

Needs and challenges

9.1 Introduction

Chapters 1 to 8 of this report identify and assess the multiple contributions that biodiversity makes to food and agriculture, to the livelihoods of farmers, livestock keepers, fishers, fish farmers and forest dwellers, and to food security and nutrition. They document what is known about the status and trends of biodiversity for food and agriculture (BFA), the drivers of change affecting it, levels of adoption of management practices and strategies that promote its sustainable use and contribute to its conservation, and the state of policies, institutions and capacities related to its management. This final chapter draws together the various threads of the analysis to identify the main challenges to the sustainable management of BFA.¹

Securing and enhancing the multiple roles of BFA will require sustainable use and conservation of the ecosystems, species and genetic diversity that compose it. For this to happen, knowledge of the roles of biodiversity in the ecological processes that underpin food and agricultural production needs to be strengthened, and used to develop management strategies that protect, restore and enhance these processes across a range of scales. Establishing effective policy and outreach measures will be needed to support the uptake of management practices that sustainably use biodiversity to promote food and livelihood security and resilience.

¹ Needs and challenges related to the sustainable use and conservation of plant, animal, forest and aquatic genetic resources are discussed in detail in the respective global assessments (FAO, 2010a, 2014a, 2015a, forthcoming).

9.2 Drivers of change

BFA is affected by a variety of interacting drivers of change: global effects, such as climate change and the operations of international markets, give rise to more immediate drivers such as land-use change, pollution, overuse of external inputs, overharvesting and the proliferation of invasive species. While there are many potential means of addressing immediate threats through the adoption of various sustainable management practices and the implementation of conservation measures, these may be neglected or overwhelmed unless political will is found to address higher-level drivers. It is also essential to build on the opportunities that are emerging as a result of trends such as growing consumer demand for biodiversity-friendly products.

At minimum, there is a need to: (i) better understand the effects of drivers of change on BFA and take urgent action to address those that are undermining the sustainability of food and agricultural production; (ii) improve the monitoring of recognized threats to BFA, such as habitat destruction, pollution, inappropriate use of agricultural inputs, overharvesting, pests, diseases and invasive alien species, and strengthen efforts to reduce them or mitigate their effects; (iii) promote the use of technologies and management practices that have positive effects on BFA and the supply of ecosystem services; (iv) implement policies that help to protect biodiversity from the effects of negative drivers and support its sustainable use; (v) remove or revise policies that have harmful effects; and (vi) promote the use of BFA in climate change

PART E

adaptation and mitigation, in disaster-risk reduction and in addressing other drivers that negatively affect production systems and the supply of ecosystem services.

9.3 Status and trends

Many key components of BFA at genetic, species and ecosystem levels are in decline. While the general declining trend – and hence the need for action – is clear, lack of data often constrains the planning and prioritization of effective remedial measures.

The extent and nature of knowledge gaps vary across the components of BFA. In the case of domesticated species and those that are widely harvested from the wild, species inventories are largely complete and the range of within-species populations (breeds, varieties, etc.) is often also well documented, although to varying degrees across the regions of the world. In contrast, many associated-biodiversity species (species that live in and around production systems and provide regulating and supporting ecosystem services), particularly micro-organisms and invertebrates, have never been documented.

Population trends are relatively well monitored for some taxonomic groups (e.g. vertebrates). For many others, however, knowledge is very limited, even at species level, and almost non-existent at within-species level. Moreover, where monitoring programmes for associated biodiversity are in place, population data are often not linked to spatial data on the distribution of production systems and hence potential impacts on production can be difficult to evaluate. In many cases, the contributions of specific components of BFA to the supply of ecosystem services are poorly understood.

There is an urgent need to improve the availability of data in all the above fields. Doing this will require, *inter alia*, improving methodologies for recording, storing and analysing data on changes in the abundance and distribution of species (including improving geographic information system facilities) and increasing the supply of

taxonomists with the skills needed to work with currently neglected taxonomic groups. Strengthening research, education and capacity-building programmes will be essential. Cooperation needs to be improved, including between the public sector and other stakeholders. In a number of countries, certain types of associated biodiversity are monitored through citizen-science projects, and there may be potential to expand activities of this kind and introduce them more widely.

Effective monitoring requires systematic and long-term commitment. The roles and responsibilities of key stakeholders need to be clearly defined. Where they do not currently exist, it may be necessary to establish national bodies to organize or oversee monitoring activities.

9.4 Management

9.4.1 State of use

A range of management practices and production approaches that can potentially contribute to the conservation and sustainable use of BFA are increasingly being implemented around the world. Detailed information on trends in such practices is, however, often limited, as is detailed information on their impacts on BFA and the supply of ecosystem services. Uptake is constrained by a variety of factors.

Overall, one of the major constraints to the development, adoption and implementation of management practices and approaches that contribute to the sustainable management of BFA is a lack of data on the characteristics of relevant ecosystems and limited understanding of ecosystem functions and services, including specifically on the roles of different components of BFA. Action needs to be taken to address knowledge gaps of this kind.

Many BFA-focused practices are relatively complex and require good understanding of the local ecosystem. They can be knowledge intensive, context specific and provide benefits only in the relatively long term. Many countries note major

challenges in up-scaling such practices and identify the need to promote them through capacity development and by strengthening incentives and policy frameworks.

Although circumstances vary greatly from country to country and across production systems, a number of broad priorities with widespread relevance can be identified. On the institutional side, policy and regulatory frameworks may need to be reviewed to assess whether they provide the necessary support to the introduction or upscaling of more sustainable and biodiversity-friendly practices and to identify any ways in which they may operate as constraints. Fuller consultation between policy-makers and a range of stakeholders, including producers, can potentially help to overcome disconnections between political and operational levels.

Where supportive frameworks are in place, any constraints to their implementation, including financial constraints, need to be identified and addressed. Education and training on sustainable management practices often need to be improved, both to increase skills and knowledge at producer level and to increase the supply of trained and qualified technical and scientific personnel (both specialists and experts with cross-disciplinary knowledge). In some places, constraints related to weaknesses in transport and communications infrastructure will need to be addressed. Everywhere, efforts will be needed to increase knowledge of how effective particular practices and approaches are in promoting the sustainable use and conservation of BFA.

The following paragraphs describe key needs and challenges related to specific management practices and approaches.

Ecosystem, landscape and seascape approaches

While available evidence suggests that there are positive trends in the adoption and implementation of ecosystem, landscape and seascape approaches in the context of food and agriculture, assessment of developments in this field is constrained by a lack of clarity regarding the nature

of these approaches and the multitude of terms used to describe them. Efforts may be required to promote common understanding in this regard, as well as to increase and disseminate knowledge on the potential benefits of such approaches.

Developing effective integrated approaches requires research on: (i) the functional roles of various components of BFA in key ecosystem processes within production systems and in wider landscapes or seascapes; and (ii) the effects that adopting such approaches have on components of BFA. The latter will require better surveying and monitoring in relevant ecosystems and the development of appropriate indicators.

Information on the application of ecosystem, landscape and seascape approaches and other innovative strategies that may be beneficial to BFA often fails to reach producers and other land or water users, or only does so after substantial delays. Priorities in this field therefore include better capturing and disseminating lessons-learned from the implementation of such approaches, including success stories.

Ecosystem, landscape and seascape approaches require cross-sectoral thinking and collaboration. This creates significant challenges to their adoption, given that institutional frameworks (policies, laws, organizational structures, etc.) are still very much compartmentalized and that there is a lack of holistic and multidisciplinary approaches both at policy level and at the level of practical implementation.

Restoration practices

Restoration practices have acquired a prominent place on the global environmental agenda in recent decades. If well planned, they can provide simultaneous benefits for agricultural productivity, biodiversity conservation and the supply of ecosystem services. Among ecosystems of importance to food and agriculture, forests and grasslands, as well as of a range of freshwater, marine and coastal ecosystems, are widely recognized as priorities for restoration. Depending on the location, key forest restoration activities are likely to include restoring connectivity between forest

PART E

fragments and restoring forest cover in areas that are important to the supply of hydrological and erosion-control ecosystem services. Where aquatic ecosystems are concerned, mangroves, seagrass beds, coral reefs, coastal sand dunes, lakeshores and riverbanks are among the key targets for restoration. Priorities will often include improving connectivity within and between aquatic ecosystems and enhancing significant habitats such as fish spawning sites. Attention will need to be paid to the threats posed by climate change.

Diversification and management practices at production level

The use of a number of diversification strategies in food and agricultural production systems seems to be increasing. Evidence indicates that agroforestry is becoming more widespread in all regions of the world. Priorities in terms of strengthening the contributions of agroforestry to sustainable development include addressing problems in germplasm supply, improving the provision of marketing advice and developing a better understanding of gender-related implications. Home gardens are major reservoirs of BFA in many parts of the world. However, knowledge of the status and trends of these systems is limited. In the case of diversification in aquaculture, while traditional extensive diversified systems are tending to decline as a consequence of resource constraints, innovative polyculture approaches are creating opportunities to increase efficiency and tackle problems related to fish health and effluent discharge. Integrated crop–livestock systems remain widespread globally. There is need for research into how complementarities between crop and livestock production can be enhanced in the context of limited availability of land and other resources, including research into the significance of within-species genetic diversity.

The use of many management practices believed to help promote the conservation of BFA, or that utilize BFA in a sustainable way, is reportedly increasing, as is awareness of the benefits of such practices among consumers, producers, governments and international agencies. This

appears to be the case, for example, for organic agriculture, low external input agriculture, management practices implemented with the aim of preserving and enhancing soil biodiversity, conservation agriculture, integrated plant nutrient management, integrated pest management, pollination management and sustainable forest management practices. Nevertheless, the availability of global data on the levels of implementation of many of these practices remains limited, and knowledge of their impacts on BFA and the supply of ecosystem services needs to be improved.

Biodiversity-based and biodiversity-friendly management practices generally require detailed knowledge of local production systems and ecosystems and are often relatively labour intensive. Consequently, their implementation tends to require the active participation of producers and their organizations, as well as the presence of effective extension services. Management interventions often need to extend beyond farm boundaries into the broader landscape or seascape. Attention needs to be paid to maintaining or restoring ecosystems that deliver services to food and agriculture and conserving the species and genetic diversity that will allow adaptation to changing conditions.

The use of micro-organisms in food processing and agro-industrial processes

Micro-organisms make multiple contributions to food processing and agro-industrial processes, and there is greater potential to expand these roles still further. Potential threats include the loss of knowledge associated with traditional food-processing practices that are in decline and the effects of climate change on microbial communities. Key tasks include improving frameworks for quality control of microbial products and for evaluating potential risks to human health or to the environment, improving registration policies for microbial products, improving education and awareness-raising, and strengthening research and conservation networks.

Rumen microbial diversity

Given their vital contributions to livestock production and their role in the production of greenhouse gases, there is an urgent need to improve knowledge of rumen micro-organisms and their functions. Considerable progress has been made in this regard in recent years, but fundamental knowledge gaps remain to be addressed.

Genetic-improvement activities

Genetic-improvement programmes for domesticated crops and livestock are well established globally, although many species and within-species populations are neglected. Programmes for trees and species used in aquaculture are becoming more widespread. Genetic-improvement activities for other components of BFA are generally uncommon, with the exception of silkworms and honey bees. There could be benefits in extending domestication and genetic-improvement activities to other invertebrate species that contribute to food and agriculture, including stingless bees, which have been found to be more effective pollinators than honey bees for certain crops, and insects that can be raised for human consumption or as animal feed. Activities of this kind are already under way in several countries. Efforts are also being made to develop methods for assisted evolution of climate resilience in corals.

9.4.2 State of conservation

Methods and strategies for *in situ* (including on-farm and in other production systems) and *ex situ* conservation of BFA, in particular of associated biodiversity, need to be improved and information on them made more widely available. Especially with respect to *ex situ* conservation, there are still technical barriers to the long-term conservation of some species. Overcoming these gaps and constraints will often require increased funding, better training of relevant personnel and better provision of technical resources. Where skills are concerned, improving capacity in the fields of taxonomy and systematics is a widespread priority. Conservation-related education, training and awareness-raising activities for stakeholders

at all levels from producers to policy-makers need to be strengthened. Improving conservation methods and strategies for BFA and strengthening their implementation will also require a more interdisciplinary approach. As and where relevant, the contributions that traditional production practices and resource-management strategies associated with local or indigenous communities make to the conservation of BFA need to be given due recognition and built on, with the participation of the communities concerned. Maintenance and transfer of relevant traditional knowledge should be supported and facilitated.

While there will often be a need to target individual species or populations that are at particular risk, components of BFA should not be considered in isolation from each other or from wider ecosystems, landscapes and seascapes. Potential synergies need to be explored, whether in terms of management strategies at production-system or landscape level that create opportunities to diversify more than one category of BFA or in terms of more efficient use of resources. Productive landscapes and seascapes need to include the habitat features necessary to support the associated-biodiversity species that underpin food and agricultural production. Ensuring that this is the case will, in places, require the restoration of degraded habitats and maintaining or recreating wildlife corridors linking patches of habitat. Given their focus on integrated action across multiple scales and on accounting for the interests and concerns of a wide range of stakeholders, ecosystem, landscape or seascape approaches (see above) may provide useful frameworks.

Conservation measures for wild foods should also not be neglected. As with other components of BFA, conservation strategies need to be based on a sound understanding of the range of species involved, their distribution, characteristics, uses and risk status. Inventory and characterization efforts for this category of BFA generally need to be strengthened. Strategies need to be put in place that allow nutritional benefits to be realized in a sustainable way and threats such as overharvesting to be identified and addressed.

PART E

9.5 Policies, capacities and institutions

Cooperation

Ensuring the sustainable use of BFA requires improved collaboration among a range of stakeholders at local national and regional levels. Synergies between the food and agriculture and environmental sectors, in particular, need to be strengthened. Constraints to cooperation often relate to a lack of mechanisms for exchanging information among and between stakeholder groups or a lack of participatory decision-making processes. Mechanisms for involving small-scale producers, and women and youth in particular, in decision-making processes need to be improved. Greater cooperation between sectors provides opportunities to increase efficiency and can be a means of securing resources for BFA-related work. Training and awareness-raising on the organization of collaborative initiatives is also needed.

Research

As discussed above, the sustainable management of BFA, in particular associated biodiversity, is constrained by numerous knowledge gaps. Research programmes need to be strengthened and the necessary research infrastructure put in place, including by addressing shortages of specialists in relevant fields. This in turn creates the need to strengthen educational curricula and improve training (see next subsection). All these measures will require adequate funding, as will improving the dissemination of research results. Strengthening research-related information systems, such as systems for monitoring the status and trends of components of biodiversity or for managing relevant geographical data, is a widespread priority, both as a means of disseminating research outputs and as a means of making relevant information available to researchers.

Research is also often constrained by a lack of coordination between research institutions or between researchers working in different disciplines or in different sectors (both within

and beyond food and agriculture). Improving coordination and linkages between institutes nationally, and at regional and international levels, potentially provides opportunities both to strengthen interdisciplinary work and to allow more efficient use of resources and information. Links between research and practical management at production-system level also need to be improved. This could involve, *inter alia*, improving researchers' links to producers, extension services and other relevant stakeholders, including by promoting greater participation throughout research-project cycles from planning to monitoring, and integrating indicators of practical impact into evaluation mechanisms for research projects.

Education, training and awareness-raising

Education and training on the management of BFA at all levels need to be strengthened, as does awareness raising on the importance of BFA among a range of stakeholders, including policy-makers and the general public. Biodiversity-related issues tend not to be well integrated into higher-education courses on food and agriculture or on other aspects of land use. Courses related to biodiversity conservation are often disconnected from those related to the use of biodiversity (i.e. on agriculture, forestry, fisheries, etc.), potentially leading to a lack of interdisciplinary skills among professionals. There is often also a need to improve the supply of graduates trained in specific fields such as taxonomy, economic valuation and cryoconservation. Ongoing capacity development among professionals and technicians is also essential.

While training for producers on the sustainable use of BFA is often inadequate, countries report a variety of success stories in this regard (for example with farmer field schools) and there are likely to be opportunities to expand, adapt and build upon some of these. Constraints to the participation of women in BFA-related education need to be addressed, and relevant extension and training programmes need to be better tailored to women's needs.

As well as organizing training activities, there is a need to improve access to information

(e.g. via publications and information systems) and create opportunities for stakeholders to interact and exchange knowledge and ideas. Improving the state of education and training will require addressing shortfalls in funding and improving cooperation and exchange of information between educational institutions and between them and other stakeholder groups.

Policy and legal frameworks

Appropriate legal and policy frameworks are essential to the effective management of BFA. However, they often remain underdeveloped or poorly implemented. Shortcomings of this kind can, for example, mean that it is difficult to ensure support for long-term activities such as monitoring. Such problems can partly be attributed to a lack of adequate coordination between the food and agriculture and nature conservation sectors and to a lack of awareness of the significance of BFA among policy-makers. Overcoming these constraints will require, in addition to awareness-raising efforts, greater involvement of multiple stakeholders in policy-development. Links between research and policy-making also often need to be improved.

For policies to have an impact, the resources needed to implement them will need to be found.

Where access and benefit-sharing (ABS) are concerned, the main priorities that can be identified are capacity-building on the development and implementation of ABS measures, and improving coordination between ministries, agencies and stakeholders responsible for ABS in the various sectors of food and agriculture.

Valuation

Valuation studies are widely regarded as a potential means of drawing attention to the important contributions that biodiversity and ecosystem services make to human well-being and as a means of guiding the development of policies, research programmes and incentive schemes. There are, however, many gaps in terms of the coverage of such studies, for example with respect to microbial genetic resources and wild pollinators. Potential means of strengthening work in this field include

fostering cross-sectoral and interinstitutional cooperation in valuation efforts, standardizing methodologies and tools, and mobilizing financial resources.

Incentives

Although incentive programmes supporting the sustainable management of BFA are becoming more widespread, such schemes are often isolated measures targeting the particular concerns of individual public programmes, private-sector operations or civil-society initiatives, and in many cases are very localized. Evidence suggests that a coordinated package of measures can create more impact in terms of improving outcomes for BFA. Other priorities include better documenting and mapping existing schemes, taking a longer-term perspective in planning, and improving cross-sectoral cooperation and institutional collaboration so as to improve the coordination of multiple incentives.

9.6 Towards a more diverse and sustainable future

BFA and the ecosystem services it supports are fundamental to efforts to increase the resilience, sustainability and productivity of food and agricultural systems, sustain livelihoods and enhance food security and nutrition around the world. Yet, much of the planet's BFA – ecosystems, species and within-species genetic diversity – is being eroded, often at an alarming rate. Urgent action and long-term commitment are needed, both to enhance the multiple contributions that BFA makes to sustainable development and to tackle the multiple threats currently driving its loss. This will require the involvement of stakeholders at all levels, nationally and internationally. Governments will need to take concrete steps to ensure their responsibilities in this field are fulfilled, particularly in light of the significance of BFA to efforts to meet the 2030 Sustainable Development Goals.

Positive global developments include, on the one hand, growing awareness internationally of

PART E

threats to the sustainability of food and agriculture, including those related to the loss of biodiversity, and on the other, upward trends in levels of adoption of various management practices that potentially contribute to the conservation and sustainable use of BFA. These developments need to be built upon by the global community. Knowledge gaps need to be filled, cooperation strengthened, including cross-sectorally and internationally, and financial, human and technical resources mobilized. Effective legal and policy frameworks need to be put in place.

The country-driven process of preparing *The State of the World's Biodiversity for Food and*

Agriculture has led to the identification of numerous gaps, needs and potential actions in the management of BFA. The next step is to take action. Over the years, the Commission on Genetic Resources for Food and Agriculture has overseen the development of global plans of action for genetic resources in the plant, animal and forest sectors. Implementation of these instruments needs to be stepped up. Consideration also needs to be given to how the international community can more effectively promote synergies in the management of all components of biodiversity, across these sectors and others, in the interests of a more sustainable food and agriculture.

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