UNEP

Handbook on Integrated Assessment of Trade-related Measures

The Agriculture Sector

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Acknowledgements

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Economics and Trade Branch

The Economics and Trade Branch (ETB) is one of the five branches of DTIE. Its mission is to enhance the capacities of countries, especially of developing countries and countries with economies in transition, to integrate environmental considerations into development planning and macroeconomic policies, including trade policies. ETB helps countries to develop and use integrated assessment and incentive tools for sustainable development and poverty reduction. The Branch further works to improve the understanding of environmental, social and economic impacts of trade liberalization and the trade impacts of environmental policies, and to strengthen coherence between Multilateral Environmental Agreements and the World Trade Organisation. Through its finance initiative, ETB helps enhance the role of the financial sector in moving towards sustainability.

In the field of environmental economics, ETB aims to promote the internalisation of environmental costs and enhance the use of economic instruments to contribute to sustainable development and poverty reduction, including in the specific context of Multilateral Environmental Agreements. The UNEP Working Group on Economic Instruments, serves as an advisory body to UNEP-ETB's work programme on economics and has been instrumental in the preparation of UNEP publications on economic instruments.

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Executive Summary

The World Summit on Sustainable Development (WSSD) has identified trade as a tool for achieving sustainable development. In this regard, trade liberalization is not considered as an aim in itself but rather one means, among a number, of achieving sustainable development and reducing poverty. However, trade policies, if not properly designed, could lead to environmental damage and reduce the benefits of liberalization to large segments of people. The United Nations Environment Programme (UNEP) country studies have demonstrated that the design of accompanying measures and "flanking policies" can substantially enhance the contribution of trade to sound environmental management, mitigation or avoidance of environmental degradation and to poverty reduction.

To enhance the policy relevance of environmental and social measures that accompany trade agreements, flanking measures should be just the beginning. Sometimes perceived as "add-ons" they can be viewed with less importance and can be easily disregarded, particularly if they have financial implications. Developing trade, environment and social policy together in an integrated fashion will enhance policy coherence and improve the effectiveness of policies to achieve sustainable development. This coherence is the ultimate goal of UNEP's work on integrated assessment (IA) of trade.

UNEP has thus adopted an approach to IA that prioritises policy relevance. In the agriculture sector, the aim is to define concrete policy options to promote opportunities and address challenges raised by liberalization in the agricultural sector – ultimately to encourage the relevant stakeholders and government departments to work together, identify threats and opportunities for trade, the environment and development, and put in place policies that are designed to operationalise any trade-offs and find opportunities for policies that are mutually supportive with the goal of furthering progress towards sustainable development.

In many respects, this exercise reflects *ex ante* planning for sustainability. It must be undertaken based on a well-defined purpose and employ a process that leads to policies that are acceptable and implementable by stakeholders and governments in a position to influence change as necessary. The dialogue should rest on a process that has at its core meaningful multidisciplinary participation and consensus building.

At the outset, a broad net should be cast that canvases priority areas from an economic, environmental and social perspective associated with the sector, specific commodities and/or regions and ecosystems as well as consideration of issues that characterise production and trade flows. An IA should include key variables that allow a practitioner to adopt an "ecosystem" approach to examining agriculture. This involves considering the interaction between human activity, ecosystems, development and ultimately sustainability. It also involves examining both the demands made by agriculture on ecosystems as well as the services it can provide.

The core of the IA will be the relationship between sustainability priorities and trade measures. The scope of an IA can range from analysing specific trade measures, such as the impact of a subsidy or tariff, to comprehensive multilateral agreements or regional trade agreements extending to investment and

institutional issues affecting global or regional governance. The extent and complexity of the IA will differ according to the type of trade measure or agreement under consideration, as well as the legal or administrative structure of the country concerned, and the level of resources available to conduct the assessment. Examples of trade measures that might be relevant in an IA include, *inter alia*, market access, export subsidies, domestic support, sanitary and phytosanitary (SPS) standards, investment, or intellectual property rights. These measures should be situated in their relevant macro and micro economic context.

Undertaking a successful IA is a difficult and complex exercise, but there is experience that can be built on as the theory and practices of carrying out IAs of trade measures and agreements evolves. Existing methodologies are being employed and refined and new ones developed for identifying the impacts of policy changes, including trade liberalization, on sustainability. Experience in UNEP's country studies and elsewhere suggests that an IA of a specific trade measure or agreement should rely on a combination of qualitative and quantitative techniques. The precise nature of this mix of techniques will depend on the scope of the IA itself. Concrete empirical data might be available for an *ex post* assessment while an *ex ante* assessment might rely on projections. Similarly, a study that prioritises biodiversity might rely on indicators that are qualitative, whereas one that examines industrial pollution intensities associated with manufacturing may have access to reliable reported time-series data. Moreover, there are a range of computable general equilibrium (CGE) and partial equilibrium (PE) models that are increasingly being employed to examine issues of poverty and income distribution. Some quantitative methodologies can be difficult to apply in practice to IA where issues are at the same time very complex, and subtle relationships can have important sustainability impacts. As necessary, qualitative approaches should be applied using sound social science techniques employing the best available data to ensure results that are comprehensive and credible.

In all cases, the approaches and techniques employed will depend to some degree on the availability of reliable data; a lack of reliable statistics and time-series data can hamper efforts to accurately project future impacts. In addition, where countries or regions typically rely to a large degree on an informal economy, efforts to model projected change can become even more uncertain. Nevertheless, even where challenges exist with respect to data availability, IAs should be viewed as opportunities to identify data gaps and encourage the collection of relevant information for future endeavours.

Typically, policy responses should be developed to address priority impacts, mitigate any negative impacts of liberalization, and promote positive impacts. They can include a broad range of approaches including command and control, market-based incentives, and institutional policies. Moreover, in identifying relevant policies within an IA, a researcher should also take into account issues of timing, and address issues where policy intervention is urgent. Finally, care should be taken to identify the spatial focus of that policy in terms of the farm level, the national level, the regional level or the global level.

Highlights of an integrated assessment of trade-related measures on the agriculture sector

- Identify the most important objective(s) driving the process:
  - define the overall purpose
  - link to relevant existing planning processes.

- Develop the IA through a process that is transparent, inclusive and participatory by:
  - allocating responsibilities
  - identifying stakeholders
  - assessing information needs
  - identifying a mechanism for disseminating information and ensuring consultation and dialogue.

- Prioritise a specific commodity or activity within the agricultural sector and include related sectors.

- Identify and prioritise the most relevant issues associated with economic, environmental and social sustainability in terms of the agricultural sector generally or a specific commodity, in the context of a particular geographic region.

- Employ an "ecosystem approach" recognizing the interaction between human activity, ecosystems, development and sustainability.

- Define to what extent human activity in the agricultural sector supports or detracts from the ecosystem's ability to provide essential services – both indirectly and directly. To do so, the following questions should be asked:
  - what are the most important issues in terms of economic sustainability?
  - what are the most important issues in terms of social sustainability?
  - what are the most important issues in terms of environmental sustainability?
  - what are the linkages between these areas, root causes of unsustainable behaviour, and priorities for the IA?

- Define the indicators that best represent the sustainability priorities.

- Identify the trade measures most relevant for the commodity(ies) being examined.

- Include trade measures that might be relevant in an IA, for example, market access; export subsidies; domestic support; standards and conformity assessment; investment; intellectual property rights.

- Consider other macroeconomic and microeconomic forces that might have independent impacts on sustainability, unrelated to trade or indirectly related to trade.

- Identify technique(s) to employ for IA. These will generally consist of a mix of quantitative and qualitative methods:

- **Some Quantitative Methods**:
  - CGE models (e.g., IMMPA or Augmented CGE Model with Representative Household Approach for, *inter alia*, employment, poverty and income distribution, or a Global Trade Analysis Project (GTAP) with an environmental component or other developing models for environmental issues such as land, water and air)
  - PE models (e.g., Reduced-form Estimation or Multi-Market models, for assessing poverty and income distribution)
  - Cost-Benefit Analysis

- **Some Qualitative Methods**:
  - Desk research, stakeholder meetings, questionnaires, field research, interviews (in-depth, informal), causal chain analysis (CCA).

- Prioritise potential risks and actual impacts.

- Based on the results of the IA, develop policies to mitigate negative impacts of trade liberalization and promote positive impacts. This can be achieved through policies that :
  - **promote capacity building**: to improve compliance with international standards, access to multilateral organisations and trade remedies, access to technology, improved research, infrastructure and data collection;
  - **are trade-related**: to build policy coherence, to address subsidies, domestic support, market access, trade facilitation, work towards the convergence of standards, ensure sustainability is promoted through investment;
  - **are non-trade related**: implementing complementary environmental and social policies to mitigate existing negative impacts, minimise risk or prepare a country for future liberalization.

Abbreviations and Acronyms

AMS	Aggregate measure of support
AoA	Agreement on Agriculture (WTO)
APEC	Asia-Pacific Economic Cooperation forum
CAP	Common Agricultural Policy (EU)
CCA	Causal chain analysis
CGE	Computable general equilibrium
CH_4	Methane
CO_2	Carbon dioxide
DPSIR	Driving force-Pressure-State-Impact-Response
DSR	Driving Force-State-Response
EEA	European Environment Agency
ETB	Economics and Trade Branch (UNEP)
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign direct investment
FTAA	Free Trade Area of the Americas
GATT	General Agreement on Tariffs and Trade
GDP	Gross domestic product
GHG	Greenhouse gas
GMO	Genetically modified organism
GTAP	Global Trade Analysis Project
IA	Integrated assessment
IMMPA	Integrated Macroeconomic Model for Poverty Analysis
IPM	Integrated pest management
IP	Intellectual Property
IPR	Intellectual Property Rights
ISO	International Standardisation Organisation
JAPA	Jiangsu Agricultural Policy Analysis
N_2O	Nitrous oxide
NAFTA	North American Free Trade Agreement
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Cooperation and Development
OPV	Open-pollinated variety
PE	Partial equilibrium
PSR	Pressure State Response
SIAP	Strategic integrated assessment and planning for sustainability
SPS	Sanitary and phytosanitary
TRQ	Tariff rate quota
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	UN Framework Convention on Climate Change
UR	Uruguay Round
USDA	United States Department of Agriculture
WHO	World Health Organisation
WCED	World Commission on Environment and Development
WSSD	World Summit on Sustainable Development
WTO	World Trade Organisation

Introduction

At the WSSD in 2002 governments adopted a Plan of Action to pursue sustainable development, which includes elements aimed at reducing poverty, changing unsustainable patterns of production and consumption, and protecting and managing the environment and the natural resource base for economic and social development. Throughout the Plan of Action special attention is paid to the agriculture sector. It is highlighted as important for poverty reduction through a focus on infrastructure, transportation, access to markets, food security and technology transfer. It is also highlighted as vital for the protection and management of the natural resource base for economic and social development. Issues including land and water use and management are fundamental to the agricultural sector. Managing these resources in an integrated manner will be essential for achieving sustainable development.

The WSSD Plan of Action indicates that IA or reviews should be adopted to identify the impacts of trade, investment and capital flows on sustainable development.[1] At the WSSD UNEP was directed to cooperate with other organisations including other United Nations (UN) agencies and the World Trade Organisation (WTO) on issues related to trade, environment and development and to use assessments as tools to identify the linkages between the three policy areas.

As a contribution towards this work, UNEP is developing tools for integrated planning for sustainability that include IAs applied over a broad range of policy areas. A core component of this work is developing an approach to Strategic Integrated Assessment and Planning for Sustainability (SIAP), which includes process principles and an analytical framework suggesting practical means to apply an integrated approach to planning.[2] SIAP is intended to facilitate planning for environment and development issues in the broad context of sustainable development. It combines techniques for environmental assessment and integrated planning, and is intended to strengthen existing tools and processes.

This *Handbook on Integrated Assessment of Trade-related Measures: The Agriculture Sector* (hereafter the *Handbook*) contributes to UNEP's work in this area, moving towards goals that were set out at the WSSD. It also builds on UNEP's past work on IA presented in its *Reference Manual on the Integrated Assessment of Trade and Trade-Related Policies* (hereafter, the *Reference Manual*) and incorporates lessons learned from UNEP's Round I and Round II country studies, a number of which focus on agricultural commodities. This *Handbook* has been developed in parallel with UNEP's Round III series of country

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[1] Environmental impact assessment (EIA) is an effective tool that has been usefully employed to determine the environmental impacts of major projects. In recent years, such assessments have been extended to consider policies and programs, including trade policies. The governments of Canada and the United States and the Organisation for Economic Cooperation and Development (OECD) have developed methodologies to identify the trade-related impacts of liberalization on the environment, and refer to the exercise as "environmental reviews". Other institutions have broadened this consideration of trade policy to look at economic, environmental and social issues. Such studies often include variables relating, *inter alia*, to poverty, employment, the mobility and quality of the labour force, migratory flows, living standards – including income levels and distribution – and cultural and gender issues. The European Commission calls its approach "Sustainability Impact Assessment". UNEP has adopted this broader approach to considering the impacts of trade policy on sustainability. In an effort to emphasize the need to consider environment, development and economic issues in an integrated fashion to promote sustainable development, UNEP uses the term "Integrated Assessment" to refer to an assessment that incorporates economic, social and environmental aspects.

[2] See UNEP, 2003a/draft.

studies on rice production. These studies illustrate the application of techniques for IA of trade and trade-related policies based on empirical evidence in a range of developing countries.

Consistent with its prominent role at the WSSD and because of its close relationship to economic, environmental, social and poverty issues for regions and communities around the world, agriculture has been selected as the focus of this *Handbook*. Agricultural activity covers around a third of the world's land surface and provides a livelihood for many of the world's poorest and most marginalized people. Food and agriculture are centrally involved in prospects for economic growth, food security, and in the generation and reduction of poverty.

Liberalization of international trade is an important catalyst for overall development. The trade patterns of developing countries have changed rapidly over the past 40 years. Agricultural exports have grown modestly compared to those of manufactured goods, resulting in a dramatic decline in the share of agricultural exports in total traded merchandise from about 50 per cent (by value) in the early 1960s to around 6 per cent by 2000.[3] The UN's Food and Agriculture Organisation (FAO) has reported that the overall agricultural trade surplus of the exporting countries has virtually disappeared and predicts that by 2030 they will become, as a group, net importers of agricultural commodities (especially temperate zone commodities). As a group the Least Developed Countries are net importers of agricultural products and the FAO reports that their agricultural trade deficit is widening rapidly and could quadruple by 2030.[4]

Changes in trade regimes can be expected to exert pressures that have both positive and negative impacts on economic, environmental and social sustainability; there will be winners and losers. Some reports suggest that developing countries stand to gain less from trade liberalization than developed countries precisely because developing countries have become net importers of agricultural products, and modest increases in world prices are unlikely to turn them into net exporters. The FAO indicates that consumers in importing developing countries stand to lose more from trade liberalization than domestic producers are likely to gain. Where developing countries have a comparative advantage in such commodities as coffee, cocoa, tea, spices and tropical fruits, developed countries' import tariffs have already been reduced and the effects of further liberalization are likely to be small.[5] Moreover, growth in these exports is constrained by low demand in developed countries, and inadequate infrastructure and inefficient marketing systems often limit opportunities for diversification in developing countries. Some studies suggest that the benefits of liberalization will go mainly to consumers and taxpayers in industrial countries, where agriculture is most protected, and to developing country agricultural exporters. In contrast, urban and landless rural consumers in developing countries might end up paying higher prices for some foodstuffs, especially cereals, milk, meat and sugar.[6] The impacts of these developments on environmental and social sustainability will depend on the ultimate scale and mix of production and associated production practices and on the ability of producers to adapt to these changes, maintain or expand viable production, diversify, or find alternative livelihoods where specific agricultural production may no longer be viable and opportunities for diversification are not available.

In light of the potential for trade liberalization to affect important economic and other processes that will shape future directions for agricultural production, it is important to explore these linkages, inform policy makers and develop policy measures, where necessary, to ensure that development in the agricultural sector occurs in a way that supports sustainable development. An IA can contribute to this goal by

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[3] FAO, 2002c
[4] *ibid.*
[5] *ibid.*
[6] Anderson *et al*, 2000.

illustrating the linkages between trade, economics, environment and development to promote *ex ante*, planning and encourage policy-making that assists social groups likely to be "losers" in the process of liberalization and mitigating potential negative impacts on the environment while at the same time, promoting opportunities offered by liberalization.

This *Handbook* presents a range of economic, environmental and social issues that can be taken into consideration when assessing the impact of trade-related policies. Consistent with the *Reference Manual*, it emphasises the importance of an open, participatory process for IA and presents approaches for conducting assessments in the agricultural sector with a focus on poverty reduction. It also proposes relevant indicators and policy responses. This *Handbook* is intended to provide guidance to individuals, research organisations, governmental organisations and policy makers at the national level. The overall structure of the *Handbook* is illustrated in Figure 1.

Section 1 identifies preliminary considerations in planning the process for an IA. It focuses on two areas that provide direction to, and a framework for, the assessment itself: purpose and participation. An IA might have more than one purpose. Given the importance of agriculture to the economies, environment and development of many countries, gaining an improved understanding of linkages between liberalization forces and key sustainability issues may be one over-arching goal of any IA. Countries might undertake an IA to inform policy makers and trade negotiators of potential impacts on sustainability prior to the end of the negotiations (*ex ante* approach). Alternatively, following the negotiations, an IA can help countries design policy measures to mitigate potential negative impacts of liberalization on sustainability, or enhance any positive impacts (*ex post* approach). Section 1 also emphasizes the importance of developing a participatory process and puts forward a number of principles to ensure meaningful stakeholder participation.

Section 2 presents criteria for selecting priority activities or commodities for examination in an IA. For the purposes of this *Handbook*, agriculture is limited to the farm sector. Section 2 also provides a general introduction to some of the sustainability issues associated with the agricultural sector to help provide a context for the IA and suggest links between economic, environmental and social variables that might be useful in constructing a framework for analysis. It outlines issues and policies associated with the sector from an economic, social and environmental perspective. It then presents guidelines that can help practitioners identify key sustainability issues, problems, root causes and opportunities and set priorities. Once these contextual questions have been addressed, an IA on the impacts of trade liberalization should consider the relationship between sustainability issues identified and trade, the potential for changes in trade rules and trade flows brought about by liberalization to aggravate or improve the situation, and finally, develop policy recommendations to mitigate the negative impacts or to promote opportunities brought about by liberalization.

Section 3 introduces some trade measures that are closely linked with bilateral, regional and multilateral efforts to liberalise trade in the sector, and that may be associated with potential sustainability impacts. In conducting an IA a researcher should identify the most relevant trade measures. Typically these will be defined in the context of specific negotiating or planning scenarios contemplated as they relate to domestic policy, international agreements or regional initiatives. A sampling of measures in Section 3 includes market access, export competition, domestic support, intellectual property rights, standards and conformity assessment and investment. This section is not designed to limit the range of potential trade measures to consider but to illustrate the types of trade measures that might be included in an IA.

Section 4 presents a variety of approaches for analysis in an IA. It builds on previous work undertaken by UNEP in its *Reference Manual* and country studies and considers relevant techniques and approaches that

might be employed to analyse the relations between trade and sustainability issues within the agricultural sector. It focuses on ways in which practitioners can apply both quantitative and qualitative techniques and effectively demonstrate correlation between and among the key components of sustainability in the sector. In so doing, a series of questions are presented, related to various processes that can be examined to link trade-induced economic change to environmental and social impacts.

Section 5 addresses issues related to policy development, which should be the ultimate goal of any IA. An overriding consideration in this section is the opportunity to pursue policies that will contribute to capacity building. In some cases policy responses will be directly related to a trade agreement. In addition, given that changes due to technical progress and general economic development can be as pronounced as those brought about by an extension of commitments on agricultural trade liberalization an IA should also pay attention to non-trade related policies promoting sustainability in agricultural production. This second range of policy responses focuses on complementary environmental and social policies that could emerge from *ex ante* or *ex post* assessments. They might accompany the implementation of a trade agreement or be put in place following negotiations to enhance any beneficial effects or mitigate negative impacts of the liberalization and associated economic activity. The effective implementation of policy responses will involve follow up and monitoring through appropriate government agencies and relevant domestic players.

Figure 1: Structure of the *Handbook*

Section 1. Preliminary Considerations: Planning the Process

Section 2. Context analysis: Sustainability issues relevant for agriculture

Environmental sustainability

Social sustainability

Economic sustainability

Section 3. Relevant trade measures

Trade agreements and measures relevant to agricultural sector, planned, in draft form or finalized.

Section 4: Approaches and techniques for analyzing impacts

Section 5: Policy options for improved sustainability

1. Preliminary considerations: planning the process

Highlights

- Identify the most important objective(s) driving the process:
  - define overall purpose
  - link to relevant existing planning processes.

- Develop the IA through a process that is transparent, inclusive and participatory, by
  - allocating responsibilities
  - identifying stakeholders
  - assessing information needs
  - identifying a mechanism for disseminating information and ensuring consultation and dialogue.

UNEP has adopted an approach to IA and planning for sustainability that emphasizes the multidisciplinary nature of an IA, requiring cooperation between relevant government ministries and benefiting from the participation of a broad range of stakeholders. The participatory process underlying the IA depends on a well-defined and articulated purpose and process. An IA that has as its core a dialogue with stakeholders offers a practitioner concrete guidance in identifying key issues, indicators and policy options, and the prospect that outcomes of the exercise will be implemented and monitored.

1.1 Purpose

A first step in an IA of a trade agreement or trade-related policy is to articulate its purpose—why it is important and the objectives it seeks to fulfil. A clear statement of purpose will guide choices in subsequent stages of implementation and help define policy recommendations. IAs of trade liberalization may be driven by one overriding purpose, or can have multiple objectives. UNEP has identified five potential purposes associated with an IA (Box 1), which are described in detail in Section II of the *Reference Manual*. They are not necessarily presented in sequential order of importance and may not all be relevant for every IA.

At a general level, sustainability rests on the principle that the needs of the present must be met without compromising the ability of future generations to meet their own needs.[7] Sustainability in agricultural production integrates the goals of environmental health, economic profitability and social and economic

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[7] WCED, 1987.

equity. Work remains to be done to clarify the relationships and develop credible and comprehensive approaches to analysing the interrelationship between trade, environment and development. In the long term, a better understanding of these relationships can encourage policy makers to develop, and stakeholders to support, sustainable development strategies and policies. IAs can contribute to such an improved understanding.

Box 1: The aims of integrated assessment - What is (are) the most important objective(s) driving the process for an integrated assessment?

- clarifying the linkages between trade, environment and development
- informing policy makers throughout government
- informing negotiators
- developing policy packages
- increasing transparency in decision-making.

In the context of present and future negotiations and policy development in the agricultural sector (including associated policy reform in regional trading blocs), IAs can contribute to informing policy makers throughout government of the implications of proposed trade policies and the directions of the relevant reforms through intra-governmental co-operation and capacity building.

A starting point is whether the assessment considers the effects of a trade agreement prior to its planning and negotiation (*ex ante*), or following its final ratification (*ex post*).[8] The first application is likely to provide optimal support for decision makers involved in planning and negotiation. An *ex ante* analysis allows for relevant environmental and social issues to be brought forward for consideration by trade negotiators and other practitioners at relevant points during negotiations. It requires techniques for planning that can project, with some degree of accuracy, potential sustainability impacts of various scenarios for negotiation and where successful, can integrate sustainability issues into the negotiation process. Where possible, and to promote policy coherence, links should be made to relevant existing planning processes.

An *ex ante* IA can contribute to policy formulation in a number of ways, including:

- contributing to the policy process by identifying sustainability issues associated with a particular trade agreement and in particular the modalities for specific liberalization;

- identifying a range of issues that reflect the political and economic interests of various stakeholders;

- helping the country or region undertaking the assessment to identify policy priorities and put forward an integrated negotiating position;

- directing the pace and/or scope of liberalization (including the sequencing of trade liberalization) to ensure that effective national environmental policies exist in vulnerable sectors;

- helping countries develop trade policies in a co-ordinated way that reflects the interdependence of economic, environmental and social goals;

- putting in place necessary environmental, as well as economic and social policies that help reap the benefits of trade liberalization;

- helping build consensus within government.

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[8] Issues related to timing are discussed at length in Section III of UNEP, 2001.

The results of an IA can assist countries in designing complementary economic, environmental and social policies at the national level to accompany the trade-related policy or agreement, as well as at the international level. Such policies can promote opportunities associated with a trade-related policy or trade liberalization agreement, or mitigate negative impacts. Additional policies to support sustainability could be implemented, as necessary, as a result of a monitoring or review process.

An *ex post* IA of trade agreements that have already been negotiated and implemented can be useful to enhance understanding of the linkages between agricultural trade and sustainability for future policy development. While *ex post* assessments provide no opportunity to influence the final outcome of a particular trade negotiation they offer the following advantages:

- *ex post* assessments can improve understanding of the linkages between trade and sustainable development by identifying concrete impacts of liberalization as opposed to projected ones;

- *ex post* assessments can identify relevant policy measures to mitigate negative impacts or promote positive impacts brought about by existing trade agreements or trade measures;

- the results of, and lessons learned from, *ex post* assessments can help define future *ex ante* IAs and inform preparations for future trade liberalization agreements.

1.2 Responsibility, consultation and participation

Underlying an IA as a fundamental tool is a stakeholder analysis, which identifies people, groups and organisations that may be affected by a policy reform or that may affect the reform. Identifying and disaggregating the first type of stakeholders, and distinguishing between those who are affected positively and negatively by the reform is central. Analysing stakeholders who may affect the reform (organisations such as unions, business associations or non-governmental organisations (NGOs)) is critical to understanding the likely support or opposition of various groups to the reform. Stakeholder analysis plays an important role in deciding the levels of disaggregation of various groups when collecting or analysing data in order to estimate the impacts of change.

The approach to IA adopted by UNEP relies on strong multistakeholder participation, offering the following advantages:[9]

- **Co-operation.** Provides opportunities for co-operation and co-ordination within and between government and civil society, building trust among the participants and leading to the creation of long-term collaborative relationships.

- **Expertise.** Introduces a broad range of ideas, experiences and expertise to enrich the IA, enhancing the knowledge of policy makers and motivating the development of the broadest range of policy solutions.

- **Ownership.** Provides participants with a sense of "ownership" over the final product thereby reducing the potential for serious conflict and increasing the likelihood of improved and lasting solutions.

- **Capacity Building.** Ensures that the interests of groups, including poor and underprivileged communities, that have traditionally played only a marginal role in policy development can be incorporated into the goals as well as the processes of decision-making, building capacity and social capital among those groups.

- **Trust.** Builds trust among various stakeholders in the process and the final product thereby providing governments with a tool to generate widespread support for sound liberalization initiatives.

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9 UNEP, 2001. See also, WWF, 2000 and WWF, 2002.

Achieving the benefits of multistakeholder participation in an IA process requires some planning, which can be revisited throughout the IA to ensure that, as the IA progresses, any changes are taken into account in the process. In some respects, this planning can occur along the lines of principles of good governance including equitable participation by relevant stakeholders; legitimate local ownership; access to information and transparency; accountability; respect of rules and regulations; who is responsible for undertaking the IA; how will different views be incorporated; and how will meaningful stakeholder participation be ensured. In its past work on IA, UNEP has encouraged groups undertaking the work to establish National Steering Committees to help plan and guide their country studies.

1.2.1 Allocating responsibilities

Planning an IA requires allocation of responsibilities. For governments, this entails identifying a lead ministry, or articulating shared responsibility among relevant ministries. At a working level, this could involve establishing specialised working groups to represent ministries with an interest in issues surrounding agriculture, such as, *inter alia*, agriculture, trade, environment, rural development, industry, transportation, statistics and international development. An overall coordinating mechanism should be put in place to ensure that the views of all relevant government ministries and/or agencies are taken into account at relevant stages.

1.2.2 Identifying stakeholders

Relevant stakeholders include those with primary (direct) and secondary (indirect) dependence on and interest in a certain sector or sub-sector. Stakeholders are a logical starting point for defining options for promoting sustainable development since they are often the first to perceive negative impacts or benefit from improved management. An IA should attempt to strike a balance between the range of stakeholders from societal organisations such as those indicated in Table 1.

Table 1: Balancing stakeholders

Societal organisation	Specifications
Government	• Local • Sub-national • National • Supra-national
NGOs	• Environmental NGOs • Development NGOs • Democracy and human rights NGOs • NGOs representing women • NGOs representing children • International NGOs
Industry	• Small and medium-sized (local) enterprises • National enterprises • Multinational enterprises • Farmers and farmer associations • Business associations • Trading organisations
Other representatives of civil society	• Labour groups • Parliamentarians (including opposition parliamentarians) • Community groups • Consumer organisations • Indigenous people • Poor communities • Academics

An IA on agriculture includes a potentially large group of stakeholders. This includes those with the power, authority and responsibility to invoke policy change. Typically, this would imply representatives from all levels of relevant government departments including those responsible for agriculture, trade, environment and development and, for specific issues, could extend to departments such as health. It might also include parliamentarians and members of the opposition.

A second group of critical stakeholders are individuals or groups with claims over the resources such as landowners, farmers and community groups including women, poor, affected communities and indigenous people. These groups often have direct knowledge of the issues and a direct interest in the outcome. The participation of local communities, in particular those groups with a claim on the resources (such as the land), can be crucial in determining the success or failure of policy measures ultimately developed, as they will often be in the best position to implement and monitor any necessary measures to promote sustainability at the local level. This outcome is most likely to occur if measures respect the ethnic, customary and legal rights of the stakeholders, which can be assured by their direct involvement in the process.

Other groups with more indirect control over the resources, but interested in the issues, should include representatives from NGOs representing both environment and development issues, consumer organisations, labour organisations and industry organisations representing companies involved in production, processing and trading of agricultural commodities and products. Depending on the geographic scope of an IA, relevant international groups or institutions should participate as appropriate to take into account international policies, actors and opportunities for influencing sustainability. In addition to UNEP, such an IA in the agriculture sector would benefit from participation from, *inter alia*, the FAO, the UN Conference on Trade and Development, the World Bank, and the WTO.

1.2.3 Identifying information needs

The availability of information is vital in ensuring the equitable participation of civil society in the process of conducting an IA. It is therefore important that stakeholders are provided with as much documentation as possible at an early stage in the process. This begins with identifying the most immediate information needs to ensure meaningful participation.[10]

Documentation could include terms of reference for the assessment, advance notice of any consultations, a proposed time-frame, key references, minutes from relevant meetings, submissions and comments received from the public or produced within the government, related studies and any other information relevant to the IA. In determining the levels of information that will be provided, the accessibility and complexity of the information, issues of language, resource issues and other practical considerations related to the characteristics of the specific stakeholders may have to be taken into account. This includes attention to different types of knowledge and information, such as scientific and indigenous, objectively verifiable and subjective, qualitative and quantitative, implicit and explicit knowledge. Existing information and databases should be adequately used. Necessary human and financial resources should be assessed to facilitate informed public participation and to improve access to, and efficient use of, varied information sources.

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[10] See UNEP, 2001.

1.2.4 Developing a process for consultation and dialogue

Special attention should be given to developing a process that encourages equitable participation. This includes ensuring that participants have a certain independence and objectivity with respect to their involvement in the planning process and its outcomes including the definition of clear procedures and transparency with respect to information and decision-making to ensure that certain interests do not predominate.

A number of mechanisms are available for establishing a process for consultation and dialogue.[11] These include face-to-face meetings, written comments, the dissemination of information and requests for input using information technology such as the Internet. Methods for consultation should be developed taking into account the fact that rural populations are often among the poorest people, and in some regions have limited access to education and technology, making the solicitation of input in written form, using the Internet for example, of limited use in some instances. Face-to-face meetings should be organized to take into account the fact that many of the stakeholders directly concerned with agricultural production are located in rural areas. Therefore, a number of smaller meetings, in more remote locales might be more useful than large meetings in urban centres.

Funding mechanisms should also be made available as necessary to encourage participation. The responsible government agency or ministry will normally fund IAs. However, where global environmental, social and economic issues are involved, there are capacity building arguments for co-funding by international organisations including, among others, UNEP. Whatever the method chosen, the consultation must establish a clear process for following up on various contributions and providing feedback to participants. The success of a number of qualitative techniques for assessment (and interpreting data from quantitative techniques) will rely heavily on robust stakeholder participation (see section 4).

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[11] *ibid.*

2. Context analysis: sustainability issues relevant for agriculture

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Highlights

- Prioritise a specific commodity or activity within the agricultural sector and include related sectors.

- Identify and prioritise the most relevant issues associated with economic, environmental and social sustainability in terms of the agricultural sector generally or a specific commodity, in the context of a particular geographic region.

- Employ an "ecosystem approach" recognizing the interaction between human activity, ecosystems, development and sustainability.

- Define the extent to which human activity in the agricultural sector supports or detracts from the ecosystem's ability to provide essential services – both indirectly and directly. Questions that should be asked:
  - what are the most important issues in terms of economic sustainability?
  - what are the most important issues in terms of social sustainability?
  - what are the most important issues in terms of environmental sustainability?
  - what are the linkages between these areas, root causes of unsustainable behaviour, and priorities for the IA?

- Define the indicators that best represent the sustainability priorities.

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A subsequent stage in developing an IA in the agricultural sector is determining its scope and coverage. This includes focusing on a specific commodity or activity of priority interest and identifying any related sectors that should be included in the IA. Criteria for selecting such priority areas of focus are presented in Section 2.1.

Setting the context for an IA should then highlight relevant economic, environmental and social variables associated with the sector, specific commodities and/or regions and ecosystems, and consider issues that characterise production and trade flows. Sustainable development involves striking a balance between environmental, social and economic dimensions, dealing with trade-offs, avoiding unacceptable change, and finding opportunities for polices that are mutually supportive. An IA should include key variables that allow a practitioner to adopt an "ecosystem" approach to examining agriculture. This involves considering the interaction between human activity, ecosystems, development and, ultimately, sustainability. It also involves examining both the demands made by agriculture on ecosystems as well as the services that it can provide.

In most cases an IA will stretch resources, both human and financial, and selecting priority sustainability issues can help employ scarce resources most efficiently, however its central purpose is to determine the

relevance and importance of agriculture to sustainability variables in a particular context. Core sustainability issues and values associated with agricultural practices are likely to vary greatly between and among regions and commodities, so this section should be applied on a case-by-case basis with the input of stakeholders.

A range of sustainability issues related to the agricultural sector is discussed in sections 2.2, 2.3 and 2.4. This is not meant to be exhaustive, but rather illustrative of the types of issues related to sustainability that might be relevant in an IA that has as the agriculture sector, or a specific commodity within it, as its focus. Section 2.5 presents guidelines to help practitioners prioritise these issues. Section 2.6 presents a sampling of indicators from which the most relevant might be selected. In a general sense, a comprehensive description of the issue under investigation, whether it be agriculture generally or one commodity, will help define the scope of the assessment, select indicators, and identify relationships between economic, environmental and social variables for further analysis.

2.1 Selecting specific activities/commodities for assessment

This *Handbook* has as its broad focus the agricultural sector. However, it may be most effective to undertake an IA of a specific commodity or production practice within the agricultural sector. These could range from production of specific crops to issues associated with the industrial processing of food and beverages, or consideration of inputs into other sectors such as textiles, cotton, jute or hemp. Criteria for selecting activities or commodities within the broader agricultural sector are presented in Box 2.

Box 2: Criteria for selecting priority activities or commodities

- The activity/commodity is important to the national economy, in particular in its contribution to export revenues.
- The activity/commodity relates directly or indirectly to major environmental media and natural resources, including biodiversity.
- The activity/commodity relates directly or indirectly to important issues of equity, employment and social wellbeing including poverty and food security.
- The activity/commodity has been, or might become, the subject of changes in the economic rules induced by trade-related policies.
- The activity/commodity is one with significant trade flows in both volume and financial terms and is experiencing changes in trade flows.
- The activity/commodity is one where one might expect, *a priori,* that there are important sustainability effects attributable to trade-related policies.

Source: Adapted from UNEP, 2001.

An expansion of the field of analysis to cover related cross-sectoral effects can be guided by the criteria in Box 3. An approach to planning that considers one commodity in isolation runs the risk of ignoring important impacts between activities and sectors. For example, in its study on cattle feedlots, the CEC's analysis extended back to the feed-grain sector, and forward to the beef-processing sector.[12] Some downstream activities associated with agricultural production include textiles and apparel, and hides and skins, both activities with the potential for significant environmental and social impacts.

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[12] CEC, 1999.

Box 3: Criteria for considering related activities

- Is there a related activity/commodity that is a major input into and/or consumer of the activity/commodity under consideration?
- Are there related economic or environmental dynamics from other activities that are necessary to the operation of the activity/commodity under consideration?
- Is there a related activity/commodity that has proliferating ecological impact on the sector under consideration?

Source: UNEP, 2001.

2.2 Economic sustainability

The structure of agricultural production varies throughout the world. There is a general differentiation between countries that are highly developed and rely on modern production practices and those that are reliant on more traditional production methods and technologies. In some highly developed economies, the structure of agricultural production is now vertically integrated and agriculture in the developed world has taken on a quasi-industrial character. It has come to be characterised by fewer, but larger and more technologically advanced farms than ever before.[13]

Among the issues associated with modern farming and intensification are increased specialisation and concentration. Studies have shown that increased economic activity that occurs as a result of liberalization often leads to the concentration of farms, which can occur to the detriment of the small producer who might move off the land and find no employment on the larger plantations where new technologies replace traditional labour-intensive practices.[14] In Mexico, for example, studies have shown that the winners from trade liberalization tend to be concentrated in the fruit- and vegetable-growing areas where production predominantly occurs on a large scale, depends on high levels of irrigation, and is destined for export.[15]

Box 4: Some trends in global agriculture

- Global expansion of the agricultural area has been modest in recent decades. Nevertheless, intensification has been rapid, as irrigated areas have increased, fallow time decreased, and the use of purchased inputs and new technologies has grown to produce more output per hectare.
- The dominant share of the world's cropland (59 per cent) is dedicated to cereal production, but cereal yield growth rates have generally slowed in recent years.
- Over the past 30 years, the quantity of livestock products has approximately tripled compared to a doubling of crop outputs. This high rate of growth in livestock demand is expected to continue as, globally, standards of living and average incomes continue to rise.
- Increased demand for both crop and livestock products will come predominantly from developing countries, and because of infrastructure, institutional and other trade and marketing constraints, will often need to be met from improved local agro-ecosystem capacity.

Source: Wood *et al.,* 2000.

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[13] In the United States, for example, in the early 1940s six million farms produced the nation's food. By 1995 less that one million farmers accounted for 95 per cent of a substantially increased total farm output. USDA, 1995, Economic Research Service.
[14] WWF, 2003.
[15] Nadal, 2000.

In the early 1900s it was common for farms to integrate both crop and livestock operations. However, since the 1960s crop and animal producers have become more separated as a result of specialization toward either crop or animal production systems. The trend towards specialisation that has occurred in the industrialised world has not only resulted in larger farms and increased output, but has also led to changes in production methods including, *inter alia*, tillage methods, use of pesticides, fertilisers and genetically modified organisms (GMOs), increased mechanisation and increased irrigation. In short, in a number of developed countries, production has been transformed by technological innovation that has resulted in high productivity of both land and labour, translating into greatly increased yields. Poultry and other livestock production have increasingly become separate specialities, leading to large industrial feeding operations, which can pose problems of waste management and disposal that rival those of small towns.[16]

In many developing countries farming is typically carried out on a smaller scale, employing a relatively larger percentage of the population in more labour-intensive production without the range of modern technologies available to farmers in the industrial world. Small-scale farming is characterised by low levels of diversification, reliance on a few products, and reliance on traditional practices and technologies with low levels of processing. Under these conditions, increases in production tend to come not from increases in yields due to efficiencies or technologies, but from an increase in the amount of land under cultivation, which can put pressure on marginal lands. The percentage of total arable land utilised is increasing in developing countries as land is transformed into cropland and agricultural land is converted to urban uses.

The majority of farmers are typically middle to low income, and in some cases subsistence producers, operating on small plots channelling a proportion of their crop to the marketplace to meet household income needs and to purchase other goods and services. The share of value-added through processing in the agricultural sector in different strata of the developing world lags well behind that of high-income countries.

Smaller farmers in developing countries are typically more vulnerable than farmers in industrialised countries, and adjustment to changing world commodity prices and market pressures, including reciprocal reductions of tariffs, can pose large challenges. In the domestic market local producers may have to adapt to competition from imports produced in countries that have access to more sophisticated technologies, more capital resources (including subsidies) and a more highly-skilled workforce. Small-scale farmers, farming on small plots of land have the most difficulty competing.

A contributing factor from the perspective of economic viability of production is the price of inputs, from energy and water to agrochemicals and seeds. A lack of support services such as irrigation, post-harvest facilities and farm-to-market roads has meant that small-scale farmers in some developing countries in particular are unable to improve productivity levels or get their products to markets at prices that cover costs. If input prices rise, the most vulnerable farmers, with limited choices and access to resources, could experience additional downward pressure on their incomes and be forced to either increase production through putting more land under cultivation (if this is an option) or abandon their farms and seek viable employment elsewhere in the agricultural or other sectors. This dynamic can contribute to rural poverty, unemployment and migration. From an environmental perspective the reduction in the application of agrochemicals could have beneficial results, but increasing production onto marginal lands could be negative.

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[16] Runge and Fox, 1999.

Despite the fact that opportunities brought about by liberalization can fuel export-led growth and increase average incomes, in countries where wealth is closely tied to land the most disadvantaged households are typically land-poor or landless and are among the most vulnerable populations. Among other supply-side constraints on production, they tend to have limited access to productive assets such as capital, technology, water and markets. Therefore, increased returns to export-crop production could have limited benefits. Only a small minority of farmers may be in a position to exploit the opportunities presented by export markets, which reinforces the importance of capacity building in an IA that involves the agriculture sector.

2.3 Social sustainability

2.3.1 Poverty

Agriculture is often closely linked to the poorest and most vulnerable populations. Poverty is largely rural, with some 70 per cent of the poorest people in developing countries living in rural areas. Ecosystem degradation tends to harm rural populations more directly than urban populations and it has its most direct and severe impact on the poor, who are also highly vulnerable to ecosystem changes that result in famine, drought or floods.[17]

For many developing countries agriculture is the main source of economic growth, which is the cornerstone of poverty reduction. Between 1990 and 1999, World Bank estimates indicate that rural areas that experienced economic growth also experienced poverty reduction. Over that decade the number of people living on less than US$ 1 a day fell from 1.3 billion to 1.2 billion, and the proportion of people living in extreme poverty fell from 29 per cent to 23 per cent.[18] As economies develop, growth of rural activities can also generate off-farm employment, which is important for providing jobs and reducing poverty.[19]

Therefore, sustainable agriculture and increasing productivity are essential. Increasing food production to meet the needs of a growing population can create pressures on the environment including pesticide pollution, water table decline, biodiversity loss and soil degradation if undertaken without adequate attention to land-use management. Nevertheless, public investment in agricultural research and improved technologies could allow increasing production in developing countries in ways that impact natural resources less harmfully.[20]

Degradation of natural resources, including degradation that occurs as a result of agricultural practices, affects the rural poor more than others because they tend to rely on fragile natural resources for their livelihoods. Overexploitation of natural vegetation, an important factor in production in rural communities in developing countries, may lead to significant loss in income for those communities and countries. Falling wages can put increasing pressure on migration flows, or impose greater pressures on the natural resource base of agriculture, as producers either abandon production or increase production. These pressures can be aggravated by limited access to crop insurance, credit and technical assistance in many communities.

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[17] Millenium Ecosystem Assessment. Summary.

[18] *ibid*.

[19] Workers follow a diverse array of opportunities, often sending much of their income back home. Studies of African farm households suggest that 15-65 per cent of farmers also work off the farm and that 15-40 per cent of family labour hours go to off-farm income-generating activities.

[20] In the United Kingdom, for example, it took more than 1,000 years to increase wheat yields from 0.5 to 2 tonnes per hectare (in the 1950s) but only 40 years to triple yields to 6 tons a hectare, due to modern technologies. *ibid*.

2.3.2 Migration/urbanisation

When economic opportunities, including employment, in rural areas are reduced by price changes or other changes brought about by trade liberalization and/or other forces, migration can occur. Typically migration from rural areas to urban centres by individuals seeking to improve their economic opportunities can have impacts on both the areas they leave as well as the towns and cities they move to.

The health of rural communities and the viability of traditional agricultural practices often depend on the human capital available for production and maintenance of the land, both of which are labour intensive in developing countries. In the countryside, excessive emigration means that rural populations decline and households get smaller, affecting social networks, community institutions and land use and conservation practices. A number of traditional agricultural practices and sustainable production methods such as terracing, minimum tillage practices and contour ploughing rely on labour intensive maintenance. Male labour migration can also increase the workload on women and children. Where this takes children out of school, it can contribute to the perpetuation of poverty across generations.

Migration into towns and cities can also affect the health of urban centres. The FAO estimates that by 2005 over half the world's population will live in cities.[21] At present, twenty cities in the world have populations of over 10 million people.[22] In the next 30 years almost all population growth will be concentrated in urban areas. The pace of growth is expected to be fastest in developing countries, where the urban population is forecast to increase from 1.94 billion to 3.88 billion.[23] Sustainability impacts that may result from increasing urbanisation include rising urban poverty rates. In many parts of the developing world in particular, urban poverty rates already exceed 50 per cent.[24]

Farmers in countries experiencing rapid urbanisation may face the challenge of supplying growing urban populations with an affordable and safe food supply. Food distribution chains may be inadequate to deal with the additional strains of having to supply increasing urban populations. In some areas of the world, urban sprawl is encroaching on prime agricultural land. This tends to move production further away from centres. In some parts of the world, long distances, bad roads, and poorly maintained vehicles already cause spoilage of 10 to 30 per cent of produce. Where these and other services (such as storage facilities or slaughterhouses) are already under pressure, increased capital for the investment necessary to produce and transport food safely over longer distances may not be available domestically and/or a country might not be able to attract the necessary capital to develop this basic infrastructure through investment.

2.3.3 Rural development/property rights

Access to quality services and physical infrastructure is often worse in rural areas than in urban areas, with or without poverty, and imposes substantial costs on almost all rural economic activity and development.[25] The physical infrastructure, such as transport, energy and water supply, available for agricultural production in rural areas is often limited. Similarly, access of rural populations to electricity, in-house water supply and telephones is limited, and of the 2.4 billion people in the world without access to improved sanitation, 2 billion live in rural areas.[26] This lack of infrastructure and access to basic services is

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[21] In Latin America and the Caribbean 75 per cent of the population already lives in cities. This figure is expected to climb to 83 per cent by 2030. Comparable figures for Asia and the Pacific are 37 and 53 percent and for Africa are 38 and 55 per cent, respectively.

[22] The number of people in African cities is predicted to rise from 297 million to 766 million, or more than the total populations today. In Asia the urban population is expected to double from 1.35 billion to 2.61 billion. World Bank. FAO, 2002d

[23] World Bank, 2002, World Development Indicators.

[24] FAO, 2002d.

[25] World Bank, 2002, World Development Indicators.

[26] *ibid.*

ultimately bad for markets and limits opportunities presented by trade liberalization that rely on good transportation networks and communication.

Property rights regimes can also impact the way land is cultivated, providing resources for environmental supports or encouraging a respect for values other than short-term profitability. Some commentators question the effectiveness of communal forms of property in achieving a socially efficient allocation of natural resources while others are of the opinion that communities are able to develop controls on the use of common property resources to allow for their efficient exploitation. This is dependent, in part, on the strength of local institutions and communal controls and their ability to prevent individual farmers from overexploiting the natural resources without accounting for the social or environmental costs of cultivating and clearing the land.

2.3.4 Food security

All countries, and in particular developing countries, consider food security to be an important issue that is linked closely to agriculture and food production. It is also closely linked to poverty, which is the largest cause of food insecurity, while food insecurity will contribute to the perpetuation of poverty.

Food security has been defined by the World Food Summit as a situation "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food, and to meet their dietary needs and food preference for an active and healthy life."[27] Underlying this definition are adequacy of food (effective supply), ample access to food (the ability of the individual to acquire sufficient food), and reliability of both supply and access (equity of food distribution). Food security is associated with a wide range of variables including food availability, access to food, food consumption and nutritional status.

Box 5: Variables associated with food security

Factors	Variables
Food availability:	Food production
	Food imports
	Food storage
Access to food:	Poverty
	Market integration
	Access to markets
Food consumption:	Food use practices
	Food intake
Nutritional status:	Anthropometry
	Micronutrient deficiency

Source: World Bank, 2002b.

Generally, food outputs from the world's agro-ecosystems have more than kept pace with global population growth and as of 1997 provided, on average, 24 per cent more food per person than in 1961, in spite of the 89 per cent growth in population that occurred over the same time period. Improvements in agricultural productivity have seen food prices drop by around 40 per cent in real terms (Box 6). Most of the increase in production has been achieved through efficiency requiring small increases in cropland.

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[27] FAO, 1996.

However, productivity gains have led to falling food prices, which can serve as a disincentive to produce. In other cases it can further encourage excessive production for domestic consumption and for export. When prices are low, net food importing countries and their consumers should benefit.

Box 6: Some trends in global food production

- Food production from agro-ecosystems is valued at around $ 1.3 trillion per year (1997). The production process directly employs some 1.3 billion people.
- Food production has more than kept pace with global population growth. On average, food supplies in 2000 were 24 percent higher per person than in 1961, and real prices were 40 per cent lower.

Source: Wood *et al., 2000.*

In a number of countries, unsustainable expansion of agricultural production into new areas (driven by short-term population pressures and food needs) takes priority over longer-term issues of resource conservation. Combined with little institutional or legal pressure to constrain this process so as to protect the resources, such expansion can reduce the capacity of countries to provide for longer-term food security. Food security can also be impacted by placing too high a priority on export crops. Where more land and resources are devoted to crops for export, domestic food production can suffer, particularly where export crops are not food crops but other commodities such as cotton or tobacco.

A range of mechanisms is important for countries to improve food security. Trade is one means; other mechanisms include stockpiling and increasing domestic production. Agriculture is often the most important export commodity in the world's most food insecure countries. For developing countries as a whole, agricultural products represent around 8 per cent of both exports and total merchandise trade, but in countries where hunger is most prevalent, the share rises to 20 per cent.[28] Food-insecure countries spend over twice as much of their export earnings on food imports than more food-secure countries. Poverty and limited trading activities constrict both export earnings and the ability of these countries to buy more food on international markets. Therefore, they import less than 10 per cent of their food, compared with more than 25 per cent in more food-secure countries.[29] In some food-insecure countries, support might be necessary to develop domestic agricultural production, enhance transportation and storage capacity, and increase access to international markets to alleviate pressures on food security and take advantage of opportunities brought about by liberalization.

2.3.5 Gender

Agriculture is a sector that relies on a higher proportion of women in the workforce than men. Indeed, women are responsible for half of the world's food production.[30] Therefore, it is likely that the role of women may figure prominently in an IA, particularly in developing countries such as those in Africa where women produce between 60 and 80 per cent of the food and are responsible for a significant role in post-harvest activities.

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[28] FAO, 2003.
[29] *ibid.*
[30] FAO, *SDdimensions. Women and sustainable food security*. SDWW, FAO Women and Population Division. See www.fao.org.sd/ip

Box 7: Women and agriculture in African countries

In many African countries women provide:
- 33 per cent of the workforce
- 70 per cent of the agricultural workers
- 60-80 per cent of the labour to produce food for household consumption and sale
- 100 per cent of the processing of basic foodstuffs
- 90 per cent of household water and fuel wood
- 80 per cent of food storage and transport from farm to village
- 90 per cent of the hoeing and weeding work
- 60 per cent of the harvesting and marketing activities

Source: FAO, *SDdimensions, Women and sustainable food security.*

Despite their critical role in agriculture, female farmers are often constrained by factors that may limit their ability to take advantage of opportunities offered by trade liberalization, or may make them vulnerable to any negative economic and social impacts resulting from shifts in production brought about by structural change induced by liberalization. Generally, these constraints are often the result of a complex set of rights and obligations reflecting social and religious norms that prevail in some rural communities. Specifically, women farmers often have difficulty gaining access to resources for production including land, credit and productivity-enhancing inputs (such as improved seeds, fertilizers and pesticides). Moreover, women tend to have less access to education, training and extension services. According to the FAO, only 5 per cent of extension services have been addressed to rural women.[31]

These disparities result in productivity differentials. In addition, limited access to education means that women often face increasing challenges finding alternative, non-agricultural employment. Given their overall importance to the agricultural sector, and their vulnerability, gender-related issues may be important in an IA, particularly in developing countries.

2.3.6 Health

UNEP's country studies have all highlighted important health impacts and point to the importance of assessing broad policies, including trade, on the environment and health (instead of commodity-related or sectoral policies).[32] (Box 8) Every year in developing countries an estimated 3 million people die prematurely from water-related diseases, and 2 million people die from exposure to stove smoke inside their homes. Infants, young children and women from poor rural families with lack of access to safe water, sanitation and modern household fuels are disproportionately affected, indicating a clear relationship between health, poverty, agricultural systems and rural energy.

Agricultural practices can influence food quality and safety and negatively impact human health. In some instances, depending on the specific commodities under examination and related production practices, health may figure prominently in an IA. A number of the agrochemicals fall into categories classified by

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[31] *ibid.*

[32] Environmental health comprises aspects of human health (including quality of life) that are determined by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations. Health is a state of complete physical, mental and social wellbeing and not merely the absence of disease. This definition is broader than the traditional medical model, which defines health as freedom from disease that can be diagnosed clinically and is concerned primarily with treating symptoms rather than their underlying causes.

the World Health Organization as extremely or highly hazardous to human health. Appropriate protection such as adequate protective clothing, masks and eye shields is seldom available to farm workers applying agrochemicals with backpack and other sprayers. The inappropriate handling of agrochemicals can lead to a high frequency of eye, skin and respiratory problems amongst farmers, even at low levels of use.

Residue from agrochemicals can also lead to high nitrate levels in drinking waters as well as soil contamination, which can affect animal and plant habitats and populations. Depending on the method used for application, the impact of pesticides may not be confined to their area of application. Where spraying occurs using low-altitude aircraft or tractor-drawn applicators, residues can be transmitted long distances in the atmosphere or in water. There is also evidence that agrochemical residues exist in food, such as rice, and pose risks to consumers.

Box 8: Findings of UNEP country studies related to health

- Impacts on health of rural population from use of agrochemicals (influenced by price changes and trade policies) and water pollution;
- Impacts on health of consumers through quality and quantity of food;
- Impacts on productivity of agricultural systems by the incidence of HIV/AIDS (also affected by migration and the quality of social services);
- Impacts on health of deteriorating water quality (i.e. increased irrigation leading to increased incidence of malaria), overall change in water use and access to safe water (competition for scarce water resources);
- Impacts of rural-urban migration on health as a result of the break-down of traditional lifestyles;
- Reduced availability of local medicines and fuel wood (as a result of increasing forest conversion for agricultural production).

Health challenges can also have feedback impacts that affect agricultural production and food security. For example, the impact of HIV/AIDS on food production at the household level and for export can be devastating.

A recent UNEP study carried out in Nigeria indicates that the rising number of cases of HIV/AIDS is expected to have negative impacts on economic and social wellbeing from the household level to the national level as a result of declining productivity and income generation.[33] The FAO predicts that by 2020 HIV/AIDS will have claimed the lives of over one-fifth of the agricultural labour force in most southern African countries.[34]

2.3.7 Traditional knowledge and culture

In many cases, the rural poor, living at the margin of subsistence, in ecologically vulnerable areas have assets that include social ties and an understanding of their local conditions. The community structures and institutions that support labour intensive production practices will be affected by out-migration and other forces induced by changing production practices. Excessive migration can lead to intergenerational divisions and a loss of traditional knowledge, for example, with respect to the use of genetic resources.[35] Even in cultures that are very resilient, the traditions handed down from one generation to another can be weakened by the spread of ideas, goods and advertising from abroad.

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[33] UNEP, 2005.
[34] FAO, 2003.
[35] Nadal, 2000.

2.4 Environmental sustainability

Agriculture is a critical sector for the global environment. By virtue of its large land and water requirements, agriculture uses and affects a greater share of most nations' natural resources than any other industry. Agricultural activities have a direct impact on the full range of environmental media including water, land, biodiversity and air. These impacts are affected by such issues as production techniques and access to inputs, infrastructure and technology. In addition, environmental degradation can also limit long-term economic sustainability in the agricultural sector. This section considers key variables from the four broad environmental media and includes agricultural inputs as a crosscutting issue affecting all four media.

2.4.1 Fresh water

Agriculture accounts for 70 per cent of global water use and has impacts on water quality and quantity. Water availability is an increasingly critical constraint to expanding food production in many of the world's agro-ecosystems. Agriculture accounts for the greatest proportion of withdrawals from the world's surface and groundwater resources. It is also the most consumptive user of water, returning the highest proportion of each cubic meter withdrawn to the atmosphere by evaporation and transpiration via plants.[36]

2.4.1.1 Water quality (freshwater quality)

Agricultural practices can be a source of water pollution as a result of agricultural runoff and seepage of fertilizers and pesticides into sources of groundwater, as well as directly into surface water. Pollution of groundwater by agricultural chemicals and wastes is a major issue in almost all developed countries and, increasingly, in many developing countries. Groundwater contained in underground aquifers is particularly susceptible to nitrate contamination from fertilizer and manure. The risk of nitrate groundwater contamination is a function of both soil drainage and the levels of fertilizer and manure application, which rise in direct proportion to agricultural activity and will depend on the mix of crops produced. It also depends on the efficiency of water use. For example, in China, the world's largest consumer of nitrogen fertilizer, up to half the nitrogen applied is lost by volatilisation and another 5 to 10 per cent by leaching.[37]

Water pollution can also occur in streams and rivers in agricultural areas due to soil and fertilizer runoff. Runoff can cause siltation and contribute to nitrogen and phosphates in surface water. Cropping patterns can add to this pollution, for example, where patterns exist of crops that require higher levels of fertilizer

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Box 9: Some trends in water use and agriculture

- Irrigation accounts for 70 per cent of the water withdrawn from freshwater systems for human use. Of that only 30-60 per cent is returned for downstream use, making irrigation the largest net user of freshwater globally.
- The 17 per cent of global cropland that is irrigated produces an estimated 30-40 per cent of the world's crops. The share of cropland that is irrigated has grown quickly, increasing 72 per cent from 1966-1996.
- Competition with other water uses, especially drinking water and industrial use will be most intense in developing countries, where populations and industries are growing fastest. Agriculture may increasingly depend upon water recycled from domestic and industrial uses.

Source: Wood *et al.,* 2000.

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[36] Wood *et al.,* 2000.
[37] FAO, 2002c.

such as soybeans and maize, or where increasing stock densities exist as a result of the intensification of livestock production. Salinity can also contribute to the decreasing quality of water and affect both the sustainability of agriculture as well as diversity of wildlife. Indicators of the state of water quality include oxygen content in the water and nitrate content in the surface water. Water quality risk indicators include levels of fertilizers and pesticides, soil quality, intensity of activity and mix of crops.

Runoff from feedlots tends to contain high levels of nutrients, salts, pathogens and oxygen-demanding organic matter. The main polluting component associated with this activity is wastewater that can contain biodegradable organic compounds, suspended solids, nutrients and toxic compounds, which can result in a reduction of dissolved oxygen and the deterioration or destruction of aquatic ecosystems. This impact tends to be exacerbated with the size of the operation and is not as serious when there is no concentration in a given area.

Among other things, water quality may be affected by patterns of production and technology use that employ high levels of agrochemical inputs located in close proximity to important watersheds. Pesticide use has increased considerably over the past 35 years, with recent growth of 4 to 5.4 per cent in some regions.[38]

2.4.1.2 Water quantity (freshwater resources)

Agricultural practices can also affect water quantity. Irrigation in the agricultural sector has an impact on water quantity as a number of countries rely heavily on irrigated crops for both domestic use and for export. In Mexico, for example, agricultural irrigation accounts for 38 per cent of total water consumption. Indeed, despite the fact that much of Mexican agriculture is rain-fed, irrigation is the basis for all export oriented crops including wheat, soybean, cotton and horticultural crops. Over 80 per cent of the country's water supply is used without charge for agricultural irrigation, and an estimated 50 per cent of this water is wasted through inefficiencies in irrigation water management.[39] The continuing expansion in irrigated agriculture and water use means that there is growing competition for scarce water resources and greater stress on the water needs of aquatic habitats (wetlands, lakes). Intensity of use can be measured by such indicators as levels of groundwater, gross freshwater abstractions per capita and by major uses.

The efficiency of use will impact levels of water consumed for irrigation in agriculture. Levels of efficiency can be measured by economic efficiency and technological efficiency. In some OECD countries, for example, the price of water paid by farmers is substantially lower than that paid by other industry and household users. From a technological perspective, summary results of agricultural water use and comparison with water resources for 90 developing countries conducted by the FAO reveals that on average irrigation efficiency was around 38 per cent in the reference period 1998. This varied from 25 per cent in areas of abundant water resources (Latin America) to 40 per cent in Near East/North Africa and 44 per cent in South Asia where water scarcity calls for higher efficiencies.

2.4.2 Land

Agricultural production also affects land, and agricultural practices can either contribute to, or detract from, soil quantity (erosion) and soil quality (degradation). According to the preliminary Millenium Ecosystem Assessment, some 40 per cent of agricultural land has been degraded in the past half century by erosion, salinization, compaction, nutrient depletion, pollution and urbanization.[40]

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[38] The 1990s showed signs of declining use of insecticides both in developed countries such as France, Germany and the United Kingdom and in a few developing countries, such as India. In contrast, herbicide use continued to rise in most countries. *ibid*.

[39] OECD, 2001a.

[40] Millenium Ecosystem Assessment. Summary. *Ecosystems and Human Well-Being*. June 2001.

2.4.2.1 Soil quantity/desertification and erosion

Erosion is an important issue for policy makers because some aspects of soil degradation are only slowly reversible (declining organic matter) or irreversible (erosion). Erosion can occur through processes related to water, wind or tillage, and where it reaches critical levels, it can affect land productivity. In the United States, it is estimated that agricultural activities are responsible for around 60 per cent of total soil erosion with the remaining 40 per cent coming from natural events such as fire, flood, drought, and activities such as forestry, conservation and off-road vehicle use.[41] Production practices can aggravate or reduce rates of erosion. For example, farming on marginal land can encourage erosion. On the other hand, terraces help reduce loss of topsoil even when steeply sloped land is cultivated. Minimum tillage can preserve soil and prevent erosion and, through reduced tractor use, can conserve energy. Contour ploughing—following the natural contours of the land—can help prevent rain-induced erosion on sloping lands. Erosion can be minimised through, *inter alia*, the adoption of conservation tillage and no-till practices, less intensive production, and the removal of marginal land from production.

2.4.2.2 Soil quality/degradation

Soil is the principal medium for plant growth and is the primary stock that supports agriculture. Good soil condition and high levels of organic matter are central to determining the current state and future productive capacity of agro-ecosystems. It also influences the provision of other environmental services such as water flow and quality, biodiversity and carbon. A depletion of soil organic matter can reduce fertility, moisture retention, soil workability and increase CO_2 emissions. Land degradation reduces agricultural productivity and is thus a major factor affecting food security and poverty reduction in rural areas. Globally, soil fertility declined about 13 per cent between 1945 and 1990.[42]

The quality of agricultural soils is associated with production practices; damage can occur through a number of processes. For example, the intensification of livestock production can contribute to nitrogen content in soil, and farming on marginal land can degrade soil and impair its long-term productivity. On the other hand, sustainable land use practices can rebuild soil organic matter levels. For example, effective crop rotation—growing different crops in succession on the same land—can return organic matter to the soil. Degraded soil can further be remedied by management practices such as land retirement, conservation tillage or crop residue management.

Box 10: Productive capacity of soil

Soil productive capacity depends on a range of interrelated factors:
- soil organic matter
- nutrient availability
- water-holding capacity
- soil reaction (pH)
- soil depth
- salinity
- the richness of the soil biota, and
- physical characteristics such as soil structure and texture.

Source: Wood *et al.,* 2000.

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[41] OECD, 2001a.
[42] World Bank, 2002, World Development Indicators.

2.4.3 Biodiversity

Because agriculture is a major land-using activity it has impacts on biodiversity. These include wildlife habitats and wild species as well as species diversity including crop genetic diversity. The single greatest source of biodiversity loss is linked to the loss of habitats and ecosystems—that is, the conversion of natural habitats for agricultural purposes.

Extensive practices that involve deforestation, field consolidation or drainage for wetlands, for example, reduce the overall areas available for wildlife and fragment natural habitats. Intensification often implies heavy use of pesticides and herbicides that directly destroy many insects and unwanted plants, pollute water and reduce food supplies for higher animals.[43] Moreover, specialisation and monoculture can lead to diminished crop diversity. The FAO predicts that pressures on biodiversity over the next three decades will be the outcome of conflicting trends. Extensive methods will tend to give way to intensification, which may in turn give way to organic agriculture in some regions.

The main threats to wild species from agriculture originate from converting grasslands, forests and wetlands to cropland and grazing. Among the most important causes of biodiversity loss are those that relate to changes in forest cover. Land use conversion is often closely associated with deforestation. Tropical rainforests, which contain approximately 50 per cent of the world's biodiversity are increasingly subject to pressures from ranching and crop cultivation. The contribution of agriculture (including crop and livestock production) to deforestation in some regions of the world exceeds the impact of commercial forestry. One estimate suggests that roughly 30 per cent of the potential area of temperate, subtropical and tropical forest has been converted to agriculture, which tends to occur at the expense of biodiversity as agricultural land supports far less biodiversity than does natural forest.[44]

Box 11: Some linkages between agriculture and biodiversity

Ways in which agriculture is currently affecting biodiversity:
- Large-scale conversion of land to agro-ecosystems, with the consequent loss of natural habitats.
- Composition and spatial structure of agricultural landscapes that can significantly reduce their habitat value.
- Loss of wild species as a direct consequence of agricultural inputs and practices, such as the toxic effects of some pesticides on birdlife.
- The general loss of diversity among and within the economic plant and animal species grown in agricultural systems.

Source: Wood *et al.,* 2000.

A recent study undertaken by UNEP in Viet Nam indicates the importance of biodiversity in wetlands being cultivated for rice production, and their typical lack of recognition and protection. In Viet Nam, wetlands are among the most threatened habitats with half of globally threatened birds in Viet Nam being dependent on this ecosystem for their survival. However, they have yet to gain any official recognition as a distinct land-use or conservation management category. In 2000, Viet Nam environmental authority identified 79 wetlands to be of national importance of which only 16 are included within the category of "special use".[45]

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[43] FAO, 2002c.
[44] Wood *et al.,* 2000.
[45] UNEP, 2005.

Modern agricultural production tends to rely on an increasingly narrow and homogenous group of plant genetic resources for the majority of the world's food output. Today, only 120 crop species are considered important at the national level and an estimated 90 per cent of the world's calorie intake comes from just 30 crops.[46] In addition to declining diversity based on the introduction of monoculture, an emerging trend associated with intensive production in some countries is the increasing use of GMOs.

These trends present risks as well as opportunities. An over-reliance on a limited number of species can pose potential risks to the long-term stability of crop production and present the threat of potentially catastrophic plant/pest disease. The importance of maintaining a base of genetic diversity for agricultural crops is important for developed and developing countries alike.

In developing countries and/or in economies where subsistence farming is important, the selection of seeds is often part of producers' strategies to cope with difficult environmental and climatic conditions such as drought, irregular rain fall, frost, winds, pests and poor soil. Traditional producers operating under these conditions will often rely on various combinations of seed varieties and dates of sowing to ensure a viable crop. Indeed, this use of genetic diversity in production is one of the most powerful resources available to many traditional producers.[47]

Box 12: The importance of modern varieties and transgenic crops

- In the early 1990s, the crop area sown for modern varieties of rice and wheat in developing countries had reached around 75 per cent, and for maize 60 per cent.
- 82 per cent of the global area planted with transgenic crops is in OECD countries—this increased from 1.7 million hectares in 1996 to 39.9 million hectares in 1999.
- The seven principal transgenic crops grown in 1998 were soybean, maize, cotton, canola (rapeseed), potato, squash and papaya.

Source: Wood *et al.,* 2000.

There are also benefits associated with using modern varieties and GMOs including savings on weed and insect control. In addition, increasingly crops are being developed that can withstand highly saline or drought conditions. For less developed countries, whose agricultural output is dominated by a single crop due to poor environmental or climatic conditions, genetically modified inputs hold out prospects for diversification in their crop base, including movement towards higher value, export-oriented crops.

2.4.4 Air

Agriculture is also a source of air pollution. It is the dominant anthropogenic source of ammonia and a major source of greenhouse gas (GHG) emissions. Ammonia is one of the major causes of acid rain, which damages trees, acidifies soil, lakes and rivers and harms biodiversity. Livestock accounts for about 40 per cent of global emissions of ammonia, mineral fertilizers for 16 per cent and biomass burning and crop residues for about 18 per cent. Emissions of ammonia from agriculture are likely to continue rising in most developed and developing countries.[48]

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[46] Wood *et al.*, 2000.
[47] Nadal, 2000.
[48] FAO's livestock projections suggest a 60 per cent increase in ammonia emissions from animal excreta. FAO, 2002c.

Air quality is also affected by practices such as smoke from agricultural burning, dust from tillage, and traffic. Burning of plant biomass is a source of carbon dioxide (CO_2), nitrous oxide (N_2O) and smoke particles. It is estimated that humans are responsible for about 90 per cent of biomass burning, mainly through the deliberate burning of forest vegetation in association with deforestation and of pastures and crop residues to promote re-growth and destroy pest habitats.[49] Additional impacts on the air can come from ozone-depleting substances such as methyl bromide, a fumigant used for pest control in soil and in storage of commodities, or pesticide drift from spraying, and N_2O emissions from the use of nitrogen fertilizer.

Box 13: Some linkages between agriculture and global climate change

- Agro-ecosystems' share of carbon storage is estimated to be 18-24 per cent of the global total.
- In agricultural areas, the carbon stored in soils is generally more than double that stored in the vegetation that these soils support.
- The primary sources of agriculture-based carbon emissions are biomass burning and methane emissions from livestock and paddy rice production.
- Livestock is the largest agriculture-related source of GHG emissions; the growth in livestock populations is also taking place primarily in developing countries.

Source: Wood *et al.,* 2000.

In OECD countries agricultural GHG emissions contributed about 8 per cent of total emissions in 1995-1997 (in CO_2 equivalents). The contribution of agriculture to the main GHG, carbon dioxide (CO_2), is only about 1 per cent. However, it accounts for 60 per cent of total OECD N_2O, and nearly 40 per cent of methane (CH_4). The contribution of agriculture to global warming will have feedback impacts on precipitation patterns and other changes that can further impact agricultural production.

In developed countries, the main contributors are livestock manure and the use of inorganic fertilizers.[50] Livestock alone accounts for about one quarter of CH_4 emissions. As livestock numbers grow, and as livestock rearing becomes increasingly industrial, the production of manure is projected to rise by about 60 per cent by 2030. Methane emissions from livestock are likely to increase by the same proportion.[51] Reducing CH_4 from beef depends primarily on improved breeding and feeding technologies and manure storage.

Agriculture also emits significant quantities of N_2O, another major GHG. This is generated by natural processes, but is boosted by leaching, volatilisation and runoff of nitrogen fertilizers, and by the breakdown of crop residues and animal wastes. Livestock account for about half of anthropogenic emissions. Annual N_2O emissions from agriculture are projected to grow by 50 per cent by 2030.[52]

In developing countries important contributors are biomass burning and wetland rice cultivation. Irrigated rice farming is a main agricultural source of CH_4, accounting for about a fifth of total anthropogenic

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[49] *ibid.*

[50] Methane combined with other gases produced in less volume by livestock (such as carbon dioxide, ozone, nitrous oxide and other trace gases), together form greenhouse gases. Though it persists for a shorter time in the atmosphere, methane is about 20 times more powerful than carbon dioxide in its warming action and therefore a major short-term contributor to global warming. Current annual anthropogenic emissions are around 540 million tons and are growing at around 5 per cent per year.

[51] *ibid.*

[52] *ibid.*

emissions. The area used for irrigated rice is projected to increase by about 10 per cent by 2030. These impacts can be mitigated where rice is grown with better-controlled irrigation and nutrient management, and using newly developed rice varieties that emit less CH_4.[53] Moreover, large quantities of CO_2 are released through the burning of biomass, mainly in areas of deforestation and grassland. When plant residues and roots decompose, the carbon they contain is transformed primarily into soil organic matter and carbon-based gases. Indirect infrastructure, energy use, production and processing, and transportation issues associated with agriculture will also have impacts on GHG and climate change. The cumulative impact of human activities, including agriculture, has been to significantly increase the atmospheric concentration of CO_2 and CH_4.

Agriculture also offers important services related to carbon sequestration, playing a role as a sink for GHGs by removing carbon from the soil. Improvements in tillage practices, cover cropping and crop residue management in Canada and the United States are encouraging agricultural soils to act as GHG sinks. Indeed, the OECD estimates that about 50 per cent of carbon sequestration needs can be achieved by adopting soil conservation and improving crop residue management (e.g. reduction of stubble burning), 25 per cent by changing cropping practices (e.g. increases in soil cover), and much of the rest through a combination of land restoration and converting cropland to pasture.[54]

2.5 Identifying priorities and putting forward the sustainability context

A challenge for practitioners undertaking an IA is to select the issues related to sustainability that are of greatest priority with respect to the issue and region under consideration, to identify drivers of sustainable or unsustainable behaviour and trade-offs between the various dimensions of sustainability in a way that reflects the major linkages between the most relevant variables and represents an "ecosystem" approach. Identifying and addressing key sustainability issues in the early stages of planning and decision-making will help focus any input into the selection of trade and related macroeconomic policies. This approach can also be applied *ex post* to design policies to promote sustainable development in the context of already-agreed upon trade measures.

At a general level, priority sustainability issues can be identified using the following criteria:

- appreciation of social, environmental and economic values for multiple stakeholders
- magnitude of current risks, threats and sense of urgency
- risks for other areas and/or future generations
- the relationship between different dimensions (positive or negative)
- number of people potentially affected by unsustainable behaviour.

Table 2 presents a matrix that can be employed to prioritise sustainability issues and illustrate trade-offs between the different variables. This matrix should be completed with the participation of stakeholders to ensure that different risks and values are reflected.

In order to address challenges related to sustainability, it is important to identify and address root causes of unsustainable pressures or behaviour. Root causes can be economic, social, environmental or institutional/political in nature. A consideration of existing potentials and opportunities (such as innovative techniques, local initiatives, social change processes, successful projects, and/or ongoing policy change) is

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[53] *ibid.*
[54] OECD, 2001a.

Table 2: Matrix to help identify sustainability priorities for an IA

Parameter and guiding question	Economic dimension	Social dimension	Environmental dimension	Relationship between dimensions
Sustainability values What is important to sustain, that is appreciated most?				
Current problems and risks What are the urgent problems or risks for priority values?				
Future problems What are the sustainability values threatened in the future?				
Spatial trade-off What are sustainability risks in areas and for people elsewhere?				
Winners and losers Who benefits and who is negatively affected by the current sustainability problems?				
Summary of main sustainability problems				

useful to identify opportunities for mutually supportive policy options and to present a starting point for developing strategies to address these root causes. This might lead to a package or combination of interrelated policy options. The matrix presented in Table 3 can be of guidance. Annex 1 presents the application of this matrix to an example, using the issue of water pollution due to excessive use of pesticides causing health problems.

Table 3: Matrix for analysis of root causes, actors and opportunities related to a sustainability problem

Problem identified: _____

Levels	Root causes of the problem, associated actors and opportunities to help solve the problem within different dimensions and at different levels			
	Economic	Socio-cultural	Environmental	Institutional/ Political
Local	Factors: Actors: Opportunities:	Id.	Id.	Id.
National	Id.	Id.	Id.	Id.
International	Id.	Id.	Id.	Id.

NB: Economic dimension includes technical and financial factors; socio-cultural dimension includes demographic, knowledge and information factors.

2.6 Sustainability indicators

Assessing and tracking impacts requires the identification of indicators that can be measured to show changes over time. Indicators should be selected on a case-by-case basis and should be specifically tailored to the identified sustainability priorities and likely impacts. The selection of indicators will depend on the specific issue being examined. Selection will also depend on geographic locations, the priorities of those undertaking the IA and of the stakeholders involved in the process. Where there are limitations based on data availability, proxy indicators might be selected, and note should be made to encourage the collection of additional necessary data for future assessments and policy-related activities.

The aim of identifying indicators is to:

- monitor and compare conditions and trends on a local, regional and global scale;
- assess the effectiveness and impacts of (proposed) policies;
- assess progress towards stated benchmarks or targets;
- track changes in public attitudes and behaviour;
- ensure understanding, participation and transparency;
- forecast and project trends; and,
- provide early-warning information.

The effective monitoring of indicators can be hampered where too many indicators are identified and where human and financial resources for monitoring are not sufficient. Therefore, the number of indicators chosen should be limited and focus on the key sustainability issues identified. Thus, there is a close linkage between the identification of indicators and the earlier strategic analysis of the sustainability context, as elaborated in section 2.5. Indicators can usefully be presented in terms of one of the frameworks presented below. Monitoring pressures and driving forces allow one to forecast trends and provide early-warning signals. Monitoring responses can generate information on successful initiatives to be strengthened.

2.6.1 Indicator frameworks

There are a number of frameworks available in which to consider frameworks. Two are presented here and should be used to the extent that they are helpful in illustrating the inter-relationships between various economic, environmental and social issues, including trade.

2.6.1.1 The Pressure-State-Response Framework

The Pressure-State-Response (PSR) Framework states that human activities exert pressures (such as pollution emissions or land use changes) on the environment, which can induce changes in the state of the environment (for example, changes in ambient pollutant levels, habitat diversity, water flows, etc.). Society then responds to changes in pressures or state with actions at household, private enterprise or public policy levels, intended to prevent, reduce or mitigate pressures and/or environmental damage.[55]

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[55] OECD, 1993.

Figure 2: Pressure-State-Response Framework
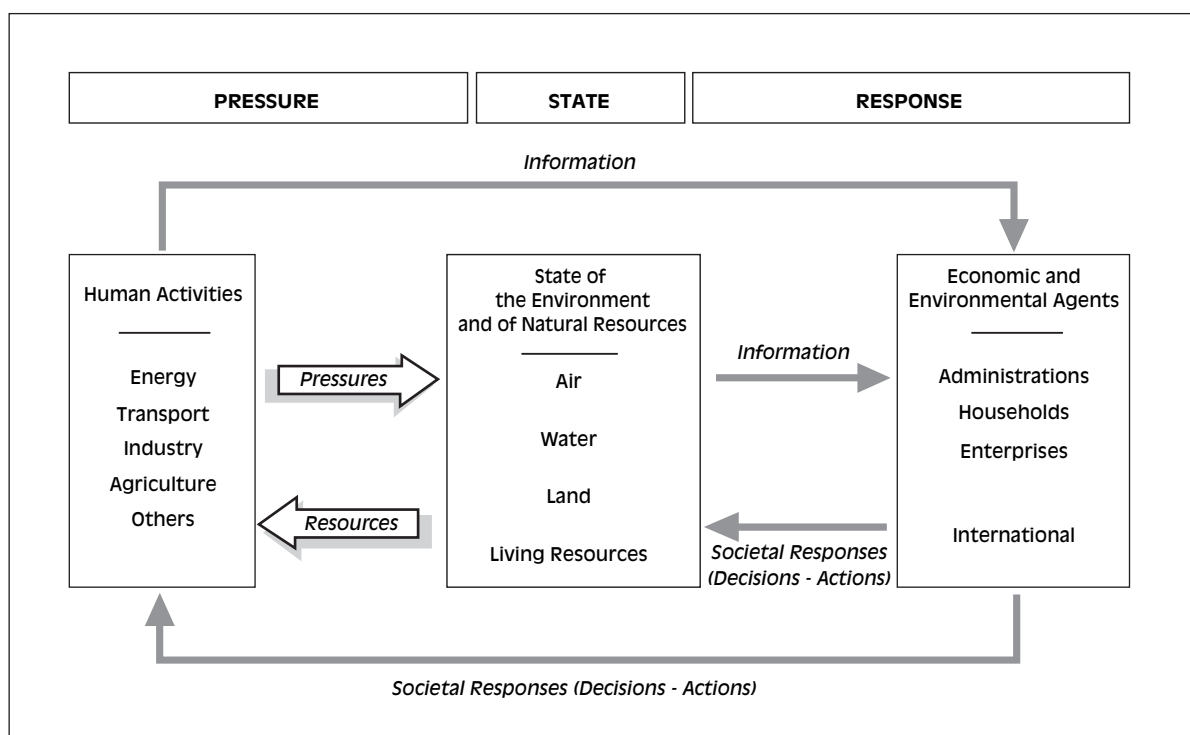
Source: OECD, 1993.

2.6.1.2 The Driving Force-Pressure-State-Impact-Response Framework

Although the PSR framework is conceptually clear and relatively straightforward to apply, it is constrained in this context by difficulties in addressing social indicators. The PSR framework has thus been adapted to replace the term "pressure" by the term "driving force" in order to accommodate the addition of social, economic and institutional indicators.[56] In addition, the use of the term "driving force" allows for impacts on sustainable development to be both positive and negative.

This framework builds on experiences with previous frameworks, and can better take into account different cultural, social, economic, institutional, political, and environmental variables. It is structured to follow causal chains from an indirect root cause ("driving forces") to a direct pressure and finally a management response.[57] The framework assumes an understanding of cause-effect relationships between interacting components of social, economic, and environmental systems, which are:

- **D**riving forces of change

- **P**ressures on sustainability

- **S**tate of sustainability

- **I**mpacts on population, economy, ecosystems

- **R**esponse of the society

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[56] See http://lead.virtualcentre.org/en/dec/toolbox/Refer/EnvIndi.htm
[57] For further information see European Commission, 1999.

Figure 3: The DPSIR Framework for reporting on environmental issues
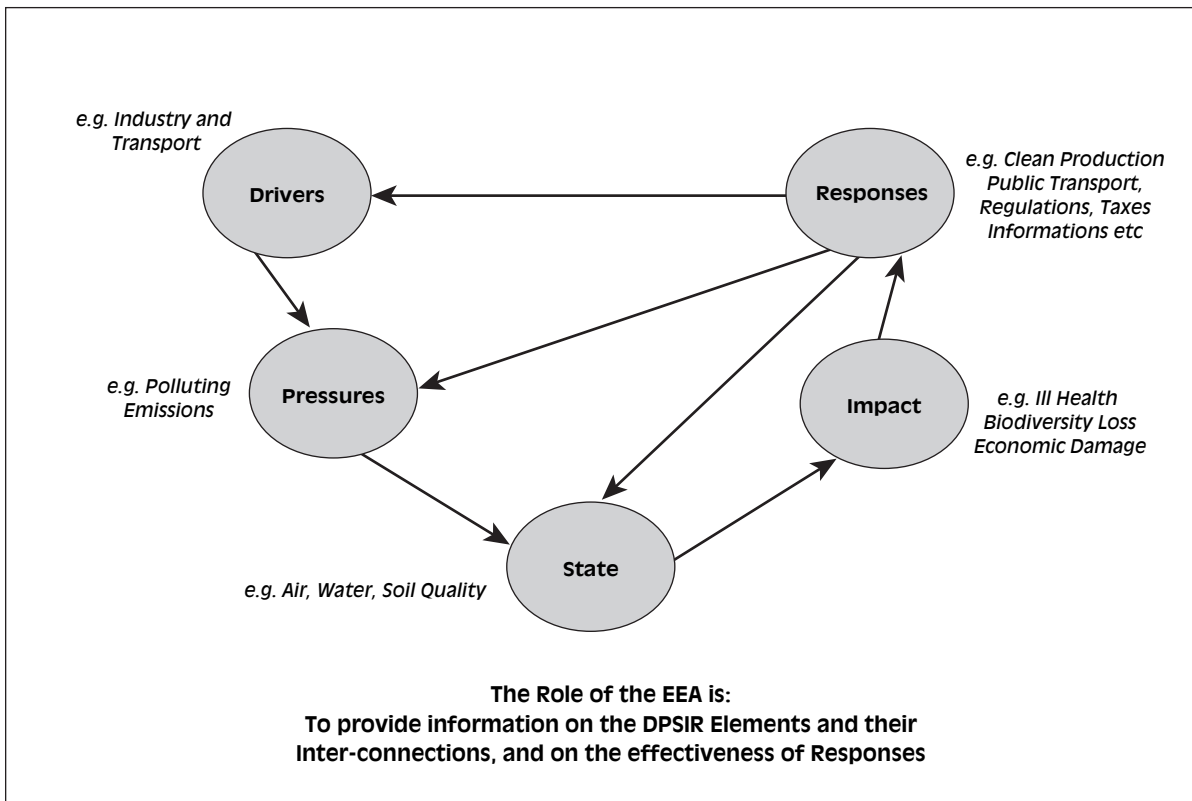
Source: European Commission, 1999.

Table 4 presents an example of the application of the DPSIR framework to the issue of declining water quality, as a result of the intensification of farming practices.

Table 4: An example of the application of the DPSIR to agriculture

	Examples of indicators
Driving force	– Social: rural emigration rate; level of education of young farmers – Environmental: climate change, increasing incidence of crop pests – Economic: subsidy rates of agricultural inputs, privatisation of agrochemical commerce – Institutional: environmental laws and regulations and their enforcement
Pressure	– Social: the amount of agrochemical being used, the use of banned pesticides – Environmental: run-off from farmland, change of temperatures (resulting from the driving force of climate change) – Economic: the efficiency of agrochemical use; farming practices; efficiency of fishing techniques; the export of farm products – Institutional: capacities of decentralized institutions, responsibilities of farmers' cooperatives
State	– Social: employment in farm sector – Environmental: water quality in surface and groundwater – Economic: income of farmers – Institutional: functioning of farmers cooperatives in land management
Impact	– Social: incidence of diseases due to contamination of drinking water sources – Environmental: eutrophication, soil degradation – Economic: poverty rate – Institutional: collapse of farmers associations, proportion incomes from export
Response	– Social: improved training and protection for farm workers – Environmental: promotion of integrated pest management (IPM) and organic fertilizers – Economic: change of subsidy levels to reduce environmental pollution, adjustment of trade policies – Institutional: tighter regulations on pesticide and chemical fertilizer use

2.6.2 Sampling of indicators related to agriculture

The ultimate selection of specific indicators should be guided by the criteria in Box 14. In some cases indicators reflect pressures, in other cases the state of an economic, social or environmental issue, and in others, possible responses to sustainability challenges. It is up to individual practitioners to select an appropriate mix of indicators for a specific issue or region on a case-by-case basis.

Box 14: Criteria for selecting indicators

- Linked directly to the results and recommendations of the assessment
- Meaningful by being linked to key sustainability issues
- Able to show trends over time
- Easily understood by non-specialists
- Relevant to trade policy and related policy initiatives
- Linked to existing monitoring programmes and institutional capacity to evaluate the results
- Measurable without the commitment of an unacceptable level of financial and personnel resources.

Annex 2 presents examples of specific indicators for the agricultural sector covering economic, environmental and social domains, particularly those discussed in Sections 2.1 and 2.3. They also incorporate, as relevant, indicators for the Millennium Development Goals, noted with MG1 to MG8 (Box 15). The indicators are intended to illustrate a range of variables associated with agriculture, the most relevant of which should be included in an IA.

Box 15: Millennium Development Goals

- MDG 1: Reduce extreme poverty and hunger
- MDG 2: Achieve universal primary education
- MDG 3: Promote gender equality and empower women
- MDG 4: Reduce child mortality
- MDG 5: Improve maternal health
- MDG 6: Combat HIV-AIDS, malaria and other diseases
- MDG 7: Ensure environmental sustainability
- MDG 8: Develop a global partnership for development

3. Relevant trade measures

Highlights

- Identify the trade measures most relevant for the commodity(ies) being examined.

- Examples of trade measures that might be relevant in an IA:
  - market access
  - export subsidies
  - domestic support
  - standards and conformity assessment
  - investment
  - intellectual property rights.

- Consider other macroeconomic and microeconomic forces that might have independent impacts on sustainability, unrelated to trade or indirectly related to trade.

The core component of the IA will be the relationship between sustainability and trade measures. This section canvasses a number of trade and trade-related measures that may be relevant, alone or in combination, to an IA. It is intended to suggest the types of measures that might be the subject of an IA, either alone or in combination as part of a broader liberalization negotiation. The scope of an IA can range from analysing specific trade measures, such as the impact of a subsidy or tariff, to comprehensive multilateral agreements or regional trade agreements extending to investment and institutional issues affecting global or regional governance. The extent and complexity of the IA will differ according to the type of trade measure or agreement under consideration, as well as the legal or administrative structure of the country concerned, and the level of resources available to conduct the assessment.

Since 1994, developing countries, whose share of world industrial exports has been increasing steadily, have not increased their share of agricultural exports. Many developing country exports still face tariffs and other barriers in developed country markets and, in particular, attempts to develop processing industries for export are sometimes hampered by tariff escalation, the erosion of tariff preferences, and reciprocal reductions in tariffs which mean that domestic industries are subject to increasing competition from products that can be produced more cheaply elsewhere. This is particularly problematic for the least developed countries where agriculture often constitutes the single most important sector in the economy and where exports are typically not diversified but based on one or two primary products for which global demand or international prices are often declining.

Developing countries remain net food importers of major agricultural commodities. For example, wheat is the most important cereal traded on international markets, and developing countries generally account for nearly 80 per cent of all wheat imports.[58] International trade in livestock and livestock products accounts

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[58] FAO, 2002a.

for about one sixth, by value, of all agricultural trade. Meat exports - mainly of bovine, pig and poultry meat - make up about half the total value. As a group, the developed countries account for more than three-quarters of world trade in livestock and livestock products.[59] The participation of developing countries in the global beef market will continue to be constrained by more difficulties in managing animal disease issues as well as the challenge of meeting increasingly more stringent food safety regulations in developed countries. As a group, developing countries are net importers of livestock items, with dairy products being the biggest single import item. Developed countries account for 90 per cent of exports of milk and milk products. Developing countries as a whole, account for 70 per cent of imports of milk and milk products.[60]

Where an IA has a specific trade focus, this should be clearly defined and delineated at the outset. Typically, an IA will have as its subject a specific trade related policy or agreement. Key trade measures that are typically relevant for the agricultural sector include the general areas that have been, and continue to be, the subject of liberalization discussions at the WTO. As the cornerstone of WTO negotiations, they are also relevant for many bilateral and regional trade agreements, which seek to achieve consistency with WTO provisions. Therefore, while some trade measures identified in this *Handbook* are related to the core provisions of the WTO's Agreement on Agriculture (AoA), they are broadly applicable to other trading relationships where similar themes will emerge. This is true also for countries that are not members of the WTO. These countries might nevertheless wish to undertake an IA of agriculture and issues such as market access, domestic support or export competition that might be applicable in the context of other bilateral and regional trading arrangements.[61]

3.1 Trade measures

Since 1994, global agricultural trade has been brought under the discipline of the Uruguay Round (UR)'s AoA, which imposed binding disciplines upon farm trade. The AoA converted non-tariff barriers into tariff equivalents and bound all tariffs. It also subjected export subsidies on agricultural products to new disciplines. In addition, domestic policies that affect the production of, and trade in, agricultural products became subject to a set of rules and bindings with the aim of disciplining these policies and making them more transparent.[62] Nevertheless, agricultural markets remain heavily protected compared to other sectors such as manufacturing. Article 20 of the AoA commits WTO members to continue negotiations to reform agricultural trade. Further to Article 20, negotiations commenced at the beginning of 2000. The negotiations seek to achieve "substantial progressive reductions in support and protection resulting in fundamental reform."

In November 2001 the fourth WTO Ministerial Conference was held in Doha, Qatar. The Doha Declaration, issued on 14 November 2001, confirmed and elaborated on the objectives of the agricultural negotiations, making them more explicit and building on the work already underway. It also set out a

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[59] Global beef production is constrained because of the extensive nature of beef production, difficulties in vertically integrating the beef production/processing chain, as well as stagnant beef demand in developed countries – growth in global beef production has occurred at 1 per cent per year over the past decade. Growth in trade has grown by 2 per cent annually in recent years but lags behind growth in other meat. Beef's share of global meat trade has declined from 45 per cent to 30 per cent in the early 1990s. One constraint on demand has been the outbreaks of disease and rising concern over food safety (particularly related to BSE) around the world, which have raised considerable health concerns among consumers, limited consumption growth in developing countries and moved it to other meats. FAO, 2002c.

[60] Throughout the 1990s the relative importance of milk production in developing countries has increased. Consumption is growing most rapidly in developing countries as a group due to rising personal incomes and diversification of diets, and this is driving increasing production. FAO, 2002c.

[61] The most relevant trade measures to include in an IA can be determined using the criteria presented in UNEP, 2001.

[62] Other WTO agreements that have important impacts on agricultural trade include the Agreement on Subsidies and Countervailing Measures (SCM), the Agreement on Sanitary and Phytosanitary Measures (SPS), the Agreement on Technical Barriers to Trade (TBT) and the Agreement on Import Licensing. The SPS Agreement, for example, provides for countries to take measures to protect human, animal and plant health while at the same time establishing rules to prevent countries from using arbitrary and unjustified health regulations as disguised barriers to trade.

timetable with deadlines, and agriculture became part of the single undertaking whereby virtually all the negotiations are expected to end by 1 January 2005.

At Doha, WTO Members committed themselves in particular to comprehensive negotiations to achieve substantial reforms in market access, reductions of export subsidies (with a view to phasing them out), and substantial reductions in domestic supports that distort trade. The ministers made special and differential treatment for developing countries integral in new commitments and in any relevant new or revised rules and disciplines. It is hoped that the outcome will enable developing countries to meet their needs, particularly those associated with food security and rural development. The ministers also took note of non-trade concerns including environmental protection and confirmed that non-trade concerns will be factored into the agricultural negotiations.

3.1.1 Market access

Market access typically includes tariffs, tariff rate quotas (TRQ), tariff quota administration, special safeguards, importing state trading enterprises and other issues. In general, the tariff levels on manufactured goods imported into developed countries are now low, with access limited through administrative protection such as supply management schemes, product standards or other non-tariff measures.

In developing countries, protection tends to be higher and access to local markets for goods and services remains more restricted. For example, developing countries account for 95 per cent of the total production of the world's rice (China and India alone are responsible for over half the world output). Rice is traditionally one of the world's most protected commodities because of its importance to food security, employment, income generation and political stability.[63]

The Uruguay Round (UR) lowered some barriers to access for developing countries into developed countries through limits on import restrictions, in exchange for developed country access to markets of developing countries through lower tariffs. In most developing countries agricultural exports have a much higher share of total exports than in developed countries. The incidence of high tariffs in agriculture relative to manufacturing is of concern for exporting countries. A number of developing countries also face issues associated with tariff escalation—the imposition of higher duties on processed products to protect domestic processing industries—which can hamper the development of processing industries in countries that produce raw materials.

Agricultural products are only protected by tariffs as all non-tariff barriers had to be eliminated or converted to tariffs as a result of the UR through a process known as tariffication whereby all import bans, quotas and other restrictive measures were converted to bound tariffs. Despite the AoA, many agricultural tariffs remain high, and tariff levels tend to increase with the degree of processing undertaken. Recent estimates by the OECD indicate that average agricultural tariffs are in the region of 60 per cent compared to industrial tariffs that rarely exceed 10 per cent.[64]

In some cases, the calculated equivalent tariffs were too high to allow any real opportunity for imports. A system of TRQ was created to maintain existing import access levels, and to provide minimum access opportunities. Lower tariffs are applied to imports below a certain quantitative limit (in-quota rate), and

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[63] Global rice production in the 1990s expanded at a rate of 1.8 per cent per year, just above population growth rates. Globally, small farmers mainly cultivated rice on holdings of <1ha. Most gains in production were sustained by productivity gains rather than land expansion. Rice is a major food staple and a mainstay for many rural populations and a convenient source of low-cost calories for urban populations. International prices have been falling in recent years as a result of expansionary production policies in a large number of countries. FAO, 2002c.
[64] OECD Policy Brief, 2001.

higher rates (out-of-quota) applied to imported goods after the quota had been reached. Discussion since the UR has focused on the high levels of tariffs outside the quotas, as well as the operation of the tariff quotas themselves.[65]

Some exporters are concerned that their ability to take advantage of tariff quotas can be handicapped because of the way the quotas are administered. Sometimes they also complain that the licensing timetables put them at a disadvantage when production is seasonal and the products have to be transported long distances. Increasing minimum access under tariff quotas, and setting a ceiling on the maximum rate of tariff, would be in the interest of most exporting countries and could lead to rising world prices of some agricultural commodities.

Some countries see tariffs and other import barriers as necessary in order to protect domestic production and maintain food security. Some developing countries say they need flexibility in deciding the level of import duties they charge to protect their farmers against competition from imports for which prices are low because of export subsidies.

In the area of market access, measures for special and differential treatment are being considered for developing countries, new WTO members and economies in transition. Some developing countries consider that their tariffs should be conditional on the reduction by developed countries of trade-distorting domestic support and export subsidies. Small, "single commodity" exporters are calling for their trade preferences in developed countries to be preserved and strengthened, while some countries find that certain preference schemes unfairly discriminate against other developing countries.

Safeguards, which are related to market access, are contingency restrictions on imports taken temporarily to deal with special circumstances such as a sudden surge in imports. At the WTO, the Agriculture Agreement has special provisions on safeguards that differ from normal WTO safeguards as follows:

• higher safeguard duties can be triggered automatically when import volumes rise above a certain level, or if prices fall below a certain level; and

• it is not necessary to demonstrate that serious injury is being caused to the domestic industry.

The special agricultural safeguard can only be used on products that were tariffied — which amounts to less than 20 per cent of all agricultural products. They cannot be used on imports within the tariff quotas, and they can only be used if the government reserved the right to do so in its schedule of commitments on agriculture. In practice, the special agricultural safeguard has been used in relatively few cases. As part of the agricultural negotiations, proposals range from continuing with the provision in its current form, to its abolition, or its revision to prevent its use on products from developing countries. Some developing countries have proposed that only they would be allowed to use special safeguards.

According to the FAO, for most agricultural commodities, the AoA's impact on prices and levels of trade has been negligible, as has its impact on many developing economies. The reductions made since 1994 have complied with the goals in the AoA, but it is not clear that market access has improved significantly. Developed country tariffs have been cut by and average of 37 per cent, but the deepest cuts have been mainly for unprocessed tropical crops that already had low tariffs. The FAO indicates that commodities also produced in developed countries, and processed products, benefited much less.[66]

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[65] In general, OECD countries' TRQs are under-utilised—the average OECD rate of utilization (fill rate) has fallen over time, from 67 per cent in 1995 to 57 per cent in 1999. OECD.
[66] FAO, 2002c.

3.1.2 Export subsidies

The AoA brought direct subsidies for agricultural exports into an international trade agreement for the first time. Indirect subsidies, such as export credit guarantees and food aid, were also covered. Developed countries agreed to reduce their expenditure on subsidies by 36 per cent and developing countries by 24 per cent. Reductions in the volume of subsidised exports were also negotiated, with a reduction for each commodity of 21 per cent required for developed and 14 per cent for developing countries. Least Developed Countries undertook no commitments to reduce their subsidies. The EU accounts for the bulk of direct export subsidies: in 1998 it spent US$ 5.8 billion, over 90 per cent of all such subsidies covered by the AoA.[67]

Subsidised exports from developed countries can depress prices on the international market. For potential agricultural exporting countries reduced prices make it difficult for countries that do not use them, to compete. For importers, they can bring benefits in terms of lower import prices. The key difference in interests among those developing countries with interests in agricultural trade lies between those who are net importers and those who are net exporters.

A minority of WTO members use export subsidies (Box 16). They are only allowed for products on which commitments have been made to reduce the subsidies and countries without commitments are prohibited from subsidising agricultural exports. This select group of countries continue to apply high levels of export subsidies focused on specific agricultural products and commodities. For example, subsidised exports account for an important share of world trade in dairy products.

Some developing countries argue that domestic producers are handicapped in the face of imports that are subsidised both at home and in export markets. This group includes countries that are net food importers. The net food importing countries could also benefit from an adjustment period if world prices rise as a result of negotiations to eliminate export subsidies abruptly. The elimination of export subsidies over a longer period of time might help net food-importing countries and least developed countries adjust to the prospect of higher food bills.

The removal of export subsidies has the potential to impact prices and production in exporting countries and importing countries. A recent FAO study looked at the impacts of gradually removing price supports and other subsidies over 30 years by 2030. The analysis focused on the expected price effects for

Box 16: Export subsidies in the AoA

The 1994 Agreement on Agriculture disciplined export subsidies in agriculture but did not ban them. The Agreement reduces the value of export subsidies (outlays) by 36 per cent over the 6 years between 1995 and 2000 for developed countries, and by 24 per cent over 10 years (1995-2004) for developing countries. The Agreement also reduces the volume of subsidised exports by 21 per cent in developed countries between 1995 and 2000 and by 14 per cent in developing countries over the 10 years between 1995 and 2004.
Least-developed countries do not have to reduce subsidies.

The AoA includes certain temporary exemptions for developing countries, allowing them to subsidize marketing, cost reduction and transport (Art 9.4)

Source: WTO.

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[67] *ibid.*

consumers and producers, in both developed and developing countries. It found that international prices could rise moderately, while prices would fall substantially in countries with high levels of protection. Producers trading at international prices would gain, while those producing at higher protected prices would lose. The FAO study found that the benefits for consumers in hitherto protected OECD markets could be high, but it also stressed that high processing and distribution costs in these countries could mean that lower prices for raw products would not translate into substantially lower prices for the final consumer. Consumers in developing countries, where processing and distribution margins are much smaller, stood to lose more significantly. According to the FAO, trade liberalization would not change the main conclusion of this study – that developing countries will increasingly become net importers of agricultural products – but that it would slow the process somewhat.[68]

3.1.3 Domestic support

The AOA puts in place rules to reduce distortions caused by support payments and encourage reform away from the most trade-distorting forms of support, towards mechanisms and instruments deemed to be minimally or non-trade distorting. Under the AoA, developed countries are required to make a 20 per cent reduction in their support for agriculture, developing countries a 13.3 per cent cut and least developed countries none. These cuts are to be made with reference to a 1986-1988 base, over a period of 6 years for developed countries and 10 years for developing countries.

- *Amber Box* – Domestic subsidies that are classified in the amber box are the most distorting forms of support and are subject to reduction requirements. The impacts of these measures are expressed in the aggregate measures of support (AMS).[69] AMS is a numerical measure representing domestic policies considered to have the greatest potential to affect production and trade—those that are considered trade-distorting. The AMS is defined as "the annual level of support, expressed in monetary terms, provided for an agricultural product in favour of the producers of the basic agricultural product or non-product-specific support provided in favour of agricultural producers in general." The AMS is subject to a number of exemptions. In particular, the UR carved out two categories of exemption from the calculation of AMS and therefore sheltered them from the application of the GATT rules. They are the "blue box" and "green box" policies.

- *Green Box* – Green box measures are exempted from reduction. The green box includes subsidies that are considered to be non- or minimally-trade distorting. They include measures that provide support that is not based on current production or factors of production. These include provisions related to environmental and conservation objectives along with other eligible policies related to, *inter alia*, advisory services, domestic food aid, decoupled income support, income insurance and safety-net programmes [70] (Annex 3).

- *Blue Box* – The blue box includes domestic support measures that are tied to programmes that limit production. It is an exemption from the general rule that all subsidies linked to production must be reduced or kept within defined minimal (*de minimis*) levels. Policies within the blue box include those that provide direct payments under production-limiting programmes tied to acreage control provided

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[68] *ibid.*

[69] Under the Agreement on Agriculture, AMS support provided to farmers is reduced by 20 per cent in developed countries over 6 years (1994-2000, with 1986-1988 as a base period). For developing countries, the commitment is 13 per cent over 10 years. The required reduction is not commodity specific. 34 WTO members have commitments to reduce their AMS. WTO members without these commitments have to keep within 5 per cent of the value of production (i.e., the *de minimis* level) — 10 per cent in the case of developing countries.

[70] Countries appear to be making an effort to design policies that are consistent with green box requirements. Green box support in OECD countries doubled between the period 1986-1988 and 1995-1998 and has been higher than AMS over the entire implementation period of the Agreement on Agriculture. OECD Policy Brief, 2001.

they are made on the basis of field area and yield (number of head for livestock) or a maximum of 85 per cent of base level production. At present, the only members notifying the WTO that they are using or have used the blue box are: the EU, Iceland, Norway, Japan, the Slovak Republic (which joined the EU on 1 May 2004) and Slovenia.

Because commitments to liberalise were based on historically high levels of support and protection, levels remained high enough to maintain much of the protection previously enjoyed, even after the cuts had been implemented. Indeed, total support to agriculture in the OECD countries was actually higher in 1998-2000 than before the AoA.[71]

3.1.4 Intellectual Property Rights

An IA of trade in agriculture might consider measures that are the subject of multilateral negotiations, and can have important impacts in the sector. One such issue is intellectual property rights (IPR). These are legal tools that protect intellectual works such as inventions, literature and designs, and include patents, copyrights, trademarks, industrial designs, trade secrets, plant breeders' rights, geographical indications and rights to layout-designs of integrated circuits. At the multilateral level, issues related to trade and Intellectual Property (IP) are governed by the WTO's 1995 Agreement on Trade Related Intellectual Property Rights (TRIPS), which covers a wide range of IP related issues and sets out rules related to trade. The architecture of the global IPR regime more generally includes a range of multilateral agreements, international organisations, regional conventions and bilateral arrangements.

The TRIPS Agreement allows countries to adapt their implementation periods, depending on their levels of development. Developing countries and economies in transition are granted a period of 5 years from the date of entry into force of the Agreement to apply the provisions of TRIPS (until 1 January 2000) and the least developed countries are given until 1 January 2006.

Agriculture is one sector, among many, that stands to be impacted by rules governing IP and trade. Among IPRs, patents and plant breeders' rights (PBR) are directly related to agriculture. The Agreement on TRIPS requires signatories to establish a system for the protection of new plant varieties. Article 27.3(b) of TRIPS allows WTO members to exclude from patentability certain plants and other micro-organisms. Despite this, they are required to provide protection for plant varieties by patents, by a *sui generis* (of its own kind) system, or a combination of these. This provision is under review. In the Doha Declaration WTO members agreed on a number of IPR issues (Box 17).

In developed countries, plant breeders have generally sought IPR protection for new plants through plant breeders' rights. In contrast, plant biotechnologists tend to use the patent system. Countries such as the United States allow both systems for new varieties. Given the importance of agriculture in developing countries, the choice of the form and level of IP protection (patent, plant breeders' rights or other kinds of *sui generis* systems) could have significant economic, social and environmental impacts.

Policies that increase the costs of key agricultural inputs have the potential to impact sustainability. From an economic perspective, factors such as the share of population relying on agriculture for food and the share of traditional varieties in agricultural products should be considered. These issues may be particularly important in developing countries where large portions of the population rely on cultivating food crops for subsistence, to sell in the market and to trade.

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[71] FAO, 2002c.

Box 17: The Doha Declaration and trade-related aspects of intellectual property rights

17. We stress the importance we attach to implementation and interpretation of the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS Agreement) in a manner supportive of public health, by promoting both access to existing medicines and research and development into new medicines and, in this connection, are adopting a separate declaration.

18. With a view to completing the work started in the Council for Trade-related Aspects of Intellectual Property Rights (Council for TRIPS) on the implementation of Article 23.4, we agree to negotiate the establishment of a multilateral system of notification and registration of geographical indications for wines and spirits by the Fifth Session of the Ministerial Conference. We note that issues related to the extension of the protection of geographical indications provided for in Article 23 to products other than wines and spirits will be addressed in the Council for TRIPS pursuant to paragraph 12 of this declaration.

19. We instruct the Council for TRIPS, in pursuing its work programme including under the review of Article 27.3(b), the review of the implementation of the TRIPS Agreement under Article 71.1 and the work foreseen pursuant to paragraph 12 of this declaration, to examine, *inter alia,* the relationship between the TRIPS Agreement and the Convention on Biological Diversity, the protection of traditional knowledge and folklore, and other relevant new developments raised by members pursuant to Article 71.1. In undertaking this work, the TRIPS Council shall be guided by the objectives and principles set out in Articles 7 and 8 of the TRIPS Agreement and shall take fully into account the development dimension.

Extended IP protection could increase the dependence of small farmers on a limited number of seed companies and result in higher seed prices. In some cases farmers may not be able to afford to purchase protected seeds year after year. There is the possibility that this increased dependence could lead to a loss of crop genetic diversity in agriculture. Patents and systems of plant breeders' rights encourage seed companies to focus their research on a few species and varieties that can be widely marketed. Traditional varieties often respond to local characteristics, including climatic and pest-related, or consumption patterns. Social and cultural practices related to production and exchange of farmer's seeds enable diverse traditional agro-ecosystems, containing a wide range of traditional crop varieties which could be threatened if they were replaced by a small number of modern varieties. Maintaining agricultural biodiversity can provide an essential foundation for efforts to secure sustainable agriculture, address rural poverty and ensure an ample food supply.

However, there may be trade-offs. First, agro-biotechnology innovations, which are protected by patents, may have positive impacts on the environment (by reducing the need for inputs) and on social wellbeing (by increasing the availability of food). These could include the potential positive impacts of creating incentives to develop new plant varieties responding to local needs (for example, drought-tolerant plants), or varieties that increase yields. Where modern breeding techniques produce seeds that reduce the use of inputs, they may generate savings for farmers. There may also be opportunities for seed companies in some countries. In addition, other IP rights, such as geographical indications, may add value to agricultural products in both developed and developing countries. Any extension of geographical indications beyond wines and spirits could contribute to the preservation of land-races and local varieties and maintain traditional knowledge related to conservation and sustainable use. These benefits may depend on the technical, institutional and financial capacities of the countries to support development and monitoring costs and on the existence of demand for "biodiversity friendly" products in industrialised countries.

3.1.5 Standards and conformity assessment

A second general trade related measure that affects agriculture is the application of standards, particularly SPS standards. SPS standards are covered by the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), which governs measures necessary to protect humans, animals, and plants from certain hazards associated with the movement of plants, animals and foodstuffs in international trade.

In order to reduce the risk of creating trade barriers, the SPS Agreement indicates when SPS measures may be allowed and what conditions they must meet - the basic requirements of notification, transparency in developing rules, and the use of international standards where appropriate.

An SPS measure is any measure applied:

- to protect animal or plant life or health within the territory of the Member from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms;

- to protect human or animal life or health within the territory of the Member from risks arising from additives, contaminants, toxins or disease-causing organisms in foods, beverages or feedstuffs;

- to protect human life or health within the territory of the Member from risks arising from diseases carried by animals, plants or products thereof, or from the entry, establishment or spread of pests; or

- to prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests.

SPS measures include all relevant laws, decrees, regulations, requirements and procedures including, *inter alia*, end product criteria; processes and production methods; testing, inspection, certification and approval procedures; quarantine treatments including relevant requirements associated with the transport of animals or plants, or with the materials necessary for their survival during transport; provisions on relevant statistical methods, sampling procedures and methods of risk assessment; and packaging and labelling requirements directly related to food safety.[72]

Under the SPS Agreement countries can set their own standards, but they must be based on science and should only be applied to the extent necessary to protect human, animal or plant life or health. They should not be arbitrarily or unjustifiably discriminate between countries where identical or similar conditions prevail. The Agreement requires that standards be based on international standards, or that a risk assessment be undertaken to provide scientific proof of the need for the measure.[73]

A related WTO Agreement is the Agreement on Technical Barriers to Trade (TBT). The TBT Agreement covers measures that do not fall under the SPS Agreement, including technical performance standards a product must meet to be imported or exported. The TBT Agreement sets out a rules-based framework for ensuring that standards do not become unnecessary obstacles to trade in the form of non-tariff barriers.

Box 18: Examples of SPS measures notified to the WTO

- European Communities: Genetically modified food and feed (Final Rule); Food safety/Animal Health (G/SPS/N/EEC/149/Add.3)
- European Communities: Nitrate - MRLs in baby foods and processed cereal-based foods for infants and young children; Food Safety. (G/SPS/N/EEC/222)
- Korea: Pesticides, antibiotics, synthetic antimicrobials and patulin - Establishment of MRLs for various commodities; Food Safety. (G/SPS/N/KOR/148)
- El Salvador: Apis mellifera honey standard - Specifications; Food Safety. (G/SPS/N/SLV/52)
- United States: Asperigillus flavus AF36 containing a new active ingredient; Food Safety/Protect humans from animal/plant pest or disease. (G/SPS/N/USA/831)

Source: Selected examples taken from WTO Committee on Sanitary and Phytosanitary Measures, 2003

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[72] WTO SPS Agreement, Article 1 and Annex A.

[73] Special provision is made for temporary measures when current scientific information is insufficient to adopt permanent measures, making the SPS one of the few WTO Agreements to acknowledge the precautionary principle.

It privileges the basic rules of notification, transparency in developing the rules and the use of international standards. It applies fully to all government standards. Non-governmental, non-mandatory standards are less strictly covered under the "Code of Good Practice". The TBT Agreement allows governments to take measures to pursue legitimate public policy objectives, such as protecting health, safety and the environment. But, these measures must be developed in a way that impacts trade as little as possible.

Certification is the procedure that companies must go through at the domestic level, to demonstrate compliance with regulations. Many standards have labelling requirements applicable to products that require these products to carry commercial information. Some countries require product certification testing to be performed in national laboratories. Accreditation enables national agencies to oversee the activities of the certifying bodies, ensuring a degree of competence and consistency in their testing. However, testing procedures can be a costly process requiring financial resources that may not be readily available. Beyond financing, the certification process also needs to be considered in terms of availability of institutional (including testing laboratories and basic infrastructure and a functional standards body) and human resources (including technical expertise) within the country to conduct the certification process. Some technical assistance and capacity building might be necessary to take advantage of any opportunities presented by standards related issues in trade regimes.

Technical regulations, standards and certification are closely linked to trade (market access) and to agriculture. As tariffs have generally come down through successive rounds of multilateral trade negotiations, the importance of behind-the-border measures, such as technical regulations, standards or requirements for certification have become the focus of those seeking to further liberalise trade. Requirements to meet domestic standards set by trading partners can create barriers to trade, especially if such standards are different to those of the exporting country or opaque. From an environmental and social perspective, requirements to meet SPS and other standards can also contribute to the upward movement of standards in countries where they are low or non-existent.

In addition, environmental labelling programmes and certification schemes (whether voluntary or mandatory) can promote environmental and social responsibility within industry, and opportunities may be created in niche markets, provided capacity limitations are addressed. For example, there may be opportunities for smaller farmers to trade in certified organic products (Box 19).

Box 19: Organic agriculture

In some cases, there may be opportunities for small-scale producers using few inputs and where food production is undertaken by producers and cooperatives that employ production methods that are similar to those required for organic farming (such as low use of fertilizers and pesticides). Certified organic products sell at a premium in most countries.

To take advantage of these market opportunities producers need the institutional capacity and infrastructure associated with labelling and certification, transportation and marketing. This may require capacity building including training and access to information.

3.1.6 Investment

Over the last 10 years, levels of foreign direct investment (FDI) have increased dramatically in volume around the world, reaching US$ 1.3 trillion in 2001, 4 times greater than 1995 levels. This trend is consistent with growth in international trade. The traditional separation between trade and investment has been eroded as manufacturing production is increasingly organised and managed at a global level.

FDI gains are concentrated in developed countries and a few developing countries in Asia and Latin America. For some developing countries, supply-side constraints including lack of investment in infrastructure, transportation, marketing and communications, limit both trade and investment. Measures taken in multilateral or bilateral agreements that encourage investment can be important for assessing the economic, environmental and social impacts of liberalization in an IA.

Investment generally consists of FDI, which itself is divided into stocks and flows (Box 20), and foreign portfolio investment. The enabling framework for FDI consists of rules and regulations governing entry and operations of foreign investors, standards of treatment of foreign affiliates, and the functioning of markets. FDI takes place generally when firms combine their ownership-specific advantages with the location-specific advantages of host countries through internalisation (e.g. through intra-firm rather than arm's length transactions). Three factors are key: the policies of host countries, the proactive measures countries adopt to promote and facilitate investment, and the characteristics of their economies. Other important policies include trade policy and privatisation, human resources, infrastructure, market access and assets such as technology and innovative capacity.

Box 20: Definitions: FDI

Foreign Direct Investment (FDI): an investment involving a long-term relationship and reflecting a lasting interest and control by a resident entity in one economy (foreign direct investor or parent enterprise) in an enterprise resident in an economy other than that of the parent enterprise (FDI enterprise, or affiliate enterprise or foreign officiate). FDI implies that the investor exerts a significant degree of influence on the management of the enterprise resident in the other economy.

Flows of FDI: capital provided (either directly or through other related enterprises) by a foreign direct investor to an FDI enterprise, or capital received from an FDI enterprise by a foreign direct investors.

Stocks of FDI: the value of the share of capital and reserves (including retained profits) attributable to the parent enterprise, plus the net indebtedness of affiliates to the parent enterprise.

Source: UNCTAD, 2003.

Regions with best inward FDI performance in 1999-2001 (the most success at attracting FDI) were Western Europe and the developing countries in Latin America and the Caribbean, East and South-East Asia and Central Asia (Table 5).

Among the regions with the lowest inward FDI were countries in West Asia, South Asia and Africa. In Africa generally, levels of inward FDI have been declining since 1988-1999. In Latin America and the Caribbean, on the other hand, levels of inward FDI have risen sharply since 1988-1999. Levels of inward FDI have also risen in Western Europe although they have declined somewhat since 1988-1999 in North America.

FDI tends to occur mainly in the tertiary (services) sector (finance and business activities) and in the manufacturing sector (equipment and chemical and metal products), with very little directed towards primary agricultural activities in either developed or developing countries (Tables 6 and 7). As a percentage of total inflows of FDI, in 1999-2000 primary agricultural activity was responsible for a mere 0.1 per cent, rising to 0.2 per cent in 2001. Levels of FDI directed towards secondary economic activities associated with agriculture, such as food and beverages and textiles and clothing are higher.

Despite low levels of investment in agriculture, increasing investment in services such as transportation and communication and other infrastructure can have positive spin-offs on agriculture. There is the

Table 5: Inward FDI performance index by region

Region	1988-1990	1993-1995	1998-2000	1999-2001[a]
World	1.00	1.00	1.00	1.00
Developed countries	1.03	0.76	0.99	1.00
Western Europe	1.33	1.11	1.62	1.77
EU	1.33	1.12	1.63	1.80
Other Western Europe	1.33	0.95	1.37	1.29
North America	1.13	0.77	0.86	0.78
Other developed countries	0.29	0.20	0.12	0.12
Developing countries	0.99	1.98	1.04	1.01
Africa	0.80	1.11	0.52	0.67
North Africa	0.85	1.05	0.39	0.47
Other Africa	0.76	1.15	0.62	0.82
Latin America and the Caribbean	0.90	1.62	1.42	1.41
South America	0.74	1.21	1.33	1.31
Other Latin America and the Caribbean	1.26	2.57	1.60	1.59
Asia	1.06	2.30	0.92	0.87
West Asia	0.27	0.36	0.14	0.11
Central Asia	..	2.93	1.53	1.63
South, East and South-East Asia	1.31	2.70	1.08	1.02
East and South-East Asia	1.74	3.22	1.30	1.22
South Asia	0.11	0.41	0.16	0.16
The Pacific	4.49	4.22	0.75	0.58
Central and Eastern Europe	1.02[b]	1.31	1.01	0.99

Note: [a]Three-year average; [b]1992-1994.
Source: UNCTAD, 2003, Annex Table A.1.6.

potential for such investment to help developing countries and Least Developed Countries diversify their production or pursue policies to encourage vertical integration through processing. Investment can help countries take advantage of opportunities associated with diversification away from an over-reliance on raw material exports, which add little economic value yet use a significant amount of natural resources including land, and/or move towards more processing of goods, both for domestic markets and for export. In countries where food distribution chains are inadequate and spoilage is common, investment in transportation infrastructure or investment that increases storage and refrigeration capacity could promote opportunities to diversify into higher value fresh produce, away from traditional commodities.

Table 6: Inward FDI flows, by selected industry, 1999-2001 (value in billion dollars)

Sector	1999-2000 (annual average)			2001		
	Developed countries	Developing economies	Total[a]	Developed countries	Developing economies	Total[a]
Primary	22.2	17.8	40.9	55.9	13.0	69.4
Agriculture[b]	0.3	1.1	1.4	0.4	1.3	1.7
Mining[c]	21.2	16.2	38.3	55.5	11.7	67.6
Unspecified	0.7	0.5	1.2	-	-	-
Secondary	217.2	61.8	280.5	91.4	56.0	148.8
Food, beverages and tobacco	7.5	3.9	12.4	4.8	2.6	8.0
Textiles, clothing and leather	5.4	1.6	7.0	-0.2	0.2	-
Tertiary	734.2	113.2	849.7	357.4	99.1	459.4
Transport[d]						
Private property transactions	0.4	-	0.4	0.5	-	0.5
Unspecified	60.1	8.1	68.3	45.3	1.7	47.2
TOTAL ALL FDI	1,034.2	200.9	1,239.9	550.5	169.8	725.2

Note: [a]includes countries in Central and Eastern Europe; [b]includes agriculture, hunting, forestry and fishing; [c]includes mining, quarrying and petroleum; [d]includes transport, storage and communications.
Source: UNCTAD, 2003, Annex Table A.1.4.

Table 7: Inward FDI flows, by selected industry, 1999-2001 (percentage distribution)

Sector	1999-2000 (annual average)			2001		
	Developed countries	Developing economies	Total[a]	Developed countries	Developing economies	Total[a]
Primary	2.1	8.9	3.3	10.2	7.6	9.6
Agriculture[b]	0.0	0.5	0.1	0.1	0.8	0.2
Mining[c]	2.0	8.1	3.1	10.1	6.9	9.3
Unspecified	0.1	0.3	0.1	-	-	-
Secondary	21.0	30.8	22.6	16.6	33.0	20.5
Food, beverages and tobacco	0.7	2.0	1.0	0.9	1.5	1.1
Textiles, clothing and leather	0.5	0.8	0.6	-	0.1	-
Tertiary	71.1	56.3	68.5	64.9	58.4	63.3
Transport[d]	12.2	7.9	11.5	9.6	11.8	10.2
Private property transactions	-	-	-	0.1	-	0.1
Unspecified	5.8	4.0	5.5	8.2	1.0	6.5
TOTAL ALL FDI	100.0	100.0	100.0	100.0	100.0	100.0

Note: [a]includes countries in Central and Eastern Europe; [b]includes agriculture, hunting, forestry and fishing; [d]includes transport, storage and communications.
Source: UNCTAD, 2003, Annex Table A.1.4.

The environmental and social impacts of both the production processes and the infrastructure present opportunities for improving economic sustainability. Diversification or expansion in processing may have the effect of increasing the wellbeing of the people employed in the sector, providing higher wage jobs, and producing a higher-value product for exports. The quality of this work will depend in part on the protections that the workers have: access to health and safety protection, good wages, and other benefits. The environmental impacts of increased processing will be associated with related industrial pollution from plants, including emissions, discharges and waste. It will also depend on the levels of technology employed and levels of capital investment in clean processing equipment. Appropriately targeted FDI can play a role in ensuring their environmental benefits (such as putting in place modern technologies) and employing management standards that meet social codes such as those that exist in some OECD countries.

3.2 Independent conditioning factors

In addition to difficulties associated with data collection, attempting to isolate specific trade-related impacts continues to be a challenge. In order to assist a researcher assess whether an observed impact is related to trade or trade liberalization, a number of conditioning factors should be considered, and where relevant their independent economic or other effects acknowledged. These factors occur at both the domestic and the international levels, some are trade related and some are unrelated to trade, shaping the nature of agricultural production and influencing trade flows; they can affect all facets of sustainability: economic, social and environmental.

Box 21: Independent conditioning factors

- International trade negotiating context
- International environment and development context
- Macroeconomic and microeconomic activity
- Domestic law and policy initiatives
- Climate
- Conflict

3.2.1 International trade negotiating context

Trade negotiations do not take place in isolation. Any IA should attempt to take into account parallel processes that might be underway in other fora, multilaterally, bilaterally or regionally. This includes considering the specific context of the agreement. For example, an IA that examines the WTO's AoA should consider the influence of the Doha Declaration and an increased focus on the removal of domestic supports and export subsidies, reductions in tariff peaks for certain products to allow greater market access for developing countries and promote south-south trade. Reforms might also include flexibility in rules that apply to developing countries that would allow them to support and protect agriculture and rural development to help ensure the livelihoods of their large agrarian populations whose farming is different from the scale and methods in developed countries.

3.2.2 International environmental and development context

International commitments on the environment under such Conventions as the UN's Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol and the Convention on Biological Diversity (CBD), as well as other regional trade agreements such as the North American Free Trade Agreement (NAFTA), the Free Trade Area of the Americas (FTAA) or APEC can impact the environmental and social impacts of agriculture. In addition, international efforts such as the New Partnership for Africa's Development (NEPAD) initiative might also be useful as mechanisms to promote sustainability in specific regions.

3.2.3 Macroeconomic and microeconomic activity

It is extremely difficult to disentangle macroeconomic, market or policy factors in explaining trends in trade. However, recent UNEP case studies show that independent macroeconomic activity can be as important, if not more important than trade liberalization in determining countries' trading positions (Box 22).

Box 22: The macroeconomic context

"When examining a specific sector, it was observed that currency devaluation or market distortions, such as price distortions, had a large role to play in determining environmental, economic and social effects. Compared to macroeconomic policies and trade-distorting policies, trade liberalization policies proved less influential in determining production and consumption effects and hence environmental effects."

Source: Abaza and Jha (eds.), UNEP, 2002e.

Macroeconomic and microeconomic conditions can affect trade flows. Among the most important variables to consider are: domestic macroeconomic forces (such as inflation and interest rates, government debts and deficits, for example); microeconomic changes in each economy (such as processes of deregulation and privatisation, for example); and major fluctuations from international forces (such as exchange rates and balance of payments deficits, for example). In some countries, the role of the "informal sector" in the economy could also be an important conditioning factor.

A very important macroeconomic indicator that can impact agricultural production is commodity prices. Export prices for primary agricultural commodities have been dropping steadily for 50 years. Between May 1996 and January 2000, the FAO total foodstuffs price index declined by some 38 per cent in real terms. The index stabilised in 2000 and 2001 but weakened further in January 2002. Among the major foodstuffs, the decline in prices has been most pronounced for cereals, oils and fats. Coffee prices have

also been severely depressed. In 2001 prices fell to their lowest level since 1973. After coffee, cotton suffered the most pronounced decline. Average prices in 2001 were down to 50 per cent of their 1995 level.[74] Weakening non-fuel commodity prices had negative implications for many developing countries that depend heavily on primary commodity exports and had unfavourable consequences for their terms of trade.

3.2.4 Domestic law and policy initiatives

There are a range of non-trade issues that have important impacts on agricultural practices and markets. This ranges from domestic measures related to farm policy reform or the cost of energy (as impacted by taxation at the national level) to international prices for agricultural commodities, to regional policies such as the EU's Common Agricultural Policy (CAP). Other impacts that might not be apparent in a trade analysis are the effects of growing vertical integration and intra-firm trade that is supported by more liberal trading regimes and in particular by increasing FDI. This intra-firm trade is not reflected in official trade statistics. Any changes in these regimes or programmes will have impacts on agricultural production, shifting between crops to respond to price levels, and other impacts that may need to be considered when undertaking an IA in this sector. Additional factors such as independent regulation on the environment on water quality, pesticides, waste disposal, food quality and safety and animal welfare can influence agricultural production. At the same time, development in technology, structural changes in the agro-food sector and farming practices, as well as the evolution of consumer demands, for example for organically produced food, are increasingly influencing environmental performance.

3.2.5 Climate

Another independent variable that can impact agricultural production is climate and the impacts of weather patterns such as *El Niño*. Indeed, perhaps more than in any other sector, weather patterns and natural disasters can affect the global supply of water, global production and trade in agricultural products. In addition, dependence on weather contributes to the vulnerability of the rural poor in many parts of the world. For example, in several parts of Africa, the reduced 2001 maize harvest was caused by bad weather and led to food shortages. In Malawi, floods affected more than 600,000 people. In Zambia, emergency food aid is required for almost 1.3 million people following the poor 2001 maize harvest. In Zimbabwe, the 2001 maize output declined by 28 per cent from the level of the previous years.[75]

3.2.6 Conflict

Conflict and displacement of populations as refugees as a result of conflict can affect food production and food security at the national and regional levels, both during a conflict, when trade might be more difficult and imports might not arrive, and in its aftermath.

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[74] FAO, 2002b.
[75] UNEP, 2002a.

4. Some approaches and techniques for analysing impacts

Highlights

- Identify technique(s) to employ for IA. These will generally consist of a mix of quantitative and qualitative methods.

- Some quantitative methods:
  - Computable General Equilibrium (CGE) models (e.g., IMMPA or Augmented CGE Model with Representative Household Approach for, *inter alia,* employment, poverty and income distribution, or GTAP with an environmental component or other developing models for environmental issues such as land, water and air).
  - Partial Equilibrium (PE) models (e.g., Reduced-form Estimation or Multi-Market models, for assessing poverty and income distribution).
  - Cost-Benefit Analysis

- Some qualitative methods:
  - desk research
  - stakeholder meetings
  - questionnaires
  - field research
  - interviews (in-depth, informal)
  - causal chain analysis.

- Prioritise potential risks and actual impacts.

The theory and practice of carrying out IAs of trade agreements is evolving. Existing methodologies are being employed and refined and new ones developed for identifying impacts of policy changes, including trade liberalization, on sustainability. Experience in UNEP's country studies and elsewhere suggests that an IA of a specific trade measure or agreement should rely on a combination of qualitative and quantitative techniques. The precise nature of this mix of techniques will depend on the scope of the IA itself. Concrete empirical data might be available for an *ex post* assessment while an *ex ante* assessment might rely on projections. Similarly, a study that prioritises biodiversity might rely on indicators that are qualitative, whereas one that examines industrial pollution intensities associated with manufacturing may have access to reliable reported time-series data. Some quantitative methodologies can be difficult to apply in practice to IA where issues are at the same time very complex, and subtle relationships can have important sustainability impacts.[76] As necessary, qualitative approaches should be applied using sound social science techniques employing the best available data to ensure results that are comprehensive and credible.

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[76] Abaza and Jha (eds.), UNEP, 2002e.

In all cases, the approaches and techniques employed will depend to some degree on the availability of reliable data; a lack of reliable statistics and time-series data can hamper efforts to accurately project future impacts. In addition, where countries or regions typically rely to a large degree on an informal economy, efforts to model projected change can become even more uncertain. Nevertheless, even where challenges exist with respect to data availability, IAs should be viewed as opportunities to identify data gaps and encourage the collection of relevant information for future endeavours.

4.1 Quantitative techniques

Broadly speaking, economic trade models are divided into computable general equilibrium (CGE) models and partial equilibrium (PE) models; each has advantages and limitations. CGE models are attractive for their ability to account for a number of factors and impacts. However, because CGE models are supported by statistical data, there are inevitably data and cost limitations. PE models, by contrast, are often more feasible and less costly as they focus on a single industry or sectors. However, connections with other sectors can be omitted in the interest of more detailed analysis, and analysis of economy-wide effects is lost.

For an *ex ante* assessment researchers should explore the usefulness of projecting the trade and economic impacts of liberalization using modelling techniques and, where feasible, extending these to include social or environmental variables. Alternatively, a researcher could rely on the results of any relevant existing models being run by organisations attempting to project prospective impacts of trade measures associated with agriculture where these results can be reliably transferred. Reliance on existing quantitative material and modelling is also of potentially great benefit in taking into account independent effects of conditioning factors such as prices and exchange rates. A quantitative approach that incorporates scenarios can include a "no-trade" scenario, where a researcher wants to include a strong "counterfactual" component in the analysis. Other scenarios could be based on gradations in levels of liberalization on issues related to the negotiations on agriculture such as tariffs, export subsidies and domestic support.

The agriculture sector has been the subject of considerable quantitative analysis at the international level. Recent analysis has focused, in particular, on the trade and economic impacts of commitments being considered in the WTO negotiations on the AoA.[77] Such studies are useful in the context of an IA to identify trade related and economic changes that may result from liberalization and, used in conjunction with additional empirical data, can be used to analyse prospective sustainability impacts.

An IA in the agriculture sector will be particularly concerned with issues related to poverty in many regions of the world (see Section 2), and techniques associated with examining the impacts of policy change on poverty are highlighted in this section. The impacts of trade on poverty will in most cases differ for rural and urban people, and for different livelihood systems. Impacts will often be felt through changes in prices.[78]

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[77] See for example, Hertel *et al.,* 2002.

[78] One framework considers the effect of trade on prices of tradable goods and then of these changes on household and individual welfare. Trade reforms are expected to "trickle down" to households through their direct effects on product and factor markets, and indirectly through changes in government revenues and social spending, all of which affect poverty. Trade-induced price changes in product markets affect both the nominal and real incomes of households in their capacity as producers as well as consumers. The lowering of tariff barriers will reduce the price of imported goods, and export liberalization may lead to lower prices for export goods. The effects on real incomes, as well as other poverty assets, will depend on whether households are net buyers or net sellers of the products concerned. The extent to which price changes will affect welfare depends upon the net supply position of each household expressed at current prices as a proportion of real expenditure. Price changes for any commodity, which account for a large share in household expenditure or income (production), will generate relatively large welfare effects on households. Furthermore, trade liberalization may have a negative impact on local industries and sectors, such as agriculture, due to high competition of imported products, and thus result in an increase of poverty. Winters, 2000.

4.1.1 Computable General Equilibrium (CGE) models

CGE models offer a comprehensive way of modelling the overall impact of policy changes on the economy. They are completely specified models of an economy or a region, including all production activities, factors and institutions, and the modelling of all markets and macroeconomic components, such as investment and savings, balance of payments and government budgets. CGE models incorporate many economic linkages and can be used to illustrate medium- to long-term trends and structural responses to changes in development policy. In the context of an IA, this tool may be most useful for examining policy reforms that are likely to play a large role in the economy and might have important impacts on other sectors and/or on the flow of foreign exchange or capital.

In CGE models, supply and demand for all goods are treated simultaneously in all sectors and countries under analysis. CGE models are significantly affected by the assumptions on which they are based and which, depending on their definition, can impact on the results. They are also data-intensive—constructed from national accounts and survey data that are first collected into Social Accounting Matrices (SAMs), which form the basis of CGE modelling (Box 23).

Box 23: What is a Social Accounting Matrix (SAM)?

A SAM is a presentation of a country's National Accounts in a matrix that elaborates the linkages between a supply and use table and sector accounts. A SAM measures distributional impacts using policy simulations with complete specifications of the economy. Prices are fixed and exogenous. The model normally contains entries for production activities, commodities, factors, institutions, the capital account and the "rest of the world".

An activity produces (and receives income from) commodities, buys commodities as production inputs, pays wages to labour, rents to capital and taxes to government. Factor income accrues to households as owners. SAMs can be constructed to distinguish household groups by, for example, sources of income. SAM techniques select some accounts as exogenous and leave the remaining accounts endogenous. In part, this selection can be made with a sound theoretical basis, but it is often arbitrary. For example, if the SAM contains an account for agricultural production and one for transportation, an experiment can be run by imposing some exogenous change ("a shock") to agriculture while leaving the transport sector fixed, or while allowing the transport sector to adjust endogenously as a result of the shock.

SAMs can be used for some simple policy simulations. For example, it can be applied to the analysis of the interrelationships between structural features of an economy and the distribution of income and expenditure among household groups. The results of the simulation vary greatly depending on the assumptions made about which accounts are exogenous and which endogenous.

Source: Adapted from Round 2003, in World Bank, 2003.

Within the overall rubric of CGE models, there are ways to incorporate social and environmental dimensions. In particular, considerable work has been done to develop CGE models that analyse the poverty and social impacts of a wide range of policies, including changes in trade policy, as well as exogenous shocks (exchange rate, international prices), changes in taxation, subsidies and public expenditure and changes in the domestic economic and social structure (such as technological changes, asset redistribution and human capital formation). CGE models are best chosen for policy analysis when the socio-economic structure, prices, and macroeconomic phenomena are all important for the analysis. They allow researchers to take into account all the sectors of the economy as well as the macroeconomy, and hence permit the explicit examination of both direct and indirect consequences of policies.

In some instances CGE models have been extended to include a consideration of environmental effects and show promise in linking trade to environmental impacts. For example, the OECD Development Centre's prototype CGE model was adapted to Mexico to create the Trade and Environment Equilibrium Analysis (TEQUILA) model. It is a dynamic, multi-sectoral model focusing on the environmental effects

of trade liberalization and induced changes in production processes. The model can derive pollution emissions from intermediate as well as final consumption, and links consumption to pollution using thirteen core indicators. Work by the OECD includes the development of a Multi-Region Social Accounting Matrix (1995) and Regional Environmental General Equilibrium Model for India (REGEMI) developed in the context of examining the potential ancillary benefits from climate policy in terms of local pollution abatement using SAM and CGE model.[79]

Another CGE model linking trade and environmental impacts is the Global Trade Analysis Project (GTAP). The standard GTAP model is a multi-region, multi-sector, CGE equilibrium model, with perfect competition and constant returns to scale.[80] It gives users a wide range of closure options, including a selection of PE closures, which facilitate comparison of results to studies based on PE assumptions.[81] Under GTAP, a CGE model is used for sectoral evaluations of trade liberalization in agriculture, forestry, fisheries, mining, processed food and beverages, textiles and wood products. GTAP models the impacts of trade on production patterns at country and sectoral levels and can be used to model environmental impacts. It accounts for interactions between countries when looking at impacts on production patterns.

GTAP has proved to be a useful tool for estimating probable trade and economic impacts of liberalization and is widely used as an agricultural model to assess liberalization.[82] It has also been used with some success in a modified form to include environmental components[83] (Box 24). However, challenges remain with respect to the range of environmental data available and the selected regions for which such data are available.

Some CGE models have an additional model to take distribution into account. These include the 1-2-3 PRSP, IMMPA and the Augmented CGE Model with Representative Household Approach. A CGE can be described by specifying the agents and their behaviour, the results that bring the different market in equilibrium and the macroeconomic characteristics. CGE models are based on SAMs (Social Accounting Matrices) and can be distinguished by the complexity and level, thereby disaggregating production activities, factors, and institutions, including households.

There are also CGE-based models that can be useful in examining the impact of economic shocks on poverty, income distribution and inequality. The first is the Augmented GCE Model with Representative Household Approach. This is a tool for evaluating the impact of economic shocks (policy changes and exogenous events) on poverty and inequality. It is based on a standard CGE model that inputs representative households (RHs) into a computed household module.[84] A second is an Integrated Macroeconomic Model for Poverty Analysis (IMMPA) developed by the World Bank and which provides an analytical framework for assessing *ex ante* the expected welfare effects of macroeconomic reforms and

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[79] This model is regional in its scope. For each region, production is modelled with a nested Constant Elasticity of Substitution (CES), constant returns to scale production function. It takes into account emissions, determined by either intermediate or final consumption of pollution products, mostly fossil fuels, into the air. RE-GEM embodies a high level of disaggregation for pollutants, products and sectors. It can be used to simulate the impacts of abatement policies targeted to specific air emissions. It includes a dynamic feature, allowing the introduction of exogenous factors such as productivity shifts and demographic changes that affect the growth and pollution trajectory. For a full description see Bussolo *et al.,* 2002.

[80] See also, Section IV of UNEP, 2001.

[81] The standard GTAP framework is documented in Hertel, 1997.

[82] For example, data from GTAP suggested that as a result of the 1994 Agreement on Agriculture, agricultural protection would fall by about one fifth or more in advanced and newly industrialised economies, but would remain extremely high compared with that for manufacturing. Moreover, a GTAP model predicted that agriculture in low and middle-income economies would remain effectively taxed relative to other sectors because manufacturing assistance would come down by a similar amount. This information provides some basis for an analysis of potential sustainability impacts.

[83] Developed by the Center for Global Trade Analysis at Purdue University.

[84] See Longren *et al*., 2002.

policies in the design and growth of poverty reduction strategies.[85] This is a CGE model that can be used to analyse the impact of macroeconomic policy and external shocks on income distribution, employment and poverty. It emphasizes, *inter alia*, the role of labour market segmentation, the role of informal employment in the transmission of policy and exogenous shocks to the poor and (in the case of low-income, highly indebted countries) the adverse effect of external debt on private incentives to invest. Its detailed treatment of the labour market is important to assess the poverty reduction effects of structural adjustment programs, because the poor often generate their main source of incomes from wages that are dependent on available employment opportunities. An IMMPA can be used in conjunction with household surveys to map impacts into distributional changes. Stakeholder analysis can be used to identify different interest groups. Social impact analysis and institutional analysis could help analysts identify constraints to market participation by certain groups which would affect poverty and inequality estimates.

Drawbacks might be encountered when using some quantitative techniques to examine developing countries or Least Developed Countries where data is not readily available, changes in trade rules such as intellectual property rights that can be difficult to quantify, or non-economic impacts are vital. For example, there is no consensus on appropriate indicators for many environmental and social variables such as those used in mainstream economics. Moreover, there are problems associated with the valuation of a number of variables associated with sustainability. This has hampered theoretical and empirical efforts to marry economics, environmental and/or social indicators into a synthetic model incorporating multiple effects.

CGE models may not be practical in some countries or for certain researchers. In general, CGE models such as those described above are data intensive, requiring a SAM (which is complex to compile), distributional data or a household survey. Challenges remain with respect to the existence of necessary data in the social realm in some countries and regions, and even more so in the environmental realm. GCE simulations are also time consuming (including the compilation of a SAM) and difficult to master. These characteristics mean that their usefulness may be limited in situations where deadlines are tight or where capacity (human and financial) constraints exist.

Finally, CGE simulations also depend to a large extent on the assumptions made in the model, particularly those that are required to "close" the model. These assumptions ensure that macroeconomic accounts (fiscal, trade, savings-investment) balance. Whether they are fixed exogenously or allowed to balance endogenously, and how they balance, can have a significant impact on the outcomes. In addition, the production accounts specified in most available CGE models are too aggregated to identify the impact of policy changes in one component of one account. Many CGE models have at most two agricultural activities, one for each tradable and non-tradable crop, or food crops and cash crops. Where relevant agricultural activities are available in a model, CGE simulations can be usefully employed to identify economy-wide changes, relative to the agriculture sector, and develop policies to encourage positive gains in other economic sectors to compensate for any losses in the agricultural sector, or vice versa. Where CGE simulations are employed in an IA, the assumptions underlying the model should be identified clearly.

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[85] For further details on the analytical framework and detailed structure of the IMMPA model see Fofack *et al.,*2003; for an illustration of its application see Emini and Fofack, 2004.

Box 24: Example of the application of a CGE GTAP model on the environment: Will Uruguay Round and APEC Trade Liberalization harm the environment in Indonesia?

A 1998 study by Strutt and Anderson (1998), which focused directly on the effects of multilateral and plurilateral trade liberalization processes in developing countries, used a modified version of the global GCE GTAP model to project the state of the world and Indonesian economies up to 2010 and 2020. It then explored the impact of full UR implementation (with and without China as a member) and the two stages of APEC-mandated liberalization. An environmental model to assess impacts on water quality and quantity and air quality in Indonesia was added to the analysis. In doing so it focused, in general accord with the OECD framework, on changes in scale, composition, technique-technology and (indirectly) regulatory effects.

The main conclusions of the study suggested that "...trade policy reforms slated for the next two decades in most cases would improve the environment (at least with respect to air and water pollution) and reduce the depletion of natural resources in that country, and in the worst cases would add only very slightly to environmental degradation and resource depletion even without toughening the enforcement of existing environmental and resource regulations or adding new ones." It further suggested that trade liberalization creates environmental harms only in specific sectors easily identified by the GTAP model, and provides the economic resources required to fully offset the potentially adverse effects.

Methodologically this study displays many of the benefits and disadvantages of the CGE approach when applied to the environment. It allowed for a tracing of the effects of the full global economy, through demand and supply, and permitted a sequenced long-term examination of environmental impacts (over the course of which there is significant change). In this application, it also highlighted the different impacts of varying forms of trade liberalization (multilateral, plurilateral, with China in or out), and thus blended *ex post* and *ex ante* forms of analysis. Yet it was "assumption sensitive" in several key places and its data requirements, in application to a developing country such as Indonesia, confined it to a limited array of standard indicators (air and water). This left a range of important environmental concerns out of the analysis, including, *inter alia,* land, biodiversity and coastal and marine zones.

A related GTAP-based, Indonesian-focused study conducted in 1998 made advances on some of the problems raised above (see Strutt, 1998). Most importantly this study focuses on land degradation through soil erosion and off-site damage and extends the application of the above model beyond air and water to cover land as well. It also incorporated an environment-to-economic feedback loop to this economic growth first (trade and trade liberalization second method) by incorporating the ways damage to land through erosion reduces productivity and production associated with that land. Its empirical findings are very similar to those of the first study.

4.1.2 Partial Equilibrium (PE) models

PE models may be more practical for some IAs. PE models equate supply and demand in one or more markets so that the markets clear at their equilibrium price levels. This makes prices endogenous. PE models do not include all production or consumption accounts in an economy; nor do they attempt to capture all of the economy's markets and prices. The approach allows the analyst to trade the impact of prices in one market with other markets, but it only captures changes in the markets included in the model. PE models are therefore best suited to analysing sectoral issues that are less likely to have large impacts on macroeconomic aggregates.

PE models can be applied to a specific commodity or ecosystem. If the countries rely heavily on commodity exports the trade liberalization component of an IA could be analysed using small models involving few countries. There are a number of PE models that have been used to analyse, in particular, the impacts of policy change on poverty and income distribution. Two are discussed briefly below.

Multi-market models. PE, or multi-market, models assess the poverty and distributional impacts of changes in the price and quantity of a small group of commodities. These models work best for evaluating policies that change the relative price of a specific good, such as the removal of a subsidy, tariff or quota. The method is as follows:

- identify a policy reform's direct effect on a market or markets

- identify which other markets are linked by demand and supply to the directly affected market(s)

- use household survey information to estimate the share(s) of income that these changes affect through own-price and cross-price elasticity of demand for the entire set of interlinked markets.

Table 8: Summary of CGE models to analyse the impact of macroeconomic policy and external shocks on income distribution, employment and poverty

	Integrated Macroeconomic Model for Poverty Analysis (IMMPA)	Augmented CGE Model with Representative Household Approach
What is it?	A dynamic CGE model.	A technique based on a CGE model with representative households that are linked to a household module.
What does it tell you?	IMMPA integrates the real and financial side of the economy and is useful in analysing both the impact of structural reforms (such as changes in tariffs or the composition of public expenditure) and the effects of short-term stabilization policies (such as a cut in domestic credit or a rise in interest rates). The detailed treatment of the labour market is key for the assessment of the poverty reduction impact of macroeconomic policies. It is also useful to distinguish between rural and urban sectors by completing projections on output and employment fluctuations, and to study poverty in different geographical areas.	This tool allows for a forecast of welfare measures and poverty outcomes consistent with a set of macroeconomic policies in the context of a CGE model.
Key elements	Includes a very detailed specification of the labour market, which is the main transmission channel of macroeconomic shocks and adjustment policies to economic activity, employment and relative prices. The labour market specification allows for a disaggregation at the urban and rural levels and in turn, for each of these areas, in the formal and informal sectors. IMMPA also links real and financial sectors through an explicit treatment of the financial systems. It emphasizes the negative effect of external debt on private investment and therefore incorporates the possibility of debt overhand. IMMPA accounts explicitly for the channels through which various types of public investment outlays affect the economy.	A GCE model that incorporates markets for factors and commodities and their links to the rest of the economy, and which generates equilibrium values for employment, wages and commodity prices as well as its "extended" functional distribution (i.e., labour differentiated by skill, education, gender, region and sector of employment). A mapping from the extended functional distribution into the "size" distribution (the distribution of income across different households). The Representative Households that appear in the CGE model (corresponding to aggregates or averages of groups of households) play a crucial role. The "size" distribution is generated by feeding data on the simulated outcomes for the Representative Household into a separate module that contains additional information about each household.

Source: Adapted from World Bank, 2003.

The impact of the policy reform can then be calculated.[86]

Reduced form estimation. Reduced form estimation focuses on the effects of policy changes or exogenous shocks on a particular variable of interest such as the effects of a change in import tariffs in another country on aggregate consumption. Once a model containing the policy variable and the variable of interest has been estimated, reduced-form models can also be used to simulate the impact of policy alternatives.

A recent country study undertaken on behalf of UNEP examined the cotton sector in China using a PE model incorporating a number of elements (including scenarios) with some success (Box 25).

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[86] World Bank, 2003.

Box 25: The JAPA Model (Jiangsu Agricultural Policy Analysis)

UNEP's country study on cotton in China employed a JAPA model, which consists of a data bank, a series of econometric models, a PE model and an interactive display system. The JAPA model was used to establish a baseline projection for 2002, and then a scenario analysis on the impact of increasing agricultural imports. The scenario analysis generated by the model, based on increasing imports, was then used to assess the economic, social and environmental impacts of trade liberalization, based on the level of cotton production and the use of inputs under existing methods of production. The study undertook an economic valuation of the social and environmental impacts to undertake the IA. A cost-benefit analysis was conducted to assess the social, economic and environmental impacts of trade liberalization.

The researchers acknowledge the difficulties associated with undertaking a valuation of environmental impacts. Nevertheless, the model scenario generated the following results based on an indication that large imports of wheat, cotton and corn will have enormous economic impacts:

Economic impacts:	Helps to solve shortages of cotton and corn that were projected
	Sown area and output decrease
	Price decreases of agricultural products
	Producer surplus and farmers' income decrease
Social impacts:	Promotes agricultural production structure adjustment, according to comparative advantage
	Utilization rate of cultivated land decrease; valuable land lies waste
	Reduction in self-sufficiency rates of agricultural commodities
	Agricultural employment decrease
	Poverty and social instability
Environmental impacts:	Reduction in the application of chemical fertilizers and pesticides
	Cultivated land may be lost.

Source: UNEP, 2002c.

Efforts to forecast issues associated with agricultural negotiations can also rely on lessons learned from past *ex post* assessments. There is a growing body of literature documenting experience in a number of countries and for a number of issues that can assist practitioners develop approaches to forecasting that are based on solid, qualitative analysis linking trade, economic, environmental and social variables.

Table 9: Examples of Partial Equilibrium models for poverty and social impact analysis

	Reduced-Form Estimation	Multi-Market Models
What is it?	PE model that focuses on the effects of policy changes (including interest rate changes or taxes) or exogenous shocks (such as a change in import tariffs in another country) on a variable of interest, such as aggregate consumption or income. It can be useful to understand the macroeconomic impact of a policy intervention on a selected variable of interest.	Uses a PE analysis of the impact of change in prices and quantities in selected markets on household income and expenditure. It specifies a system of demand and supply relationships for a few sectors of the economy, so that the impact of policies in one sector can be seen in other sectors in the economy.
What can it be used for?	This is a common application of econometric analysis, used to examine a range of different outcomes. It can be applied to most policy changes or exogenous shocks. In the context of an IA, it might be most useful for considering policy reforms that have significant indirect effects.	This model is useful to analyse the poverty and distributional impact of policies that affect the prices and quantities of a small group of commodities. They can be used to estimate distributional impacts of the imposition or change in taxes, subsidies, quotas, or tariffs on specific commodities.
What does it tell you?	It can provide a good estimation of the impact that changes in a given policy or exogenous shocks have on a particular variable of interest. Once a model containing the policy variable and the variable of interest has been estimated, reduced-form models can also be used to simulate the impact of policy alternatives.	This model allows the estimation of the impact of a policy or external shock on prices and output in a few sectors, and on household wellbeing.

	Reduced-Form Estimation	Multi-Market Models
Related tools	Can be complemented with household surveys to identify distributional changes. Stakeholder analysis can be useful to identify different groups of interest for the analysis.	Stakeholder analysis can be useful to identify different interest groups. Could be complemented by a CGE model if policy reform is likely to have general equilibrium impacts.
Key elements	Assumes an underlying system of demand and supply equations but the model itself does not fully specify the whole array of economic and social interactions. The model is solved to derive a single estimating equation: an econometric model that relates the outcome and the policy variables or shock of interest. This can be done on the basis of two observations separated over time by a policy change. When using a single cross-sectional dataset there must be significant variation across the sample population to estimate the equation. Analysis on aggregate units, such as cross-country regressions, should ideally be conducted on panels of cross-sectional and time-series data.	These models involve a system of equations, representing actors (producers, consumers, government), production or profit functions, factor and product markets, income accruing to the owners of productive inputs (including labour), and final consumption. Expands the traditional benefit incidence analysis to capture the induced substitution effects across selected goods in response to policy reform. First step is to identify the market or markets where the policy reform under analysis is expected to have a direct effect. Household survey information would then be used to derive estimates of income, own-price and cross price elasticities of demand for the entire set of interlinked markets. Market closure (either price or quantity clearing) is imposed for each good in the system of equations.
Limitations	The elasticities of the policy variable to the variable of interest are often based on cross-country regressions, and may differ from the elasticity in the country itself.	Limited to selected markets and ignores interlinked markets. It is useful to conduct sensitivity analysis of the results for different values of the parameters used in the model.

Source: Adapted from World Bank, 2003.

4.1.3 Cost-Benefit Analysis (CBA)

CBA is the calculation of values for all inputs into and outputs from a project or proposed policy, and the netting out of the first (costs) from the second (benefits), discounting for future flows. Impacts are considered generally beneficial if the project or policy is likely to generate outputs that are more valuable than the inputs used (Box 26).

Box 26: Major steps in a Cost-Benefit Analysis

- **Clarify assumptions**. All assumptions used for the CBA should be made clear, as well as methods of estimation *(ex ante)*, and preserved for future assessments.
- **Clarify issues of standing**. This entails identifying whose costs and benefits are being considered, as they may well differ among actors.
- **Identify the alternatives**. Clearly identify the scenarios under consideration, including the option of doing nothing, as a basis for comparison.
- **Set out assumptions**. Where assumptions are made they should be explicit and referenced.
- **List the impacts of each alternative project**. Potential impacts should be listed for the policies under consideration as well as for the "do-nothing" alternative. This involves determining the quantities of inputs and outputs involved, even where there is no expectation of assigning a value to them.
- **Assign values to the impacts**. Monetary values should be attached to each of the impacts, where possible.
- **Discount future values to obtain present values**. Exponential discounting can be used to calculate present values of all future costs and benefits. While discounting is useful for medium term flows, it is inappropriate for long-term projected variables (the longer the period, the less meaningful the discounted present day values).
- **Identify and account for uncertainty.** Some attempt should be made to recognize uncertainty or risk involved in a course of action. This may involve a sensitivity analysis that calculates the value of the project under different outcomes or it could involve a real options analysis that attempts to calculate an explicit value in light of risk.
- **Compare benefits and costs**. Costs and benefits should be compared to determine if the project or policy choice might have a positive net present value.
- **Conduct a post-project analysis**. When possible, a follow-up analysis should be conducted to determine the quality of the original analysis and to help improve future analyses and projects.

Despite its overall utility in the field of IA, there are a number of limitations that exist with respect to CBA that should be acknowledged at the outset. At a practical level, CBA may be constrained by difficulties associated with valuation. CBA presumes that goods have a monetary value and decisions are based on a calculation that typically determines whether or not a project or policy is economically desirable. Difficulties may be encountered in attempts to value the non-economic aspects of environmental and social goods and services such as clean air or good health, important variables that should be considered in any IA.

Valuation and Accounting

The values attached to inputs and outputs in a CBA represent their relative importance in the analysis and are at the heart of the exercise. In some cases, inputs and outputs will be goods that are regularly traded in markets at well-known and predictable prices. This might be the case, for example, with inputs such as labour, agrochemicals, seeds or gasoline, or outputs such as crop yields. It is more difficult when assessing other trade-offs associated with an IA such as the value of important habitats, species, ecosystems and equity issues, for example. In addition, there are uncertainties associated with discounting over future generations, as it is an important component of sustainable development. Techniques that can be employed in valuation, detailed in UNEP's *Reference Manual*, are presented in Box 27.[87]

Box 27: Approaches used in the valuation of trade-environment linkages

Conventional market-based approaches
- The Change in Productivity Approach
- The Cost of Illness Approach
- Cost-based Approaches

Surrogate market-based approaches
- Hedonic Pricing Approach
- Travel Cost Method

Constructed market-based approaches
- Contingent Valuation Methodology
- Contingent Ranking

Source: UNEP, 2001, pp. 38-43.

There are also several efforts to improve the measurement, through accounting, of economic activity on the environment at the national and global levels.[88] Building a nation's economic use of the environment into national income accounts is an attempt to reflect the value of services provided by the environment and the cost of environmental damage to the extent that the environment provides raw materials and energy used to produce goods and services, absorbs waste from human activities and plays a fundamental role in life support and the provision of amenities such as landscape.[89] The growing interest in modifying existing Systems of National Accounts (SNA) to promote understanding of the links between economy and environment will enhance the application of methodologies relevant for IA. New methods for accounting

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[87] See also, Mcracken and Abaza (eds.), UNEP, 2000.
[88] See, United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development and World Bank, 2003.
[89] *ibid*

can clarify in concrete monetary terms what some of the necessary trade-offs might be to achieve sustainable development. Moreover, attempts at valuation can improve the ability of policy makers to apply market instruments to achieve environmental and social goals. Some examples of developing categories of accounts for integrated environmental and economic accounting are presented in Box 28.

Box 28: Integrated environmental and economic accounting: categories of accounts

Category 1. Physical and hybrid flow accounts. The objective is to see the extent to which the economy is dependent on particular environmental inputs and the sensitivity of the environment to particular economic activities. This category considers purely physical data relating to flows of material and energy. It also shows how flow data in physical and monetary terms can be combined to produce so-called "hybrid" flow accounts. They provide information at the industry level about the use of energy and materials as inputs to production and the generation of pollutants and solid waste.

Category 2. Economic accounts and environmental transactions. This category of accounts takes elements from existing SNA that are relevant to the good management of the environment and shows how the environment-related transactions can be made more explicit. These accounts identify expenditures incurred by industry, government and households to protect the environment or to manage natural resources. They take those elements of the existing SNA that are relevant to the good management of the environment and show how the environment-related transactions can be made more explicit.

Category 3. Asset accounts in physical and monetary terms. The environment comprises natural resources, land and ecosystems. This category includes assets in physical and monetary terms for each of these three broad categories. These accounts record stocks and changes in stocks of natural resources such as land, fish, forest, water and minerals.

Category 4. Extending SNA aggregates to account for depletion, defensive expenditure and degradation. This category deals with the extension of the existing SNA aggregates to account for depletion and degradation of natural capital as well as for so-called defensive expenditures related to the environment. This component presents non-market valuation techniques and their applicability in answering specific policy questions. It discusses the calculation of several macroeconomic aggregates adjusted for depletion and degradation costs and their advantages and disadvantages. It also considers adjustments concerning the so-called defensive expenditures.

Source: United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development and World Bank, 2003, pp. 7-11.

The development of successful accounting relies importantly on the availability of comparable time series data, which may remain a challenge in some countries and regions. Nevertheless, continued improvements in data collection and methods for assessing the monetary value of environmental damage will strengthen the application of these methodologies, and their ability to suggest policies to encourage environmental protection and promote sustainability. This work is closely related to the further development of IA as an improved understanding and the prospect of measuring environment-economy interactions (including trade) promises to improve strategic planning and frame policy responses that will promote sustainable development.

4.2 Qualitative techniques

Efforts to generate quantitative data can be used in combination with qualitative analytic techniques. Qualitative data is any information that is not numerical in nature. Where the adoption of quantitative techniques is not practical or feasible, a qualitative analysis can be useful to point to potential environmental and/or social impacts of policy change. Qualitative analysis is also particularly useful for examining implications of trade agreements and trade policies on trade rules that might be difficult to quantify, such as changes in intellectual property regimes, or on domestic environmental laws and regulations. It is important for a researcher to ensure that any qualitative analysis employs techniques that generate comprehensive, reliable and credible findings, and be based on criteria such as those presented in Box 29.

Box 29: Sample of techniques and criteria for qualitative research

Techniques

- – Direct observation
- – Field research
- – Focus groups
- – In-depth interviews
- – Participant observation
- – Questionnaires
- – Semi-structured interviews
- – Unstructured interviewing
- – Stakeholder meetings
- – Desk research

Criteria

Credibility. Establishing that the results of qualitative research are credible or believable from the perspective of the participant in the research. Since, from this perspective, the purpose of qualitative research is to describe or understand the phenomena of interest from the participant's eyes, the participants are the only ones who can legitimately judge the credibility of the results.

Transferability. This refers to the degree to which results of qualitative research can be generalized or transferred to other contexts or settings. From a qualitative perspective, transferability is primarily the responsibility of the one doing the generalizing. The qualitative researcher can enhance transferability by describing the research context and assumptions that were central to the research. The person who is "transferring" the results to a different context is responsible for judging how sensible the transfer is.

Dependability. Dependability emphasizes the need for the researcher to account for the ever-changing context within which research occurs. The researcher is responsible for describing the changes that occur in the setting and how these changes affected the way the researcher approached the study.

Confirmability. Qualitative research tends to assume that each researcher brings a unique perspective to the study. Confirmability refers to the degree to which the results could be confirmed or corroborated by others.

Source: Adapted from World Bank, 2003.

There is a considerable literature exploring variables that can transmit changes in economic activity into environmental and social impacts and thereby demonstrate causal links, or at least a strong correlation, between economic changes induced by trade and sustainability. Where a researcher encounters data or other limitations an approach can be adopted that includes a series of questions identifying specific pressures induced by changes in trade and linking them to potential impacts or risks, supported by available data. In some cases, this will include combining quantitative and qualitative techniques, where quantitative studies are available to forecast *ex ante* or to measure *ex post* trade-related and economic change.

Researchers should consider ways in which agricultural negotiations governing market access, domestic support, export subsidies and other non-trade issues will affect trade flows and subsequent economic activity with respect to the issues under investigation and related to the relevant geographic locale. Trade effects will depend in part on the amount of production and development that is export oriented, bearing in mind that food security continues to be an important factor in domestic production development. Trade impacts can be aggravated by any ongoing protectionism in developed countries, domestic support, and the subsidisation of food exports that compete with developing countries' commodities.

Changes in the rules governing agricultural trade will, to varying degrees for different countries and with respect to different commodities, influence the economic performance in the sectors and influence the overall scale of agricultural activities, the structure of agriculture in different countries, the mix of inputs and outputs, the production technology and the regulatory frameworks. These adjustments, in turn, will impact on the international and domestic environment and society by increasing or reducing pressures that

contribute to, or detract from, sustainability. Environmental impacts can be traced through pollution effects in such medium as air, water, and land; health and safety from exposure to pollution; and resource effects due to changes in demand for natural resources that contribute to resource exhaustion and/or degradation.[90] The adjustments will also impact on the wellbeing of societies, and in particular rural societies who depend upon agriculture for their livelihoods. Social impacts can be traced through variables such as those identified in Section 2 including, for example, health, income, prices and access to basic services. The direction and magnitude of the effects will depend on the state of the environment and on the production impacts of further agricultural trade liberalization, on the strength of institutions and the flexibility of communities as well as on the environmental regulations in place and the existence of a social safety net.

In some cases impacts on agricultural sustainability induced by trade might be direct. In other cases, impacts will come about through economic changes and production related changes inducted by changes in trade rules and trade flows. An analysis to identify causation or correlation should be undertaken in order to link trade-induced changes in the agricultural sector to impacts on sustainability.

Approaches have been developed to categorise impacts of trade related policies and trade liberalization in ways that allow for relationships to be traced from economic impacts of trade through to environmental and/or social impacts, incorporating relevant avenues for analysis and including both quantitative and qualitative techniques. Taken together, an analysis based on relevant processes that transmit trade-induced economic change with sustainability impacts can form the basis of a Causal Chain Analysis (CCA) to trade impacts of trade liberalization on key components of sustainability (Box 30). Where data is available, this can be complemented with input of quantitative data.

Box 30: CCA applied to the agricultural sector

This example assumes a proposal for a sectoral trade agreement to remove all import duties in all countries on a single agricultural commodity. The agreement is expected to increase, to varying degrees, both agricultural impacts and exports in most countries (i.e. there is a cause-effect link between the proposed agreement and foreign trade). This initial "foreign trade effect" will cause changes in levels (positive and negative) of production, income, employment and investment in the agricultural sector in most of these countries (which could have a further feedback effect on foreign trade). Because of linkages between the agricultural sector and other sectors in each country, there will also be some changes in production levels and so on in other sectors - and these changes may have a feedback effect on the production levels etc. in the agricultural sector. As a result, the initial foreign trade change will have an aggregate effect on production levels etc. in each country, which will be spread across many economic sectors. As a result of this causal chain of events within the economic sector, there are likely to be some changes in core economic indicators of sustainability.

The removal of import duties on this agricultural commodity may also have some environmental impacts. This may be due, for example, to changes in the output level of this agricultural product (and of other agricultural production, industrial goods etc. that have changed as a consequence) and/or to changes in their composition, production technology and location. This is likely to lead to some changes in environmental indicators of sustainability. Depending on the nature, scale and significance of these environmental changes, they may have a feedback effect on the levels of the economic and social sustainability indicators.

The removal of import duties on the agricultural commodity may also have social impacts. Agricultural communities whose exports of this commodity have increased will improve their material wellbeing and poverty levels could be reduced. The opposite may be the case in those countries where imports of the commodity have risen. There may also be differential effects on males and females, depending on the role of each in its production. Changes in government revenues (due to the removal of the import duty and consequential changes in other tax revenues) may lead to changes in public expenditure levels for health and education. Because of inter-sectoral linkages, consequential social impacts may be experienced in some non-agricultural communities. As a result, there may be some changes in the core social indicators. In turn, these may have some feedback effects on the economic and environmental indicators.

Source: Kirkpatrick and Lee, 2002.

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[90] OECD, 1994.

The questions presented below are illustrative of the types of variables that might be developed in each IA on a case-by-case basis depending on the preliminary choices made in the IA dealing with priority sustainability issues, the purpose and scope of the assessment, including its geographic location, timing, indicators and the result of any consultations. They are intended to supplement the general approach to IA discussed in Section IV of the *Reference Manual*, building on work of other organisations such as with specific reference to the agricultural sector. A number of the UNEP country studies have applied an analytical approach to IA in the agriculture sectors, generating useful information about the impacts of structural adjustment policies (Box 31).

Box 31: Examples of positive and negative impacts: the export crop sector in Nigeria

Economic Impacts

Positive:
- Trade liberalization has led to an increasing contribution by agriculture to Nigeria's GDP.
- Trade liberalization offers opportunities for unskilled and semi-skilled workers on cocoa and rubber farms as well as in rubber-processing factories.
- The rate of abandonment of old cocoa trees has been reduced, leading to the more productive use of natural resources.
- Export-crop farmers earned higher incomes.

Negative:
- Trade liberalization brought about higher disparities in income among farmers in the same community.
- It has led to an unsustainable use pattern of natural resources including over-tapping of rubber trees and the cultivation of marginal lands.

Environmental Impacts

Positive:
- The cultivation of cocoa and rubber, unlike arable crops, prevents erosion; the formation of a canopy and the fallen leaves from the trees contribute to a rich ecosystem.
- Low levels of depletion of soil nutrients as a result of nutrient re-cycling by the roots of the crops.

Negative:
- Destruction of biodiversity as a result of expanding areas of cultivation.
- Increased incursion onto marginal lands, which encourages degradation and loss of soil productivity.
- Because of low prices, farmers are abandoning rubber trees and the canopy has broken down due to the felling of over-tapped trees, which will lead to soil degradation.
- Levels of petroleum hydrocarbons in rubber processing factories were found to be highly concentrated and dangerous to the community.

Social Impacts

Positive:
- The standard of living of export-crop farmers has increased and some now own luxury cars, build houses with concrete and iron sheet roofs.

Negative:
- Prevalence of minor diseases such as body itching, painful sensations in the eyes and swollen hands arising from the use of agrochemicals.
- Misuse of agrochemicals for the treatment of toothache and stomachache by farming households.
- The tree crop promotion supports male farmers and discriminates against women as the land tenure systems in the southern areas of Nigeria do not allow women to inherit lands and they cannot purchase farmland without the permission of their husbands.

Institutional/Regulatory Impacts

Positive:
- Removal of the bureaucracy for marketing export crops; farmers sell their products to buyers directly.

Negative:
- No monitoring or regulatory device for buyers of produce for export from the farmers, which leads to sub-standard grading of products and a reduction of the value of commodities.
- Buyers, in an attempt to attract the farmers, distribute agrochemicals that are often adulterated and ineffective on the farm.
- If the prices of agrochemicals were not high, their over-use could have led to serious environmental degradation arising from lack of regulatory control and advice on appropriate levels and use.

Source: UNEP, 2002b.

There is no one conceptual framework for analysis, although a number of existing frameworks address a similar series of questions. The OECD's 1994 framework considers product, scale, structure, technology and regulatory effects. The CEC's 1999 framework considers production, management and technology, physical infrastructure, social organisation and government law and policy. A recent study undertaken for the EU focusing strictly on the agricultural sector and specifically on major food crops identifies production systems as the critical factor linking trade reform, economic structure and sustainability impacts (Box 32).

Box 32: EU's sustainability impact assessment of WTO negotiations on major food crops

The EU's 2001 study on Major Food Crops employs a conceptual framework that reflects the elements of a CCA identified in Box 28. It applies the following four steps in its analysis:

Trade reform: This includes changes in market access, export subsidies and domestic support.

Economic structure: This includes changes in tariff structures, relative prices, terms of trade and business opportunities.

Production system: This includes changes in production volumes, production technology, crop mix, transportation and resource allocation.

Sustainability impacts: This includes changes in water quality/quantity, land conservation, soil degradation, national income, employment, rural poverty/livelihoods and equality.

The analysis is supported to the extent available by empirical data and modeling results. The study does not carry out independent modeling exercises, but draws upon existing work and results from such research.

Source: Maltais *et al., 2002.*

Many of the core issues are covered in the above frameworks. Each IA should prioritise and examine those issues most relevant, based on the preliminary sustainability mapping and likelihood of economically induced changes from liberalization. By way of introduction, the following categories illustrate a range of issues that might be relevant for an IA in the agricultural sector.

4.2.1 Pricing impacts

Liberalization is expected to lower the level and frequency of price-depressing interventions such as subsidies and domestic support measures. At the same time, tariffs are expected to decline. Reduced levels of trade protection in importing regions increases demand for imported food products, which can stimulate growth. At the same time, the reduction in export subsidies can reduce total supply from some major exporting regions. Identified social and environmental indicators (i.e. food security, poverty, equity, land use, water, biodiversity) may be affected, *inter alia*, by changes in the following mechanisms for supporting agricultural production, through changes in prices. There may be important differences between impacts on different actors within a country – i.e. large-scale *versus* subsistence producers.

- Crop specific interventions
- subsidies to agrochemical inputs
- subsidies to other inputs such as water and energy
- removal of export subsidies and impacts on net-food importing countries.

4.2.2 Production and technology

The dynamic effects of changes in trade patterns will affect sustainability through changes in economic activity that occur largely at the production level—i.e. what kinds of crops are being produced, where, how much, how and by whom. Liberalization can lead to changes in the levels and composition of agricultural

production based on specialisation and comparative advantage. Impacts can also be felt as a result in other sectors, reflecting a mix of agricultural and non-agricultural goods produced and consumed, holding constant the scale of economic activity, such as a decrease in the share of food production and land in production, and an increase in manufacturing.

An expansion of farm production will have impacts on land use and land use change. The extent of that change in land use depends on the type of crop and crop production method introduced. In general, examples of land use change associated with the farm sector have included the clearing of primary forests, including tropical forests, for arable lands, and the conversion of natural prairies and grasslands for crop growing or livestock grazing as well as the draining of wetlands either for irrigation or land conversion purposes. In high-input production systems environmental impacts of increased production might include salinization of irrigated areas, nutrient and pesticide leaching, pesticide resistance, loss of crop genetic diversity. In low input production systems erosion or loss of soil fertility might occur. Where production decreases, these types of impacts might be lessened.

The benefits brought about by increasing production might not accrue to all actors equally. The same is true where liberalization encourages decreases in production of specific crops, and where actors with the resources and the ability to take risks are able to diversify more readily than smaller producers. In all cases, the identified social and environmental indicators should be assessed in light of the following types of issues, across all relevant social actors:

- nature of the product mix and associated production techniques
- opportunities for diversification
- incidences of concentration and specialisation
- impacts on processed products
- existence of export crops
- geographic locale
- efficiency
- land distribution issues
- tenancy rights issues
- access to credit
- access to markets
- existence of financial institutions
- existence of investment
- access to infrastructure and technology
- availability of extension services
- availability of training
- employment practices including wage levels and employment rights.

4.2.3 Regulatory and institutional issues

Regulatory effects refer to the impacts of trade policies and agreements on laws and regulations that affect sustainability. These include, for example, laws related to employment practices, minimum wage and protection of worker's rights. They also include laws related to the existence of a social safety net, and policies related to education and training which are important where changes in economic structures require those forced off their land, for example, to acquire new skills to take part in new employment

opportunities. From an environmental perspective, laws and regulations that demand environmentally responsible corporate behaviour will help promote sustainability. In addition, negative effects can occur if provisions of trade agreements undermine the ability of governments to set standards for environmental protection or discourage the application of high standards.

- Are parallel environmental, resource conservation and social policies appropriate to be taken in conjunction with trade liberalization?
- Are national institutions, regulatory regimes, and domestic social structures and, if necessary, safety nets, in place to support agricultural reform that is environmentally and socially sustainable?

4.3 Prioritise risks and actual impacts

Once a range of sustainability impacts associated with a particular trade measure has been identified, a determination should be made in the IA as to their relative significance. Prioritising the most important sustainability impacts will help best inform negotiators during trade negotiations and can focus the development of appropriate policy measures to support sustainability. Identifying priorities should rely on a series of criteria, developed for the IA.

At a general level, priority risks and impacts can be identified using some of the criteria applied to priority sustainability issues in the contextual analysis in Section 2:

- appreciation of social, environmental and economic values for multiple stakeholders
- magnitude of current risks, threats and sense of urgency
- risks for other areas and/or future generations
- number of people affected.

Additional factors that might be considered in determining priorities for policy action include:

- the spatial distribution of the impacts and the extent of existing economic, social and environmental stress in affected areas
- the direction of changes to base-line conditions
- expected cumulative effects
- the nature, order of magnitude, geographic extent and duration of changes[91]
- whether critical environmental thresholds are being reached
- whether the impacts are irreversible
- the regulatory and institutional capacity to implement mitigating measures.

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[91] In assessing magnitude it is important to consider issues such as existing stresses on the environment and social structures/supports. For the environment, the ability to absorb additional stress, whether of great magnitude, or of smaller magnitude that adds incrementally to the stress over time, or in combination with other stresses and thereby threatens key ecosystems in a more subtle way. Magnitude should be defined to include incremental and overtime impacts.

5. Policy options for improved sustainability

Highlights

- Based on the results of the IA, develop policies to mitigate negative impacts of trade liberalization and promote positive impacts. This can be achieved through policies that :
  - *promote capacity building:* to improve compliance with international standards, access to multilateral organisations and trade remedies, access to technology, improved research, infrastructure and data collection.
  - *are trade-related:* to build policy coherence, to address subsidies, domestic support, market access, trade facilitation, work towards the convergence of standards, ensure sustainability is promoted through investment.
  - *are non-trade related:* implementing complementary environmental and social policies to mitigate existing negative impacts, minimise risk or prepare a country for future liberalization.

The WSSD has identified trade as a tool for achieving sustainable development and UNEP has adopted an approach to IA that prioritises the policy relevance of the work; trade liberalization is not considered as an end in itself but a means to enhance sustainability and reduce poverty.[92] The UNEP country studies have demonstrated that the design of appropriate policies can enhance the contribution of trade to sound environmental management, to the mitigation or avoidance of environmental degradation and to poverty reduction. The final stage of an IA is to develop policy responses that might be implemented to promote sustainability in the agricultural sector based on the findings of the research and analysis. The aim is to define concrete policy options to promote opportunities and address challenges raised by liberalization.

Box 33 presents general criteria to guide the selection of appropriate policy responses. Emphasis should be placed on policy recommendations that are practical and enforceable. To be practical, policies should take into account existing political and policy realities. For example, many environmental outputs are jointly produced with agricultural commodities. Any policy action aimed at internalising environmental costs and benefits may affect the quantities produced and consumed of the commodity and therefore the related trade flows, prices and incomes. The higher the level of conflict, the greater the risk of imposing a burden on others, and the lower the degree of equity and political acceptability.[93]

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[92] UNEP's approach to developing policy responses at a general level is described in Section V of UNEP, 2001.
[93] OECD, 2001b.

Box 33: Criteria for selecting appropriate policy responses

- Sustainable development priorities
- regulatory consistency
- policy coherence and co-ordination
- level of resources
- feasibility of the policies
- existing capacity.

Source: UNEP, 2001.

Typically, policy responses should include a broad range of approaches including command and control, market-based incentives and institutional policies. Moreover, in identifying relevant policies within an IA, a researcher should also take into account issues of timing, and address issues where policy intervention is urgent. Finally, care should be taken to identify the spatial focus of that policy in terms of the farm level, the national level, the regional level or the global level. According to the OECD, clearly defined and accepted property rights and reference levels may be the single most important factor determining the acceptability of any policy action.[94]

5.1 Capacity building

There should be an important focus in developing policy responses aimed at the over-arching goal of capacity building. Capacity building is an essential ingredient of economic growth and poverty reduction. In the long-term, capacity building is required to ensure that the vision of sustainable development is broadly shared, provides the basis for policymaking and thereby becomes an achievable goal. In all cases, an IA should consider and highlight, where possible, key contributions that can be made through the interactions between agriculture, trade, and environmental and social wellbeing, on the capacity of countries to promote sustainable development.

In the context of agriculture this link is particularly important (Box 34). Developing countries represent two thirds of the WTO membership, most of the undernourished population of the world, and 96 per cent of the world's farmers. Typically these farmers do not have the technological capacity to take advantage of new means for increasing production and distribution in a way that guarantees a safe and steady supply of

Box 34: Benefits of capacity building

Capacity building can promote:

- availability of technologies
- storage facilities and transportation networks for agricultural products
- agricultural research
- data collection and analysis
- training in production techniques and training of government officials
- access to multilateral organisations through institutional and legal capacity
- access to multilateral trade remedies
- compliance with international standards.

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[94] *ibid.*

food. Developing country proposals at the WTO related to the AoA negotiations typically emphasise the need for adequate and operational special and differential treatment provisions to further policy objectives in terms of food security and poverty reduction and improve their capacity to trade on a level field with more developed nations.

Issues of capacity include access to trade remedies as well as the negotiation of beneficial trading rules. Many developing countries lack the resources and the expertise to engage in long drawn-out disputes surrounding anti-dumping and countervailing measures. Some developing countries tend to feel ill-equipped to take part in formulating the international standards related to agriculture established in bodies such as the International Organisation for Standardisation (ISO) and the FAO/WHO Codex Alimentarius Commission, and favoured (along with the IPPC and the OIE) under the WTO's Agreements on Technical Barriers to Trade (TBT) and SPS Measures. This is compounded in some cases by the small scale of their export operations, their greater vulnerability to disease outbreaks and pest infestations, and inadequate public health and veterinary services.

Compliance with WTO rules and obligations and preparing legal briefs in trade disputes make heavy demands on the resources of Least Developed Countries. Capacity building measures including multilateral technical and financial assistance, developed through a comprehensive IA could improve notification records and compliance.

Capacity building is also closely associated with helping to create the conditions for poverty reduction. One challenge is to identify policies that enable poor people to participate more equitably in markets, at both the national and the global levels. Marked declines in poverty and inequality are consistent with trade-led growth, as witnessed by the experience of Southeast Asia. However, in order to ensure that these benefits are realised, and realised in an equitable manner, intervention and support will often be necessary, along the lines of the policies identified in the sub-sections that follow.

5.2 Trade-related policy responses

An *ex ante* assessment might lead to a policy response that suggests the adjustment of a trade-related policy or a trade agreement. Adjusting a policy or an agreement is one response that can occur prior to or during a negotiation in response to an issue of concern raised in an IA. Adjustments might also be made within mechanisms proposed within a trade liberalization agreement such as a dispute resolution process that allows for a significant environmental or social voice and a carving out of exceptions designed to promote sustainability by protecting environmental or social priorities. These adjustments might be made within national negotiating positions at points during the negotiation where review of existing commitments is called for. Alternatively, the results of an *ex post* assessment can modify the development of prospective trade-related policies for future agreements.

In some cases, trade-related changes can simply include levels of flexibility in the implementation of a negotiated provision of a trade agreement. The emphasis in Least Developed Countries and other vulnerable countries (such as single commodity producers, or small island developing states) as well as low income net food importing countries might be on securing adequate and reliable supplies of staple foods. Specific measures might be considered to increase flexibility, enhance production for domestic consumption and protect the livelihoods of low-income farmers. Trade-related provisions could include exempting sensitive or food-security crops from tariff reduction commitments. It might also include the design of new Special Safeguard Mechanisms available to developing countries in response to import surges, and the exemption of domestic support measures for food-security goals from reduction commitments. Middle-income countries that are net exporters might seek reductions in trade barriers. Low-income net food importers might consider support for key crops or livestock to relieve poverty.

Other policies that could be put in place in conjunction with trade agreements are policies to encourage access to technologies to support diversification and capacity building. Dependence on single commodities can come about as a result of the natural resource endowments of a country and can be aggravated by trade preferences in developed country markets. Efforts could be included in negotiations to include technical assistance to help single commodity producers diversify. This could include access to technology and support for diversification of the commodity base or, where possible, into other economic sectors such as tourism and manufacturing. Underlying this discussion is the question of whether a liberal trade regime would favour some developing countries with inherent advantages in agriculture, or whether other developing countries would be disadvantaged by more liberal trade.

The exceptions in Article XX of the GATT for certain SPS measures are important for agriculture. Some countries may be required to invest in resources, infrastructure and regulatory mechanisms to develop appropriate SPS measures in order to expand export capacity. Countries in a position to do so, at the domestic level, should invest in meeting international SPS standards in areas such as livestock production and export. In other countries, this might require external assistance.

Depending on the outcome of the IA, examples of measures and strategies that could contribute to protecting the poorest and most vulnerable countries include the following:[95]

- addressing direct and indirect export subsidies;

- rationalising and simplifying access to OECD markets;

- examining trade preferences particularly for countries whose preferences have been eroded through multilateral liberalization, and deepen existing preferences for very poor countries;

- reducing OECD tariffs and consumer taxes on processed agricultural products with special preferences for products from developing countries;

- eliminating tariff escalation for tropical commodities in the developing as well as the developed countries;

- creating or expanding safety nets and food distribution schemes to ensure that low-income consumers are not penalised by rises in the prices of food imports;

- in developing countries, removing taxes on agricultural exports and tariffs on non-agricultural imports (machinery, fertilizers and pesticides) would improve the terms of agricultural trade and help farmers compete on international markets;

- in developed countries, removing trade barriers in labour intensive manufacturing (for example, a rapidly growing textile industry would create new income opportunities for cotton farmers in the tropics);

- encouraging deeper and broader preferential access to the market for manufactured goods in some developed countries could make an important contribution to food security in Least Developed Countries, providing them with the means to finance their rapidly increasing food import needs in the future;

- encouraging FDI that is not based on lower environmental or social standards.

Where important issues related to sustainability are identified, a commitment could be made to pursue those issues in committees set up under the trade agreement that are designed to work through the timing and implementation of provisions of the agreement. Where a trade agreement or a trade measure is seen to

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[95] See also FAO, 2002c.

have large environmental or social impacts there may be time, as a result of an *ex ante* IA, to propose a parallel regime that will consider environmental and/or social issues in conjunction with the implementation of liberalization. In some cases this could occur at the national level. In others, where issues cannot be dealt with domestically, because of their regional nature or where capacity issues exist, it might be appropriate to propose an institutional response at the regional or even multilateral level – through existing institutions or through the creation of new ones.

One risk of policies adopted after-the-fact is that they are considered less significant and are easily disregarded, particularly where they have financial implications. Mainstreaming environmental and social policy objectives into trade policies would enhance policy coherence and improve policy effectiveness in terms of sustainable development objectives.

5.3   Implementing complementary environmental and social policies

Complete liberalization of agricultural trade could produce valuable overall welfare gains, but some groups would win while others would lose. Some studies suggest that the benefits would go mainly to consumers and taxpayers in industrial countries, where agriculture is most protected, and to developing country agricultural exporters. In contrast, urban and landless rural consumers in developing countries might end up paying higher prices for some foodstuffs, especially cereals, milk, meat and sugar. Specific measures should therefore be put in place to help the "loser" groups.[96] Where an agreement is already negotiated, or options for trade-related policy intervention are limited, this is the task envisioned by developing complementary environmental and social policies to mitigate any such negative impacts where they occur and enhance populations' abilities to take advantage of the opportunities and the benefits provided by liberalization.

Environmental and social issues that will be impacted by changes in agricultural trade will often fall under the purview of national governments. National governments are typically in the best position to develop and implement appropriate policies to take advantage of the gains brought about by trade while ensuring that domestic policies are sound and focused in such as way that they can offset any potential negative impacts and promote sustainable production.

An IA should also focus on non-trade related policies promoting sustainability in agricultural production, in parallel with any trade-related agricultural reform. These policies could emerge from *ex ante* or *ex post* assessments. These might accompany the implementation of a trade agreement at the outset, or be put in place following the negotiation of an agreement in order to enhance any beneficial effects or mitigate negative impacts of the liberalization and associated economic activity. In its *Reference Manual,* UNEP classified such policies into three general categories: market based instruments, command and control policies, and institutional support. Typically a mix of policies is recommended to allow flexibility, control costs and address the range of issues likely to arise (Box 35).

Market-based instruments can be useful to address market distortions arising from environmental and social externalities. Government support measures can promote the unsustainable use of a resource, or encourage the use of a resource that is ultimately unsustainable. In some cases those who reap the benefits from over-exploitation or from degradation do not pay the full costs, and those who preserve natural resources or who pay the costs of conservation gain few of the benefits. In some cases the welfare effects of liberalising trade would be ambiguous if environmental externalities were left uncontrolled, and can only be assured if such externalities are internalised by appropriately targeted measures.

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[96] FAO, 2002c.

A range of market-based instruments is available to promote sustainability. These include tax policies, subsidies, deposit refund systems, exchange rate policies, funds, user fees and administrative charges, monetary and credit charges.[97] In Nigeria, a recent IA recommended the application of an effluent charge on pollutants arising from the activities of rubber processing industries to minimise or eradicate the untreated petroleum hydrocarbon generated by their factories.[98]

Box 35: Policy recommendations: the banana sector in Ecuador

- Establish a database of capital goods that constitute "certified clean technology" and apply significant import tariff reductions
- grant preferential credit rates to businesses that wish to adopt clean technology processes
- promote environmental certification
- promote price fixing policies that take into account social and environmental externalities and are competitive in international markets
- encourage capacity building and technology transfer by creating special programmes among producers and exporters
- institute awards for excellence in environmental and social practices
- strengthen institutions that can address the internalization of sustainable policies for Ecuador's banana production.

Source: UNEP, 2002d.

Market-based instruments can also be used as positive incentives for promoting best practices in agricultural systems and management strategies that encourage diversity and productivity. Commodity and price support programs could be restructured to allow farmers to realize the full benefits of the productivity gains made possible through sustainable practices. Tax and credit policies could be modified to encourage a diverse and decentralised system of family farms rather than corporate concentration and absentee ownership. Marketing orders and cosmetic standards could be amended to encourage reduced pesticide use.

Measures might be taken as part of an agri-environmental programme, consistent with existing provisions in the WTO's AoA (Green Box), SPS or TBT agreements. This could include support for agro-forestry, shade coffee, organic production, the use of native species, best practices for land management (such as no-till practices to help improve soil structure or reduce erosion), improved management of plant nutrition to reduce the overuse of chemical fertilizers, or encourage techniques such as IPM.

Command and control policies rely on the direct control of market flows by governments rather than on the functioning of price systems in the marketplace, and encompass measures such as land zoning, licensing, strengthening property rights and legal reform. These include regulatory measures, standard-setting, policing with penalties for non-observance, property rights, insurance and liability related policies.

Governments at all levels have an important role to play in regulating issues that affect agriculture, ranging from establishing regulations for food hygiene and trade to road construction, which is crucial to get food to markets. Governments are also responsible for implementing laws and policies with respect to land-use planning and zoning. This includes identifying appropriate tracts of land for agricultural use *vis-à-vis* commercial use, as well as areas that should be protected for their inherent environmental or social value.

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[97] For a more detailed description of individual policies, see Section V of UNEP, 2001.
[98] UNEP, 2002b.

Expanding cities need more and more infrastructure, transport facilities, slaughterhouses and food supply and distribution issues, all of which contribute to urban and other land-use planning and can be addressed by government.

To be enforceable, practitioners should consider enforcement needs at the farm level, which involves compliance monitoring and sanctioning. Where actions such as inorganic fertilizer or pesticide tax are implemented through markets there is no need for compliance monitoring at the farm level. The more difficult the measurement of the required farm obligation or outcome, the greater the enforcement cost (budgetary cost and environmental losses associated to the degree of non-compliance). For example, prescriptions that can be observed visually (e.g. land set-aside, establishment of green covers or landscape features) are easier to monitor and enforce than non-visible constraints that require sophisticated technical equipment to achieve reasonable compliance records.[99]

Government regulations could be put in place to:

- Subject pesticides to more rigorous testing.
- Monitor more closely residue build-up.
- Strengthen regulations and strategies for the management of animal waste.
- Strengthen regulations related to the use of chemical fertilizers and pesticides.

From an institutional perspective, governments can strengthen and expand national and local institutions to support sustainability in agriculture and address impacts. Such support can extend to universities and related research policies, and other education programs including rural education. Policies, programs and institutions can also address issues associated with labour and employment, contributing towards socially just and safe employment that provides adequate wages, working conditions, health benefits and chances for economic stability. Particular attention might be paid to policies to improve agricultural productivity at the domestic level. Box 36 contains examples of institutional policy responses proposed as a result of UNEP's IA of the export-crop sector in Nigeria.

A range of policy options and policy packages can address sustainability challenges arising from trade liberalization, or can be put in place to ensure that the benefits of liberalization are widely shared among the population. The following bullet points provide examples of policy options that might be pursued:

- policies to improve access to credit; this might include particular attention to rural areas and to women;
- public investment in technology and infrastructure, particularly in poor communities and marginal areas including support for marketing activities, improving access to local marketing information, improving transportation and storage facilities, and improving processing and packaging techniques;
- public investment into agricultural research;
- public investment in institutions to set standards and ensure quality control of agricultural products;
- public investment in rural infrastructure such as irrigation;
- public investment in training extension workers and increased extension to women;
- improved data collection on social and environmental variables related to agriculture and sustainability including household and gender-related data;
- access to education to improve off-farm employment opportunities;

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[99] OECD, 2001b.

- access to training on best management practices for agriculture including the use of organic fertilizers and IPM;

- access to training for the development of niche markets for organic products and fair trade, including certification and labelling issues;

- improving health care to provide the foundation for a healthy workforce. Particular attention could be paid to pay attention to health issues in the agricultural system, control of water-borne diseases and safe pesticide handling methods;

- policies to redistribute land and improve tenancy rights with a particular focus on women and the poor;

- improving preparedness plans for relief and rehabilitation including the development of early-warning and storm-forecasting systems, improvement of transport and communications in areas vulnerable to disasters, development and distribution of crop varieties and livestock breeds resistant to drought, storms and floods, higher temperatures and saline conditions;

- measures to reduce GHG emissions including the removal of subsidies and introduction of environmental taxes on chemical fertilizers and energy inputs, improvement of fertilizer use efficiency, development of rice varieties emitting less CH_4, improved management of livestock waste, restoration of degraded lands, improvement of crop residue management or expansion of agro-forestry and reforestation;

- policies to improve water use efficiency including encouraging no-till/conservation agriculture in rain fed areas and appropriate water pricing, management and technology in irrigated areas;

- promotion of agro-forestry to increase ecosystem resilience and maintain biodiversity;

- encouraging demand for organic crops produced without chemical inputs.

Box 36: Examples of institutional policy responses: the export crop sector in Nigeria

- A Farm Development Advisory System should be evolved to advise non-producers of cocoa and rubber on appropriate environmentally friendly and profitable enterprise combinations of other new export crops.
- The Federal Ministry of Health should ensure the availability of more health services to rural areas where cocoa and rubber are produced to assist in the treatment of ailments that might result from the exposure to agrochemicals, and promote the adoption of safe methods of pesticide application.
- Publicity and education programmes on how to use the chemicals should be developed.
- Federal and State Ministries of Information in co-operation with other relevant departments should revise and improve on the long-standing methods of disseminating agricultural information to farmers, including pictorial presentations since most farmers are illiterate, and through the radio.
- A supervisory marketing agency led by the Government, but including stakeholders, that can monitor the sale and promote the production of cocoa and rubber in and environmentally friendly manner and oversee the supply and use of appropriate agrochemicals should be put in place.
- Capacity building programmes on environmental issues should be organised by the Federal Ministry of Environment and academic institutions (this will require outside funding).
- Increase research for export crops, including research on disease resistance and high yielding varieties on data generation and on training.

Source: UNEP, 2002b.

6. Conclusion

This *Handbook* is not intended to provide a single blue print for IAs of agriculture. Rather, it highlights relevant issues for institutions and governments wishing to undertake such an exercise and flags considerations that should be taken into account. It is timely given the important role that agriculture plays in ongoing multilateral, regional and bilateral trading relations. By including the major priorities related to the three pillars of sustainability: environment, economy and social wellbeing, and taking into account the views of stakeholders throughout the process, the IA is designed with the overall goal of helping policy makers identify integrated policies that promote sustainable development and that are supported and can be implemented by a wide variety of stakeholders. This includes encouraging the development of trade policy that is integrated to include social and environmental goals.

Building on these foundations, there are various ways to undertake the IA. The *Handbook* presents a number of quantitative and qualitative approaches that can be employed by researchers depending on their objectives, the specific subject matter, domestic priorities, data availability, time restrictions or the availability of expertise and financial resources. The availability and relevance of various methods will continue to evolve as does the theoretical literature and the practical experience. This development will also point to where more and better data needs to be collected, where there might be resources dedicated to training, and how efforts to adopt appropriate valuation and accounting practices evolve. As such, this *Handbook* should be viewed as part of an ongoing exercise and a work in progress to assist policy makers and others pursue development that is sustainable, while harnessing the opportunities provided by trade liberalization.

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Annex 1: Example of the application of the "Root Causes" matrix and policy options

An example of the application of the criteria for prioritising sustainability variables to the issue of water pollution due to excessive use of pesticides and thus causing health problems is as follows:

- Affects water quality, both surface and groundwater. Farmers need to invest more in pesticide use as pests become resistant. Leads to increasing costs for medicines to cure water-related diseases.
- Poses serious risks for farmers including deterioration of health and/or increasing indebtedness.
- Causes downstream problems for communities dependent on the water for drinking.
- Affects biodiversity and soil fauna, thus degrading the soil, with risks for future generations.
- Affects profitability of farming, as costs increase and productivity declines due to increasing pest resistance.
- Affects a large and increasing number of stakeholders.

Table 1.1 presents an example of the application of the matrix for prioritising root causes in an IA to the example of water pollution due to excessive use of pesticides, including sustainability variables and relevant trade issues.

Annex Table 1.1: Application of matrix to the issue of water pollution due to excessive use of pesticides causing health problems

	Root causes (R) of the problem, associated actors (A) and opportunities (O) to help solve the problem, in different dimensions and at different levels			
Levels	Economic	Socio-cultural	Environmental	Institutional / Political
Local	R: Local illegal availability of banned pesticides A: Local traders O: Decentralisation, organisation of farmers	R: Poor farmers buy cheap pesticides, poor environmental awareness A: Traders O: Increasing awareness among users	R: High incidence of pests and pest resistance A: -- O: IPM technology, local rice varieties, crop diversification, indigenous practices	R: Lack of enforcement capacity of local authorities A: Local authorities O: Capacity building by donor programmes
National	R: Subsidy level of pesticides / input supply A: Ministry of Agriculture O: Need to restructure subsidy	R: Problem has low priority in national press A: Ministry of information O: Increasing attention in local press	R: Deforestation in catchment area disrupting water balance A: Upstream landowners O: Forest management schemes	F: Extension promotes high pesticide use A: Extension Department O: Alternative extension packages, farmer-to-farmer extension on IPM
International	R: Illegal trade of pesticides A: Chemical concerns O: Pressure by environmental NGOs	O: Growing international public awareness of health problems and willingness to pay for organic rice	O: Good results with IPM in some countries	

Examples of the policy options that might be available are as follows:

a. subsidies to promote IPM and organic rice farming based on successful pilots in the country and in other countries;

b. strategic partnerships with international hotels and other consumers interested in buying organic rice for a higher price;

c. education of small-scale rice producing farmers, including women and children, to support IPM;

d. research aimed at pest resistance of indigenous rice varieties;

e. elimination of subsidies for pesticides and other agrochemical inputs;

f. ban on imports of prohibited pesticides consistent with WHO conventions;

g. institutional strengthening of government to encourage the enforcement of banned pesticides consistent with WHO conventions;

h. developing with financial institutions credit schemes to support more sustainable rice production.

Annex 2: Selected indicators for agriculture

Annex Table 2.1: Examples of economic indicators for agriculture

GDP	% of GDP attributed to agriculture
Productivity and Structure of Production	Agricultural output (in value or in volume)
Crop mix – changes in food crop production	Number of farms Average farm size Average production (000 m tons) % change *Per capita* production (tons per person) % change Average crop yield (kg per ha) % change
Average yields	Proportion of farm area with monoculture Proportion of farm area with arboriculture Proportion of area with mixed cropping Diversity of crops (number of crops from one farm or region) Proportion of breeding
Structure of Trade	
Imports	Levels of imports for agricultural products % change
Exports	Levels of exports of agricultural products % change, % of GDP
Food aid	Net cereal imports and food aid as a % of total consumption Food aid as a % of total imports
Investment	Investment share in GDP
Subsidies	Subsidy levels for agrochemicals Subsidy levels for exports Subsidy levels for trade Subsidy levels for the farm sector …..
Farm Employment	Number / proportion of people employed in the farm sector
	Estimate of unemployed (age 15-24, each sex and total) (MDG8) Rural unemployment levels, structural versus seasonal unemployment. Rate of creation of food processing businesses Ratio of subsistence farmers to waged agricultural labourers
Farm Income	Total farming income Proportion of subsistence farmers as compared to market farmers Average earning of farmers and farm workers Agri-environmental expenditures Levels of agricultural support (for agrochemicals, the private sector, exports and trade)
Prices	International and national commodity prices Price of staple foods Exchange rate ($ with local currency)
Agrochemical Imports	Total amount of chemical fertilizers imported Total amount of pesticides and herbicides imported

Annex Table 2.2: Examples of indicators for environment and natural resources

Freshwater Resources	Renewable water resources (per capita)
Intensity of use	Annual water withdrawals (per capita) in m³ Water balance (per capita) Withdrawals by sector (as a % of total) for agriculture, industry and domestic use
Efficiency of use – Technical efficiency – Economic efficiency	Amount of water diverted for irrigation % of cropland that is irrigated Intensity of use by major uses (e.g., irrigation) Irrigation technology
Freshwater Quality	BOD/dissolved oxygen (DO) in inland water Concentration of nitrates and phosphates in inland waters
Water quality trends and risks	Concentration of heavy metals Exceedance of critical loads of PH in water Incidence / Frequency of water-related diseases in urban / rural areas Amount of agrochemicals used near water resources used for drinking
Land	Land area (1000 ha) Cultivated area (1,000 ha)

Stock of agricultural land and land use	Cultivated area per capita (ha)
	Forest area; Percentage forest to land area (MDG 7)
	    Annual rate of forest conversion to agricultural land-use (%)
	Wetland area; Percentage of wetland to land area
	    Annual rate of wetland conversion to agricultural land (%)

Livestock densities	Numbers of heads of cattle, pigs, sheep and goats per km² or agricultural land Nitrogen and phosphate generated by livestock manure per km² of agricultural land
Production practices	Crop mix (see above) Total area with organic farming Land management practices Number of tractors
Agro-forestry	Area with agro-forestry systems Tree density agro-forestry farms Proportion of forest on farmland
Soil degradation (desertification/erosion) and soil quality	Soil cover Rate of soil erosion Nutrient quality of the soil Levels of salinization Current state of drainage Exceedance of critical loads of PH in soil Soil Organic Matter content
Biodiversity	
Wildlife habitat	Total protected area as % of national territory Land areas under management categories I to IV of the IUCN classification Ratio of area protected to maintain biological diversity to surface area (MDG7) Intensively farmed agricultural habitats Land use patterns such as change in land areas covered by forest for agricultural use % area of key ecosystems/habitats
Wild species	Number of threatened species (mammals, birds, vascular plants, fish, reptiles, amphibians) Number of threatened or extinct species compared to the number of known species Number of protected species Wild species diversity
Crop genetic diversity	Levels of non-native (invasive) species Number or proportion of indigenous crop varieties actively used Levels of open-pollinated varieties (OPV) or GMOs used in production % of agricultural production dedicated to monoculture
Energy Resources	
Energy consumption for agriculture	Energy consumption for agriculture Electricity consumption per capita (kwh) Energy use (kg oil equivalent) per 1$ GDP (PPP) (MDG7) Existence / Use of renewable energy sources

Air Quality	SOx per unit of GDP (kg/1,000 USD)
	NOx per unit of GDP (kg/1,000 USD)
Urban air quality	SO_2 concentrations in selected cities
	NO_2 concentrations in selected cities
Ozone	Atmospheric ODS concentrations
	Ground-level UV-B radiation
	Stratospheric ozone levels in selected cities
	Emissions of ozone depleting substances (MDG7)
	Existing CFC recovery rates
Climate Change	Levels of CO_2 emissions (million metric tons of carbon equivalent)
CO_2 emissions	Gross agricultural GHG emission
CH_4 emissions	CO_2 emissions per capita (MDG7)
N_2O emissions	CO_2 emissions intensities (per capita, per unit of GDP) in agriculture
	Emission intensities for other GHGs (such as CH_4, N_2O) in agriculture
Technology	Expenditure on air abatement pollution control
	Capacity of SO_X and NO_X abatement equipment at stationary sources
Use of Agrochemical Inputs	Nitrogen efficiency rate
Nutrient use	Cost-efficiency rate of fertilizers used
	Average annual fertilizer use per area (specify which fertilizers)
	Total (000 metric tons) of fertilizer used
	Use of organic fertilizers (amount, number of farmers)
	Area where integrated fertility management practices are being used
	Area where crop rotation is used
	Area where mulching is being used
Pesticide Use and Risks	Pesticide use (kg/ha cropland) (specify which pesticides or herbicides)
	Areas sprayed by pesticides
	Average amount of banned pesticides used per area
	Use of non-chemical pest control (area, number of farmers)
	Use of IPM (area, number of farmers)

Annex Table 2.3: Examples of indicators for social wellbeing, development and equity

Poverty	Gini Index of income equality
	Population living below $1 per day (%) (MDG1)
	Population living below national poverty line (%)
	Poverty gap ratio (incidence x depth of poverty) (MDG1)
	Share of poorest quintile in national consumption (MDG1)
Education	Net enrolment ratio (MDG2)
Farmer education	Proportion of pupils starting grade 1 who reach grade 5 (MDG2)
	Number of illiterate adults
	Adult illiteracy rates (%)
	Literacy rate of 15-24 years old (MDG2)
Gender	Gender Development Index (GDI)
Economic activity	Ratio of female to male rural household heads
	Ratio of male to female time inputs to farming
	Ratio of estimated female to male earned income
	Female economic activity rate (% for age 15+)
	Female economic activity rate (as % of male rate)
	Female employment in agriculture (% of female labour force)
	Share of women in waged employment in the non-agricultural sector (MDG3)
Education	Female adult literacy rate (% age 15-24) (relative to men) (MDG3)
	Female youth literacy rate (%) (and compared to male)
	Female combined primary, secondary and tertiary gross enrolment ration (%) (and compared to male) (MDG3)
Health	Average daily per capita calorie supply, 1999 (kilocalories)
	Average daily per capita calories from animal products, 1999 (kilocalories)
Hunger	Underweight children under age 5 (%) (MDG1)
	Prevalence of malnutrition among children under age 5
	Undernourished people (as a % of total population)
	Proportion of population below minimum level of dietary energy consumption (MDG1)

Access to basic services	Proportion of population with sustainable access to an improved water source (urban and rural) (MDG7)
	Proportion of population with access to affordable essential drugs on a regular basis (MDG8)
	Proportion of the urban population with access to improved sanitation (MDG7)
	Sewage treatment connection rates
HIV/AIDS	HIV prevalence among pregnant women aged 15-24 (%) in major urban areas (MDG 6)
	HIV prevalence among pregnant women 15-24 (%), outside major urban areas (MDG 6)
Children	Infant mortality rate (MDG4)
	Under 5 mortality rate (MDG4)
	One year-old fully immunized against measles (%) (MDG4)
	Proportion of births attended by skilled health personnel (MDG4)
	Prevalence and death rates associated with malaria (MDG 6)
	Prevalence and death rates associated with tuberculosis (MDG 6)
Property Rights	Proportion of households with access to secure tenure (MDG7)
Urbanisation	Urban population (as % of total)
	Rates of migration to from rural areas to cities
Culture and Traditional Knowledge	Integration of cultural dimension at all levels of development cooperation
	Recognition, preservation and promotion of cultural values and identities including traditional knowledge
	Recognition, preservation and promotion of value of cultural heritage
Food Security	Food availability (level of food production, food imports, food storage)
	Access to Food (poverty, market integration, access to markets)
	Food consumption (food use practices, food intake)
	Nutritional status (anthropometry, micronutrient deficiency)
Food Safety	Average distance from depots to vulnerable communities
	Quality of storage depots
	Quality of transportation networks
	Residue of pesticides on grains and other food
Demographics	Total population (millions)
	Annual population growth rate (%)
	Immigration/emigration rate
Access to Technology	Telephone mainlines (per 1,000 people) (MDG8)
	Cellular mobile subscribers (per 1,000 people) (MDG8)

Annex 3: Examples of green box measures as notified by WTO members

Annex 2 Criteria	WTO Member	Notification	Name and Description of measure with reference to criteria in Annex 2 of the AOA
General Services – Research	EC	EEC/12/Rev.1 EEC/16/Rev.2	Improvement of production potential through animal and plant selection and of production techniques through, e.g. testing of machinery; development of experimental centres; pilot projects and demonstration projects; salaries of personnel.
General Services – Research	USA	USA/10 USA/17 USA/17	Cooperative State Research, Extension and Education Service (CSREES) Research function. Provides grants to state agricultural research establishments. Participates in cooperative planning with state research institutions. Cooperative State Research Service Buildings and facilities Alternative Agricultural Research: Research function. Provides assistance in developing new products from agricultural and forestry material and animal by products.
General Services – Pest and Disease Control	Botswana	BWA/5	Developed animal disease programme: Diseases of national and economic importance such as Foot and Mouth, Anthrax, Black Quarter, Brucellosis and Rabies; the Government continues to offer free vaccination to farmers to prevent their animals from acquiring these diseases through a yearly vaccination campaign. There is also the issue of Tsetse fly, which the Government continues to fight through eradication campaigns by using safe and environmentally friendly methods. Plant protection programme: Due to the agro-climatic conditions of Botswana plants are susceptible to diseases and these are to be controlled by the use of pesticides and insecticides that ordinary farmers do not know how to apply. The plant protection unit assists such farmers in controlling these plant diseases. Also, the unit assists farmers with the spraying of locusts and quela birds when they attack their fields. The programme involved the purchase of a new spraying aircraft.
General Services – Training Services	Costa Rica	CRI/6	Training service: Organisation of conferences, seminars and workshops for agricultural producers.
General Services – Extension and Advisory Services	Jamaica	JAM/2 JAM/4	Extension and advisory services: primarily to rural farmers. to train and develop extension personnel; administer farmers' training programmes; assist farmers in organisation cooperative marketing ventures and disseminating marketing information to them; provide a linkage between research organisation and farmers; Implementing agency for selected farming projects, e.g. watershed development and hillside agriculture.

Annex 2 Criteria	WTO Member	Notification	Name and Description of measure with reference to criteria in Annex 2 of the AOA
General Services – Inspection Services	South Africa	ZAF/5 ZAF/13 ZAF/21	Veterinary Services: To promote animal production, animal health and the quality of the products of animals through the determination of norms and standards as well as coordination and rendering of services. Phytosanitary services and Quality Control: To promote crop production and quality of plant products through the determination of norms and standards as well as the coordination and rendering of services.
General Services – Marketing and Promotion Services	Thailand	THA/15 THA/23 THA/29 THA/37	Marketing and promotion of farmers' organisation programme: The programme provides assistance in terms of advice on market information and management of framer's organisation to help producers market their products effectively.
General Services – Infrastructural Services	Fiji	FJI/1 FJI/6	Drainage and irrigation: Construction and provision of infrastructure. General services aimed at draining low-lying potentially fertile land. It also includes dredging of heavily silted rivers and provision of flood defences.
Other General Services	Brazil	BRA/6/Rev.1 BRA/10 BRA/13	Agrarian organisation; agrarian reform settlement. Promotion of structural changes in regions with structural disadvantages, problems related to natural resources ownership and labour force supplies; structural adjustment assistance for investment aids; land distribution to landless rural workforce; land reform credits; agrarian related studies and research; legal services; social assistance to rural workers.
Non-separated General Services	Trinidad and Tobago	TTO/2	Research, pest and disease control, training, extension and advisory services, marketing and promotion services and infrastructural services. General and Product Research for increasing yields and the application of new and improved crop varieties. Irrigation and Drainage Worlds to maintain and increase productive land area in various agricultural projects throughout the country; provision of market information to farmers and marketers; extension and training services to farmers; animal health and quarantine services on-farm and at the border to prevent outbreak of diseases
Payments under Environmental Programmes	India	IND/1	Soil conservation in catchment areas of river valley projects; integrated watershed management in the catchment areas of flood-prone rivers in the Indo-Gangetic basin; fodder grassland and pasture development; desert development programmes; control of shifting cultivation.
Payments under Regional Assistance Programmes	Cuba	CUB/6 CUB/7 CUB/8	Regional development aid programme: 1995 – Financial assistance programmed and projects for regional development (Annex 2, paragraph 13) 1996, 1997 and 1998 – Financial assistance programmes and projects for regional development in mountain areas (Turquino Plan).

Source: WTO.