other topics included in this compendium. Examples include raising awareness about pollution abatement of recreational water bodies (section 3.2.2 Recreational water), interventions for a sustainable healthy diet (section 10.2 Healthy diets and the environment) and interventions for safe and sustainable mobility (section 9.2 Environments for safe and sustainable transport, active mobility and physical activity).

Overview

Human health and well-being depend on the natural environment, which is the source of clean air, water, healthy soils and food. The natural environment comprises ecosystems, which when healthy and thriving, also confer protection against climate change and disaster risk. Ecosystems include for example forests, marine and freshwater ecosystems, grasslands and mountains and comprise a range of different species that interact with each other and the surrounding environment. The stability and health of ecosystems, however, depend on biodiversity.

Biodiversity has many more strong links to health; examples include the prevention of infectious disease outbreaks and pandemics, nutritional diversity and food security, and the provision of medicines. Ecosystems and biodiversity are directly threatened by human activities such as land use change, overexploitation of resources, climate change, pollution and invasive alien species. Reducing pressure on the natural environment, from deforestation to intensive and polluting agricultural practices, to unsafe management and consumption of wildlife, will protect the environment that humans rely on, for their health and ultimately their economy *(1-3)*.

What is the situation regarding the protection of nature and biodiversity in my country?	The indicators of SDG 14 "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" and SDG 15 "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" are directly relevant for assessing national efforts towards greater protection of nature, ecosystems and biodiversity *(4)*. The majority of SDGs are directly or indirectly related to biodiversity. Indicators for country assessment of the 20 Aichi Biodiversity Targets (listed below) have also been proposed *(5, 6)*.
What do we want to achieve?	The tenth meeting of the COP held in 2010 in Nagoya, Aichi Prefecture, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011–2020 period *(7)*. The 20 Aichi Biodiversity Targets *(6)* aim for: 1. increased awareness of the values of biodiversity 2. integration of biodiversity values into decision-making 3. elimination of incentives that are harmful to biodiversity 4. sustainable production and consumption 5. reduced loss of natural habitat 6. sustainable management of marine resources 7. sustainable agriculture, aquaculture and forestry 8. reduced pollution to levels that are not detrimental to ecosystem function and biodiversity 9. prevention and control of invasive alien species 10. reduced anthropogenic pressures on vulnerable ecosystems 11. increased and improved protected areas 12. prevention of species extinction 13. maintaining and safeguarding genetic diversity 14. safeguarding ecosystems that provide essential services 15. restoring ecosystems and enhancing their resilience 16. implementation of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization 17. adoption of National Biodiversity Strategies and Action Plans (NBSAPs) 18. respect for traditional knowledge, innovations and practices of indigenous and local communities 19. improved knowledge of biodiversity values, functions and trends, which is shared and applied 20. increased financial resources for effectively implementing the Strategic Plan for Biodiversity 2011–2020.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
General: policies and actions			
1. Implement and update NBSAPs in line with the 20 Aichi Biodiversity Targets *(2)*.	Environment Other sectors	National	Governance
2. Incorporate biodiversity values, ecosystem protection and the "value of nature" into national and regional policies, strategies and programmes, including in public health policies and in national accounting and reporting systems *(2)*.	Health Other sectors	National	Governance
3. Eliminate or reform incentives, including subsidies that are harmful to biodiversity, including those that promote monoculture production systems *(7, 8)*.	Industry Other sectors	National	Taxes and subsidies
4. Implement integrated public health and biodiversity-related interventions for the management of both short- and long-term health risks resulting from biodiversity loss and unsustainable practices *(2)*. Selected examples include *(9)*: • integrating biodiverse green spaces in urban development; • improving availability of and accessibility to diverse diets; • tightening control and rationalizing use of antimicrobial agents, pesticides and other biocides; • ecosystem-based adaptation, ecosystem-based mitigation and ecosystem-based approaches to disaster risk reduction; • maximizing the health benefits of exposure to biodiverse environments; • implementing policies and programmes in line with the One Health approach (human, animal, plant, ecosystem health) *(10)*.	Health Environment	National; community Universal health coverage	Regulation; other management and control
5. Implement integrated environment and health surveillance to support timely and evidence-based decisions for the effective identification and management of short and long-term risks to human health posed by ecosystem degradation and biodiversity loss *(2)*.	Health Environment	National; community Universal health coverage	Assessment and surveillance
6. Ensure sufficient financial resources to effectively protect nature and preserve biodiversity and ecosystems *(6)*.	Finance Environment Health	National	Governance
7. Implement preventive and precautionary strategies and policies and safe minimum standards for sustainably managing ecosystems and for valuing ecosystem services for health *(2)*. Examples include considerations of the purposeful introduction of invasive alien species, avoidance of high-density monocultures, human activity/settlement adjacent to biodiverse ecosystems, integrated disease surveillance in wildlife, livestock and human populations, ecosystem-based approaches for climate change mitigation and adaptation and disaster risk reduction.	Environment Health	National	Regulation; other management and control

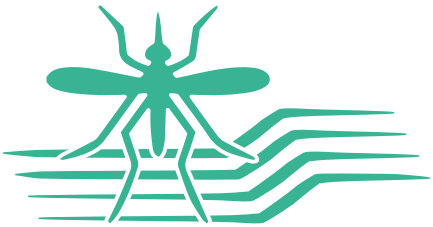
Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
8. Strengthen international and regional partnerships, joint work programmes and intersectoral collaboration on biodiversity–health linkages *(2)*.	Environment Health	National	Governance
9. Adopt integrated approaches to health, such as One Health, Ecohealth and Planetary Health, which promote cross-disciplinary and/or cross-sectoral collaborations for health and biodiversity *(2)*.	Health	National	Governance; other management and control
Ecosystems: policies and actions			
10. Avoid ecosystem loss and degradation and promote ecosystem integrity and resilience and protection of species *(2)*.	Environment	National; community	Other management and control
11. Reduce the adverse impact on biodiversity and ecosystems from land-use change, loss of natural habitats, overexploitation of nature such as of marine ecosystems, environmental chemical pollution, invasive alien species and climate change *(2)*.	Land use planning Environment Industry Other sectors	National; community	Other management and control
12. Protect and conserve genetic resources *(2)*.	Agriculture Environment	National; community	Regulation; other management and control
Medicine and disease: policies and actions			
13. Recognize contribution of genetic resources and traditional knowledge to medicine *(2)*.	Health	Health care Universal health coverage	Information, education and communication
14. Ensure benefit-sharing arising out of the utilization of genetic resources *(2, 11)*. Benefits derived from the use of genetic resources may include the sharing of the results of research and development carried out on genetic resources, the transfer of technologies which make use of those resources, and participation in biotechnological research activities. Benefits may also be monetary when products based on genetic resources are commercialized.	Industry Agriculture	National	Regulation
15. Limit unnecessary use of antibiotics and other pharmaceuticals *(2)*.	Health	Health care; national Universal health coverage	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
16. Limit or control human–wildlife contact to reduce the risk of infectious diseases, including zoonotic and vector-borne diseases *(2)*.	Agriculture Forestry Environment Health	Workplace; national; community	Regulation
Awareness raising and capacity building			
17. Strengthen core national capacities that enable health systems to prepare for and effectively respond to public health threats resulting from ecosystem degradation *(2)*.	Health Environment	National	Governance
18. Raise awareness about the health benefits of biodiversity and ecosystem protection *(2)*. Examples include the positive impacts of biodiversity on: a. food security and nutrition b. water supply and other essential ecosystem services c. pharmaceuticals and traditional medicines d. mental health and physical and cultural well-being.	Health Environment	National; community Universal health coverage	Information, education and communication
19. Develop education programmes and training on the importance of health–biodiversity linkages at various levels and the sustainable management of ecosystems for professionals in the health and biodiversity sectors as well as for the public *(2)*.	Health Environment	Health care; national; community Universal health coverage	Information, education and communication
20. Promote lifestyles that contribute to positive health and biodiversity outcomes *(2)*. Interventions that promote sustainable healthy diets (section 10.2 Healthy diets and the environment) and safe and sustainable mobility (9.2 Environments for safe and sustainable transport, active mobility and physical activity) are presented elsewhere in the compendium.	Health Environment	National; community Universal health coverage	Information, education and communication

Selected tools
WHO/Secretariat of the Convention on Biological Diversity/UNEP 2015: *Connecting global priorities: biodiversity and human health: a state of knowledge review (2)* This review synthesizes the available information on the most important interlinkages between biodiversity, ecosystem stability, nutritional diversity and health.
Convention on Biological Diversity 2013: *Quick guides for the Aichi Biodiversity targets (6)* provides resources, tools and indicators for each target.
Hesselink et al. 2007: The Communication, Education and Public Awareness (CEPA) programme of the Convention on Biological Diversity provides a toolkit for national focal points and coordinators of NBSAPs *(12)*.

Selected tools
The Economics of Ecosystems and Biodiversity (TEEB) provides guidance to policy-makers for mainstreaming the values of biodiversity and ecosystem services into decision-making at all levels *(13)*.
UNEP 2012: *Global environment outlook 5 (14)*
UNEP 2019 *Global environment outlook 6 (15)*
Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2019: *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (3)*
WHO 2020: *Guidance on mainstreaming biodiversity for nutrition and health (8)*

8.2 Vector control



Overview

Vector-borne diseases are human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors. In most, but not all, cases the vector is a female mosquito in search of a blood meal. Vector-borne diseases account for more than 17% of all infectious diseases and cause more than 700 000 deaths annually *(16)*. They comprise a range of diseases such as malaria, dengue, Chagas disease, human African trypanosomiasis and leishmaniasis.

Diversity, composition and abundance of vector populations are closely linked to local climate and ecosystems. Changes to environmental factors and systems such as through climate change but also management and use of land, clearing of forests, mining and other extraction industries, large-scale construction and development projects, urban and peri-urban development, water resources and solid waste management may influence vector abundance and distribution *(17)*.

The table below lists some major vectors and the diseases they transmit *(16)*.

Vector	Disease(s)
Mosquitoes	Malaria, dengue, lymphatic filariasis, Japanese encephalitis, Mayaro virus disease, yellow fever, Chikungunya, West Nile fever, Zika virus disease and Rift Valley fever, Oropouche virus disease (mosquitoes and midges)
Sandflies	Leishmaniasis
Tsetse flies	Human African trypanosomiasis
Blackflies	Onchocerciasis
Triatomine bugs	Chagas disease
Ticks	Tick-borne encephalitis
Aquatic snails	Schistosomiasis

Vector-borne diseases are mainly prevented through vector control. Vector control includes both chemical insecticide-based methods and non-chemical methods (see the following section on integrated vector management).

WHO response to vector control: integrated vector management

The WHO *Global vector control response 2017–2030 (17)* provides strategic guidance to countries and development partners for urgent strengthening of vector control as a fundamental approach to preventing disease and responding to outbreaks. It requires a re-alignment of vector control programmes, supported by increased technical capacity, improved infrastructure, strengthened monitoring and surveillance systems, and greater community mobilization.

The global vector control response builds on the basic concept of integrated vector management (IVM) with renewed focus on improved human capacity at national and subnational levels and for strengthened infrastructure and systems.

IVM, a rational decision-making process to optimize the use of resources for vector control, was presented in 2004 in a WHO global strategic framework, and subsequently in other supporting documents *(18, 19)*. IVM is a management approach that improves the efficacy, cost–effectiveness, ecological soundness and sustainability of vector control interventions with available tools and resources. One of the key elements of an integrated approach to disease vector control is the integration or combination of different, often chemical and non-chemical vector control methods against multiple vector-borne diseases.

Chemical vector control methods include use of insecticide-treated nets, indoor residual spraying, outdoor spraying and other methods such as adding chemicals to water bodies and use of insect repellents. Concerns with insecticide resistance and environmental toxicity have increased the need for alternatives and, where feasible, more environmentally-sound approaches *(20)*.

Non-chemical methods include biological and other methods and environmental management. Biological methods include the utilization of natural enemies of the vector and biological toxoids. Housing improvements can also facilitate vector control, although in many cases these also deploy an insecticide, for example on insect screens *(20)*.

Environmental management seeks to change the environment in order to prevent or minimize vector propagation and human contact with the vector-pathogen by destroying, altering, removing or recycling non-essential containers that provide larval habitats. It comprises the planning, organization, carrying out and monitoring of activities for the modification and/or manipulation of environmental factors or their interaction with humans for preventing or minimizing vector propagation and reducing human-vector-pathogen contact *(21)*.

Three types of environmental management exist.

1. Environmental modification – long lasting physical transformations to reduce vector larval habitat.
2. Environmental manipulation – temporary changes to vector habitats.
3. Changes to human habitation or behaviours – actions to reduce human-vector contact. It includes for example reduction of vector breeding habitats, use of PPE and housing alterations *(20, 22)*.

How prevalent are vector-borne diseases in my country?

National reporting systems may capture statistics on different vector-borne diseases. As part of SDG Target 3.3 – by 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases – SDG 3 indicators also monitor the occurrence of vector-borne diseases at national level:

- SDG indicator 3.3.3: Malaria incidence per 1,000 population
- SDG indicator 3.3.5: Number of people requiring interventions against neglected tropical diseases.

In addition, the WHO Global Health Estimates provide a comprehensive and comparable assessment of death and disability due to diseases and injuries for all WHO Member States and all WHO regions of the world *(23)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
General: policies and actions			
The Seventieth World Health Assembly resolution WHA70.16 and WHO report *Global vector control response 2017–2030 (17)* promote effective, locally adapted and sustainable vector control by: • strengthening of inter- and intra-sectoral collaboration • engaging and mobilizing communities • enhancing vector surveillance, and monitoring and evaluation of interventions • scaling up and integrating tools and approaches.			
1. Develop or update national and regional vector control policies and action plans in line with the WHO global vector control response strategy *(17)*. Priority activities include the following. • Conduct/update national vector control needs assessment and develop resource mobilization plan (including for outbreak response). • Appraise and enhance national entomology and cross-sectoral workforce to meet identified requirements for vector control. • Train relevant staff from ministries of health and/or their supporting institutions in public health entomology. • Establish national and regional institutional networks to support training/education in public health entomology and technical support. • Establish/review progress of national agenda for basic and applied research on entomology and vector control. • Establish national inter-ministerial task force for multisectoral engagement in vector control. • Develop national plan for effective community engagement and mobilization in vector control. • Strengthen national vector surveillance systems and integrate them with health information systems to guide vector control. • Align national targets for protection of at-risk population with appropriate vector control across vector-borne diseases.	Health Environment Education Housing Waste Water/sanitation Research Other sectors	National	Regulation
2. Strengthen inter- and intra-sectoral action and collaboration on vector control *(17)*. • Re-align programmes so that staff are equipped to address multiple vectors and diseases and integrate efforts for greater efficiency and effectiveness. • Broaden collaborations within and beyond the health sector.	Health Environment Education Housing Waste Water/sanitation Other sectors	National	Governance
3. Enhance vector surveillance, and monitoring and evaluation of interventions *(17)*. • Strengthen and integrate national surveillance systems for vectors, interventions and diseases. • Coordinate surveillance and action between neighbouring countries.	Health Education	National; community Universal health coverage	Assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
4. Scale up and integrate tools and approaches for vector control *(17)*. • Ensure vector control methods are selected and combined appropriate to the local setting. • Integrate innovations as recommended by WHO.	Health Research	National; community Universal health coverage	Other management and control
5. Combine different vector control methods and interventions and integrate vector control efforts for different vectors and diseases in an appropriate and evidence-based way *(20), (17)*. Vector control strategies need to be adapted to and appropriate for the local context. Aspects of effectiveness, human and environmental safety, risk for development of resistance, affordability, community participation and policy and logistic support need to be considered when choosing vector control methods.	Health	National; community Universal health coverage	Other management and control
6. Support improved water resource, wastewater and solid waste management for improved control of many disease vectors *(24), (17)*.	Health Water/sanitation Education Waste Environment	National; community Universal health coverage	Infrastructure, technology and built environment
Awareness raising and capacity building			
7. Educate the community, community health workers and community leaders and raise awareness about the linkages between vector occurrence and disease prevalence, transmission mechanisms and ways of avoiding exposure *(20), (17)*. Strengthening capacity in the community should consider special training requirements of, for example, community health workers and agricultural extension workers.	Health Other sectors	National; community Universal health coverage	Information, education and communication
8. Engage and mobilize the community in vector control efforts for achieving greater coverage and sustainability and thereby effectiveness of vector control *(17)*. Enable communities to lead and sustain vector control activities, such as eliminating vector habitats from their environment and improving housing.	Health	Community Universal health coverage	Information, education and communication

Note: The examples below summarize recommendations on malaria and dengue, which are two major vector-borne diseases.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Malaria			
The two core interventions for malaria vector control recommended by WHO are insecticide-treated nets and indoor residual spraying. One of these core interventions should be chosen and supplied to the entire population at risk for malaria. In specific settings, and under special circumstances, these core interventions can be supplemented by larviciding (conditional recommendation) or other forms of larval source management (no recommendation). As yet there is no evidence for the public health value for deployment of personal protection measures such as repellents and clothing (conditional recommendation against deployment of topical repellents and insecticide-treated clothing as interventions with public health value), however topical repellents and insecticide-treated clothing may provide personal protection against malaria. Due to limited evidence no recommendation is given on the non-chemical methods for malaria vector control listed below. They should only be applied supplementary to (one of) the core interventions. Space spraying against malaria should be strongly discouraged given the limited evidence of the intervention's effectiveness and the potential for wastage of resources *(23)*.			
9. Support larval source management as supplementary interventions for mosquito reduction. Larval source management as a supplementary intervention for malaria vector control includes environmental management such as habitat modification and manipulation, larviciding and biological controls. In general and where feasible, environmental management (habitat modification and manipulation) should be the primary strategy to reduce the availability of larval habitats. However, no systematic reviews have so far been conducted to inform the development of WHO guidance in this area *(23)*. This may include the management of wetlands and drains and management of irrigation *(20)*.	Health	National; community Universal health coverage	Other management and control
10. Support housing improvements as potential additional measures to reduce the transmission of malaria and other vector-borne diseases *(23)*. Available evidence indicates that poor-quality housing and neglected peri-domestic environments are risk factors for the transmission of malaria and other vector-borne diseases. However, specific evidence-based recommendations on housing and vector-borne diseases are still needed. The evidence base for housing improvement as an approach for malaria prevention and control is currently under review.	Housing Construction Health	National; community Universal health coverage	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Dengue			
Dengue mosquito control will reduce dengue, particularly when targeting *Aedes aegypti* in urban habitats, though a sustainable tool to do so is lacking. Novel delivery methods have been developed to control *Aedes* vector populations using residual killing agents, including targeted indoor residual spraying, which shows promise for reducing dengue. Adulticiding for dengue prevention is most effective when it is conducted as part of an IVM plan that includes source reduction and larviciding. Successful dengue prevention programmes include a combination of tools and strategies that are applied with enhanced intersectoral and interdisciplinary cooperation and strong community engagement.			
11. Implement environmental management (source reduction) measures as the main pillar of dengue vector control *(25)*. Environmental management measures for dengue vector control include the following. • Environmental modification such as installation of reliable piped water on premises. • Environmental manipulation such as frequent emptying, cleaning or mosquito-proof covering of water containers, removal or filling of non-essential water containers, improved solid waste management, and screening of construction sites, open drains, and water bodies with stagnant water. • Changes to human habitation and behaviour such as installing mosquito screens on windows, doors and other entry points. • Perifocal treatment of larval habitats and peripheral mosquito resting surfaces or targeted residual spraying in homes and other settings such as schools and workplaces as part of an integrated dengue vector management programme.	Health Other sectors	National; community Universal health coverage	Other management and control

Selected tools
WHO 2019: *Guidelines for malaria vector control (23)*
WHO 2017: *Global vector control response 2017–2030 (17)*
WHO 2017: *Framework for a national vector control needs assessment (26)*
WHO 2016: *A toolkit for integrated vector management in sub-Saharan Africa (19)*
WHO 2016: *Technical handbook for dengue surveillance, dengue outbreak prediction/detection and outbreak response (27)*
WHO 2013: *Larval source management (28)* This report is an operational manual on larval source management.
WHO 2012: *Handbook for integrated vector management (20)*
WHO 2012: *Core structure for training curricula on integrated vector management (29)* provides guidance on training on IVM.
WHO 2011: *Operational guide for assessing the productivity of* Aedes aegypti *breeding sites (30)*

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