5. *How can priorities be established for actions to address the health consequences of ecosystem change?*

5.1 What considerations are important when setting priorities and what is science's role in informing decisions?

Priorities for actions addressing the human health consequences of ecosystem change should reflect the priorities and values of those who are affected by the action (R16). The final decisions about priorities therefore should be taken either by individuals or by their legitimate political representatives with reference to these values. Often decision-makers use multiple criteria (such as equity concerns, efficient use of scarce natural resources, political feasibility and cultural considerations) to set priorities. Scientific assessments can inform these decision-making processes. Assessments should strive to be policy-relevant without being policy-prescriptive, providing timely and useful information that allows stakeholders to judge how an action or inaction corresponds to their priorities.

Policy-relevant scientific assessments have led directly to many important decisions protecting public health from environmental risks. In many countries and settings, legislation regulating environmental exposures to lead, asbestos and secondary tobacco smoke, for instance, have been facilitated by evidence synthesized by health scientists who measured the links between environmental exposures and health outcomes, reached a reasonably broad consensus regarding health impacts, and presented these findings to policy-makers. Experiences implementing the Montreal Protocol on Substances that Deplete the Ozone Layer demonstrate that health considerations also can be important in decisions by local policymakers and stakeholders to address global environmental issues. This experience may encourage decision-makers similarly to address the health aspects of other risks, such as desertification, biodiversity loss and climate change.

5.2 How can we measure the size and distribution of the health effects of ecosystem change?

In the last decade, new approaches have been developed to assess the overall effects of environmental risks and other risks to population health. Where it is possible to measure the effect of an ecosystem alteration on the rates of

specific diseases, this can also be used to estimate the overall 'burden of disease' caused by that change. This can be described in terms of disability-adjusted life years (DALYs). DALYs represent the sum of years of life lost from premature death (e.g. the actual age at death compared with natural life expectancy) and the number of years of life lived with a disability (e.g. the duration of the disease, weighted by a measure of its severity). These measures allow health impacts experienced as a result of multiple causes or through multiple causal pathways to be summed together. For example, the combined effects of climate change on morbidity and mortality from infectious diseases, malnutrition, and the impacts of natural disasters can be aggregated into a single DALY measurement. Potentially this allows direct comparisons of the effects of different ecological changes (or any other risk factors) on population health and can act as a guide for rational priority-setting for an action (R16).

It is important to consider which subsections of the population are most affected by ecological changes, including the distribution of disease by age, gender, social status, ethnicity and geographical region. Global estimates for the year 2000 indicated that among the poorest countries with the highest mortality rates, between one-sixth and one quarter of the disease burden was attributable to childhood and maternal undernutrition. Children and pregnant women are at much greater risk from malaria, both in terms of morbidity and mortality, particularly if they are malnourished. Morbidity and mortality due to heatwaves, meanwhile, is highest among the elderly.

Burden-of-disease assessments depend on access to quantitative data sufficient to relate changes in exposure to the incidence of specific diseases. Within the environmental health field, such assessments have been carried out most successfully among defined or discrete population groups, in relation to localized environmental factors characterized by a set of well-defined dose-response health effects, e.g. air pollution exposures or environmental lead exposures. Such assessment is more difficult to apply in the case of ecosystem effects acting through more diffuse causal pathways. For example, reduced availability of fresh water could affect health adversely by increasing a range of water-borne diseases and also by reducing agricultural production. However, any quantitative projections of these effects are likely to have a higher degree of uncertainty than the examples just described. This is due to the multitude of other important causal factors (such as weather conditions during growing seasons) and diverse causal pathways of the impacts. For instance, water availability may influence not only plant growth rates but also agricultural pests and diseases, all of which in turn affect overall yields.

Considerations of timescale are equally important. Comparative risk assessments of the burden of disease attributable to climate change indicate that health impacts are modest compared with other risk factors over the brief time frames in which many political decisions are taken (a five-year horizon, at most). However, they become considerably more significant when impacts are considered over several decades. They are, therefore, of greater relevance where far-sighted policy-makers make decisions with long time horizons. Examples include large capital investments, such as planning decisions on the reconstruction of urban combined sewage systems or building on flood-prone areas. These would benefit from consideration of changing risks over decades rather than years. The burden-of-disease framework also fails to take account of differences between environmental risk factors that could be readily addressed by robust policies as new information becomes available about health impacts (e.g. urban air pollution), and other impacts (such as biodiversity loss) which may be irreversible.

Burden-of-disease evaluation is thus an appropriate tool for estimating and aggregating health impacts attributable to one particular ecosystem mechanism or to a range of ecosystem mechanisms. This tool potentially can aid priority-setting and decision-making to address ecosystem change. However, burden of disease assessment should be regarded as only one component of evidence as such evaluations cannot account fully for complex causal pathways, long timescales and potential irreversibility. These important properties need to be included in final considerations about any response to ecological change (R16).

Box 5.1 Interventions to reduce ecosystem change's pressures on health services - examples of promising responses


J.Vizcarra/PAHO

Vaccination campaign in El Salvador.

- Provide technical and financial assistance to implement the Global Strategy for Health for All, including health information systems and integrated databases on development hazards.
- Strengthen advocacy for the provision of basic preventive and curative health care at all levels. Review delivery of basic health services at the local level to ensure that priority problems of poor people are addressed adequately.
- Make essential drugs affordable and available to the world's poorer nations including, where necessary, alterations in the multilateral trade system, national policies and institutional drug supply management.
- Implement long-range health and human resource planning to train, recruit and retain staff. Develop codes of conduct for international recruitment of health professionals.
- Strengthen health services for displaced communities and those affected by war, famine or environmental degradation.
- Implement health impact assessment of major development projects, policies and programmes and monitor indicators for health and sustainable development.

5.3 What kinds of intervention options are available?

Responses to ecosystem changes include: mitigation (reducing or reversing the extent and rate of change) and adaptation (increasing systems' resilience to change - to reduce the current and future risks and take advantage of opportunities posed by those changes) (R16). Decisions on priority actions should include the best evidence available on the likely effectiveness of any intervention in either class. Mitigation and adaptation response options can include legal, economic and financial, institutional, social and behavioural, technological or cognitive measures and actions. They encompass both spontaneous responses to ecosystem change and planned (anticipatory) interventions by affected individuals and institutions such as governments. Responses that protect human health very often involve actions outside the health sector (see Box 5.1).

The health sector bears responsibility for informing decision-makers about the health effects of ecosystem changes and potential interventions. Where there are trade-offs to be made, for instance between more effective long-term mitigation and a faster rate of present-day economic growth, it is important for politicians, regulators and the public to understand the health consequences. These can be included alongside economic or other costs when setting priorities. Optimally, decision-makers may assign a higher priority to win-win options – for example, specific greenhouse gas mitigation measures that lead not only to long-term reductions in the risks of deaths in heatwaves, floods, droughts etc. but also bring benefits in terms of fewer deaths from air pollution in the short-term.

In almost every type of policy or community response to ecosystem changes, the consequences for health may be either positive or negative (R16). The outcome will depend on how the policy or regulation is framed, and what account is taken of contingencies and local circumstances. For instance, global trade and economic agreements have greatly facilitated the increased quantities and diversity of food products available in many markets around the world, which may be beneficial to health. In other settings, however, globalized trade in food may have contributed to diminished food access and security, deepening poverty, and deteriorating standards of public health.

A microscopic view of the tiny crustacean Mesocyclops. *Certain* Mesocyclops *species have been identified in Viet Nam and other Asian locales as highly efficient predators of the* Aedes aegypti *larvae, the main mosquito vector of dengue fever, and are important for controlling the disease.*

Adaptation interventions need to be designed at spatial and temporal scales appropriate to the health outcome of concern, taking into consideration the social, economic and demographic driving forces (R16). They also should be targeted towards particularly vulnerable groups that have the least capacity to adapt to ecosystem change. Such targeting requires understanding of which demographic or geographical subpopulations may be most at risk, the factors contributing to their vulnerability and which of these can be modified feasibly and effectively. Some of the most important determinants of vulnerability to any particular level of risk are the level of material resources, effectiveness of governance and civil institutions, quality of public health infrastructure, access to relevant information and existing burden of disease. These factors are not uniform across a region or nation; rather, there are geographical, demographic and socioeconomic differences.

Cross-sectoral policies that promote ecologically sustainable development and address underlying driving forces also will be essential (R16). Agenda 21 and the Rio Declaration on Environment and Development describe a comprehensive approach to ecologically sustainable development incorporating cross-sectoral policies. In defining the options that may be available through cross-sectoral policies, the following strategies are of specific relevance to health.

- Integrated action for health, making use of tools such as health impact assessment of major development projects, policies, programmes and indicators for health and sustainable development.

Examining a cup of water for Aedes aegypti *larvae in a community in north Viet Nam. This is a simple way to examine the effectiveness of interventions. Large-scale trials in the region involving the introduction of* Mesocyclops *into water tanks and containers have eliminated dengue in a number of locales. This is an example of improved environmental management of vector-borne disease yielding health benefits and also helping to minimize the impacts on ecosystems from excessive use of chemically-based vector control tools.*

- Including health in sustainable development planning efforts such as Agenda 21, multilateral trade and environmental agreements, and poverty reduction strategies.
- Improvement of intersectoral collaboration between different tiers of government, government departments and NGOs.
- International capacity-building initiatives that assess health and environment linkages and use the knowledge gained to create more effective national and regional policy responses to environmental threats.
- Dissemination of knowledge and good practice on health gains from intersectoral policy.

5.4 How should priorities for these options be established?

The process for deciding priority options varies across jurisdictions, institutions and cultures. The MA has identified a series of elements that tend to improve outcomes for ecosystems and human well-being (R18.ES) including the following.

- Use of best available information with consideration of the full range of effects of policies, including trade-offs, across ecosystem services.
- Where possible, valuation of both marketed and non-marketed ecosystem services.
- Aim to maximize efficiency (benefit per unit investment) but not at the expense of effectiveness (overall benefit).
- Consideration of equity and vulnerability in terms of the distribution of costs and benefits.
- Recognition that not all values at stake can be quantified, thus quantification can provide a false objectivity in decision processes that have significant subjective elements.
- Provision of regular monitoring and evaluation.

Use of certain quantitative tools may support priority setting. In the health sector, risk assessments are conducted (e.g. using burden of disease tools) to estimate the direct health gains that could be obtained from alleviating a particular risk factor. Cost-effectiveness analysis (CEA) may be used to assess the health benefits of policy options directly against financial costs in order to select options that maximize health efficiency.

However, many policies have effects across multiple ecosystem services, often with long-term, diffuse and uncertain effects on both health and non-health aspects of well-being. In these cases decision-making may be supported better by a combination of techniques, including cost-benefit analysis (which value diverse benefits in the same units, usually monetary); analysis of the distribution of costs and benefits across different socioeconomic groups; and qualitative considerations of the precautionary principle.

Once a decision to intervene has been made, cost-effectiveness criteria also can be used to select a preferred intervention among various alternatives (R16). Increasingly, approaches such as CEA are used to set priorities among interventions that will bring similar health gains - when the main factor that distinguishes between the interventions is their cost. Policy-makers can use cost-effectiveness ratios (e.g. dollars per DALY) of the various options to select those that provide the greatest health gains for any specified level of resources. Thus, CEA can be useful to compare similar kinds of policies whose effects are limited mainly to the health sector and are comparable in terms of deaths or DALYs. An analysis of cost-effectiveness across different socioeconomic groups can be conducted in order to gain more information about how interventions are likely to benefit particularly vulnerable groups in the population.

5.5 How can stakeholders and policy-makers be involved?

In order to affect either official policy or individual behaviour, it is necessary to take account of how risk is perceived among vulnerable communities. Effective risk communication strategies maximize the chances that policy interventions will enjoy popular support, and thus be successfully implemented. .

Vulnerable communities that are most likely to be affected by ecological changes should be involved throughout the entire policy-focused assessment process, not as an afterthought. Community engagement in the process provides access to local knowledge about the effects of ecological factors, ensures that the assessment addresses the issues of greatest concern to those affected, and maximizes the probability that any recommended change in policy or behaviour will be adopted. If a source of information is not widely trusted, it is unlikely that recommended changes will be accepted.

WHO/Pierre Virot

Community surveys have shown that some groups tend to be regarded as highly trustworthy; others (such as government agencies) are treated with caution. Health care providers tend to be regarded as one of the high-trust groups, underlining again their important role in explaining the significance of healthy ecosystems.

Consultation should make the best use of the expertise of both stakeholders and researchers. Engagement of all relevant groups will also result in credible research with rapid translation into practice. Stakeholders may have expert local knowledge but inaccurate ideas of the true nature of risks associated with different factors; researchers should have more exact knowledge of disease processes and relative risks but may estimate inappropriately how general concepts apply to local situations. Accurate and accessible reporting of assessment results can remedy inaccurate risk perceptions and enhance the public's ability to evaluate science and policy issues. In many past policy experiences, poor reporting misled and disempowered a public that is affected increasingly by applications of science and technology.

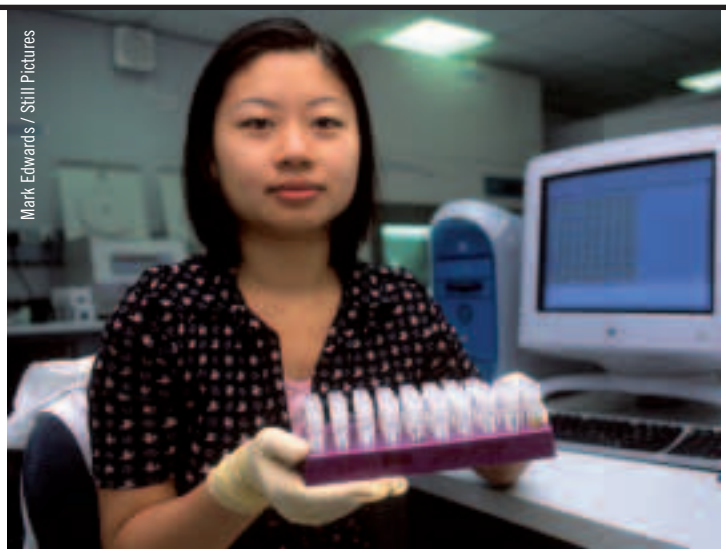
Emotive and economically important issues such as global environmental change present additional challenges to risk communication and to understanding risk perception. It is important to avoid overrepresentation of the views of a minority of the population who may emphasize only one aspect of an issue (special interest groups, for instance, may focus only on the need to conserve ecosystems without reflecting wider societal interests in enhancing economic growth too). Such groups can include industries that perceive action to protect the environment to be harmful to business. They may have significant resources to promote assessments of risks or public perceptions that are consistent with their own financial interests, not necessarily the interests of the wider population.

5.6 How does uncertainty affect priority-setting?

There are unavoidable uncertainties about the impacts of global environmental changes on public health. These include the potential magnitude, timing and effects of global environmental change; sensitivity of health to changes in ecosystem services; effectiveness of different courses of action in addressing potential impacts; and the shape of future societies (e.g. changes in socioeconomic and technological factors, and associated disease burdens). Traditional epidemiological methods are not well-suited to such issues as they are designed to test the influence of discrete risk factors on well-defined health outcomes (such as smoking's effect on lung cancer) and to emphasize avoidance of an incorrect identification of a harmful effect. In contrast, global environmental change has diverse and wide-ranging rather than discrete effects on individuals or small areas and an absence of control groups. It may be difficult or impossible to reverse, so false negative effects are equally as important as false positives. However, new epidemiological methods are being developed to predict the emerging health impacts of environmental change.

The level of uncertainties and the unsuitability of standard approaches lead many scientists to avoid attempting to answer some questions posed directly by decision-makers. For example, a policy-maker may ask whether a particular mitigation strategy is likely to lead to overall benefits or harm to health. Scientists tend to respond with a scientifically more rigorous and less uncertain answer to a small part of the equation (such as a demonstration that climate variations cause increases or decreases in disease vector abundance in a specific location).

It is important that scientific assessments attempt to give direct answers to decision-makers' questions, even if they can be only very approximate. However, it is essential that any such assessments be accompanied by an accurate and understandable description of underlying assumptions, associated uncertainties and the implications of the uncertainties for the potential outcomes of decisions being made. Sometimes it is argued that the existence of these uncertainties precludes policy-makers from taking action to mitigate and adapt to global environmental change. This is misleading, since decision-makers (from politicians to individual citizens) make many decisions with uncertain outcomes every day. An informed decision is better than an uninformed one. Uncertainties attached to potentially large and irreversible risks strengthen rather than weaken the case for precautionary action.



HIV Research.

Indigenous residents of an Indonesian forest region use a Global Positioning System (GPS) to map boundaries, prevent illegal logging and thus protect vital ecosystem services upon which they depend.

Scientific assessments can provide decision-makers with a range of information on how actions to deal with global environmental change may address their concerns. These include, for example, identifying interventions that provide the greatest health protection for the lowest costs and that correspond to their values, such as fairness and equity. It may appear that by providing several different approaches to priority-setting and failing to recommend specific courses of action, the scientific community is providing a poor service. This is not the case. By presenting different kinds of approaches, assessments can be "policy-relevant, but not policy-prescriptive"- helping to clarify the current state of knowledge in relation to decision-makers' values but leaving them with the final decision on whether and how to act. Scientists fail in their responsibilities when they describe current scientific understanding of issues in a manner that does not relate to decision-makers' concerns; provides information biased towards particular subgroups or special interests; or hides uncertainties in an assessment of an action or inaction.