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Developing

Socio-economic Scenarios

for use in Vulnerability and Adaptation Assessments

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NATIONAL COMMUNICATIONS SUPPORT UNIT

HANDBOOK

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DEVELOPING SOCIOECONOMIC SCENARIOS FOR USE IN VULNERABILITY AND ADAPTATION ASSESSMENTS

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FOREWORD

Agriculture and water are vital resources for any country, and this importance is reflected in the attention paid to both sectors by policy-makers. But often management decisions are taken at the local, national, or even regional level, without any consideration of what may happen in the future. This is where socio-economic scenarios can be useful tools for making better-informed policy decisions.

For example, water supplies for irrigation may be reduced and subverted for the increased demand from municipalities. But will this action be sufficient to provide for a future increased population? And what of the climate change impacts, which are expected to lead to decreased rainfall and decreased agricultural production? Socio-economic scenarios are one way of answering these questions and improving our understanding of our future vulnerabilities.

More than 130 non-Annex I Parties have been preparing Initial National Communications for submission to the United Nations Framework Convention on Climate Change (UNFCCC) and are about to begin Second National Communications. The majority of these national communications contain assessments of vulnerability and adaptation, a key component of which should be socioeconomic scenarios. However, national project teams working to prepare the national communications report that constructing socioeconomic scenarios is one of their greatest challenges, and in many cases has not been undertaken. Even after the scenarios are constructed, their uncertainties often seem to make it difficult for analysts to interpret the results with sufficient confidence to make policy decisions. In response to this need, the UNDP-GEF National Communications Support Unit commissioned this handbook.

Developing socioeconomic scenarios of the future is important because socioeconomic changes may substantially increase or decrease vulnerability to climate change. For example, as populations grow, human activities that pollute may increase and habitats may be fragmented. Together, these changes may increase the vulnerability of some aspects of human welfare. If the economy grows and technologies can be developed, vulnerability may be reduced in some sectors but possibly increased in others. These interactive changes can be explored (although not predicted) through the development of alternative socioeconomic scenarios of the future.

The purpose of this handbook is to assist countries in developing socioeconomic scenarios, in conjunction with the Adaptation Policy Framework (UNDP, 2004), for analyses of vulnerability and adaptation as part of their national communications under the UNFCCC. This handbook is organized to provide guidance in a systematic unifying framework that functions at differing spatial scales: locally at the sectoral level, with or without integration of the sectors; nationally, with integration of the sectors; multinationally (regionally) and/or globally, taking account of cross-border impacts.

For any study of climate change impacts, vulnerability, or adaptation, the UNFCCC process generally includes development of a "business-as-usual" scenario (i.e., without climate change) for comparison with scenarios that account for climate change. For some purposes, including only current climate variability in socioeconomic scenarios may suffice to measure vulnerability and point to short-term strategies. However, developing additional socioeconomic scenarios that account for longer-term climate change will help to evaluate the ultimate consequences of short-term strategies.

Similarly, if vulnerability and adaptation assessment (see Burton et al. 2004) is the main goal of a study, the local and sector-specific scales are likely to be the most important. Ideally, scenarios should be nested in a larger national, regional, or global framework. For example, farmers may make decisions based on the market prices of a product in a national or global economy. Matters of national security, such as energy, food, and water, must be seen in a global context. This handbook provides a systematic framework for preparing socioeconomic scenarios for assessment of both climate change impact and adaptation across differing spatial scales.

At each level, the manual demonstrates a systematic process for describing and, where possible, quantifying alternatives for the future. Global and regional projections provide some general constraints within which to develop country- and sector-specific projections. More generalized data are most useful in long-term (e.g., century) projections. Sector-specific data are most useful for shorter-term projections and planning.

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The National Communications Support Unit does not endorse the use of any single model or method for national-scale assessments of climate change. It encourages the use of a range of models and methods appropriate to national circumstances.

GLOSSARY

Adaptation Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that moderates harm or exploits beneficial opportunities. Can be anticipatory or reactive, private or public, autonomous or planned.

Adaptive Capacity Degree to which adjustments to projected or actual changes in climate are possible in practices, processes, or structures of systems. Refers particularly to adjustments in anticipation of change.

Coping Capacity Ability to adjust to climate events in the short term.

Indicator A statistic of direct normative interest that facilitates concise, comprehensive, and balanced judgments about the condition of major aspects of a society.

Proxy Literally, something used in place of another. Proxies fulfill three criteria: they (1) summarize or otherwise simplify relevant information; (2) make visible or perceptible phenomena of interest; and (3) quantify, measure, and communicate relevant information.

Resilience Tendency to maintain integrity when subject to disturbance.

Sector An aspect of overall vulnerability that may be analyzed separately with regard to its impact on human welfare.

Sensitivity Degree to which a system will respond to a change in climatic conditions.

Scenario A coherent, internally consistent, and plausible description of a possible future state of the world (see p. 5, “What is a scenario?”).

Storyline A qualitative, holistic picture of the general structure and values of society in the future, describing conditions that might be brought about by human choices concerning economic and social policy, human reproduction, occupations, and use of energy and technology.

Vulnerability Extent to which climate change may damage or harm a system, depending not only on the system's sensitivity but also on its ability to adapt to new climatic conditions.

Vulnerability Assessment An analysis of the gap between the impacts of climate change and capacity to adapt to those impacts (Burton et. al, 2004).

SCENARIOS FOR VULNERABILITY AND ADAPTATION ANALYSIS

Scenarios of climate change and its impacts are generally based on knowledge of the physical world: atmospheric chemistry, temperature, precipitation, and so on in the case of climate change scenarios, and climate change-induced reactions of plants, animals, and ecosystems, in the case of impacts scenarios. However, we cannot know what the climate-changed future will be like for human societies unless we know something about future populations and how they will live. Indeed, we cannot fully understand how vulnerable we may be to climate change without knowing something about future socioeconomic conditions.

To date, the issue of developing socioeconomic scenarios has been addressed in limited and limiting ways. Most existing socioeconomic scenarios are limited to demographic and economic characteristics, such as projections of total population, national income (i.e., gross domestic product, or GDP), and energy production and consumption. Land use and rates of technological change are also sometimes included. Then, straight-line projections of these central factors become the scenario.

This handbook is aimed at improving the construction of socioeconomic scenarios in two ways. First, it broadens the scope of factors to be included. Careful selection of the factors to include in a socioeconomic scenario is obviously important if the results are to be meaningful input to a vulnerability analysis. This handbook will offer guidance on selecting such factors as well as on sources of existing socioeconomic scenarios that can be adapted for use in a specified vulnerability analysis. Second, the guidance focuses on the local sectors that are most relevant for policy, incorporating examples on agriculture and water resources, while also identifying other potentially important factors at the country level.

What Is a Scenario?

A scenario is not a prediction. It is "a coherent, internally consistent and plausible description of a possible future state of the world" (Carter et al. 1994). The Third Assessment Report of the Intergovernmental Panel on Climate Change's (IPCC's) *Special Report on Emissions Scenarios* (Nakicenovic et al. 2000:594) further defines a scenario as

> a plausible description of how the future may develop, based on a coherent and internally consistent set of assumptions ("scenario logic") about key relationships and driving forces (e.g., rate of technology changes, prices). Note that scenarios are neither predictions nor forecasts.

Thus, a scenario comprises a set of interrelated variables to form a whole picture of what the world — or, in this case, what the country, sector, or locality (urban area, watershed, etc.) — might be like at some future date(s). A scenario is not a forecast, which describes a future that is *highly likely*. Instead, a scenario describes a *possible* future. Taken together, a collection of scenarios might constitute alternative futures — some desirable, some undesirable. Moreover, a scenario is distinct from a projection, which is often a simple extrapolation of historical trends in one or more variables.

Scenarios can be based on different assumptions and focus on qualitatively different dimensions. For instance, a scenario based on structural analysis of historical, social, and cultural conditions will be quite different from a scenario based on analysis of supply, demand, and market opportunities. Each of these scenarios would have implications for policy, but the targets of policy would be different.

Methodological Approaches for Creating Scenarios

Scenarios can be highly qualitative descriptions, highly quantitative computer-based data arrays, or some combination of qualitative and quantitative characterizations of the future. One method that is typically qualitative uses stakeholder involvement to set the boundaries of the study, and to identify and describe important factors. Of course, a stakeholder process may also involve quantitative models and data.

Consistent with the Adaptation Policy Framework (Burton et al., 2004), the guidance for sectoral analyses suggests a "bottom-up" approach, in contrast to the "top-down" approach used in the country-level analyses. Used in socioeconomic analysis and modeling, the terms "top-down" and "bottom-up" indicate differences in viewpoint and purpose:

- A top-down analysis takes a highly aggregated view of the object of study. Spatial and temporal differences (e.g., in income) are often averaged out or otherwise not accounted for, and trend curves are generally smooth, so that short-term changes are not discernable. GDP per capita is such an aggregate statistic—very good for country-to-country comparisons and to determine whether wealth is increasing or decreasing over the long term, but severely limited for assessing the effects of a drought or flood.

- A bottom-up analysis, in contrast, is highly disaggregated, focusing on the local level, specific circumstances, and short-term effects. Data and analyses often emphasize differences among people, and the standard deviation, range, and volatility of events over time. Some measure of the frequency and severity of floods in a given location would help to assess a particular society's capacity to withstand or recover from future flood events, but would provides little help in the comparative or trend analysis required for a global assessment.

Socioeconomic scenarios should be both top-down and bottom-up. First, the scenarios must be specific about how local climate impacts and socioeconomic factors interact within the larger context as people produce food, manage water, build settlements, and so on. Second, scenarios should set the global, regional, and country context within which vulnerability (and adaptation options) can be assessed. No single locale can act independently of larger socioeconomic conditions and policies. The ability to show the connections between top-down and bottom-up analyses is highly desirable in developing useful scenarios.

Useful scenarios recognize that factors ranging from the global to the local are interrelated. The focus of well-designed scenarios goes beyond merely identifying factors and collecting data and will consider *how the factors interact in a given place and time affect human well-being*.

This guidance recommends a stakeholder involvement process, development of qualitative "storylines" of the future, and selection of proxy values to represent important elements of socioeconomic conditions, all supplemented by research and quantitative data, as appropriate. Box 1 describes two general approaches: one combines qualitative and quantitative methods (Approach 1), and one is purely qualitative (Approach 2).

Involving Stakeholders

In order to develop scenarios that are useful for vulnerability and adaptation assessments, stakeholders must participate in the selection of storylines, indicators, and projections. Stakeholders should include various government ministries and bureaus, and representatives of important economic, environmental, and cultural sectors. Respect for cultural differences and indigenous knowledge is important. An open, continuing, and iterative process can provide insights and increase stakeholder ownership of the scenario descriptions. The stakeholders should be involved not only in developing scenarios but also in applying them to vulnerability and adaptation studies. The Adaptation Policy Framework and its Technical Paper #2 discuss stakeholder processes more fully.

The Whole Picture: Storylines of the Future

In the past, analysts developed scenarios by selecting key drivers of socioeconomic change and projecting current trends in these drivers into the future. Little if any consideration was given to whether the projected factors, when combined, comprised a coherent picture of the future. Furthermore, previous scenarios, while representing significant advances at the time of their development, accounted for only a narrow range of potential socioeconomic pathways toward the future.

Recognizing this problem, the researchers of the IPCC's *Special Report on Emissions Scenarios* (SRES) developed "storylines"—that is, coherent, alternative pictures of the future within which certain trends make sense. Storylines provide qualitative, holistic portraits of the general structure and values of society. They describe conditions that might be produced by human choices about economic and social policy, human reproduction, occupations, and use of energy and technology. The pace of population growth and of economic development are set within and partially explained by poli-

Box 1: General Approaches to Developing Socioeconomic Scenarios

Approach 1: Qualitative and Quantitative

1. Form a stakeholder group and ask for input to identify the important issues in socioeconomic development (Steps 2 and 3) and how best to represent them for policy purposes (Step 4) (see Technical Paper #2, Adaptation Policy Framework).
2. With stakeholder input, develop storylines for scenarios (see pp. 8, 13-14, 19-20, 22-23 in this report).
3. Determine key sectors (e.g., agriculture and industry) targeted for development (see p. 10).
4. Select indicators and the appropriate proxies (quantitative) to represent future changes (e.g., cereals production versus consumption, animal protein demand, industrial production, extent of trade, etc.) (see pp. 10-19).
5. Provide a national context using additional indicators (see pp. 20-21 and/or 25-26).
6. Report results for use in vulnerability and adaptation assessments (see Adaptation Policy Framework).

Approach 2: Qualitative

1. Form stakeholder group and ask for input to identify the important issues in socioeconomic development (Steps 2 and 3) and how best to represent them for policy purposes (Step 4) (see Technical Paper #2, Adaptation Policy Framework).
2. With stakeholder input, develop storylines for scenarios (see pp. 8, 13-14, 19-20, 22-23 in this report).
3. Determine key sectors (e.g., agriculture and industry) targeted for development (see p. 10).
4. With stakeholder input, characterize the key sectors and their connections to national processes for business-as-usual and alternative scenarios (i.e., with and without climate change).
5. Report results for use in vulnerability and adaptation assessments (see Adaptation Policy Framework).

cies' alternative tendencies to support various forms of global governance or localized self-sufficiency.

Nakicenovic et al. (2000) developed four SRES storylines, which were widely reviewed in a public process. Within these storylines, families of scenarios diverge qualitatively and quantitatively. The two "A" storylines and associated families, for example, posit high economic growth, while the two "B" storylines and families explore the consequences of lower economic growth. "A1" and "B1" families are oriented toward global convergence, while "A2" and "B2" families focus more on regional governance structures. Environmental policies and outcomes are different in each family of scenarios. These SRES storylines are discussed in more detail in the final section of this guidance.

Proxy Values: Building Blocks for Scenarios

Vulnerability and adaptive capacity are in many respects intangible and difficult to measure directly, so analysts use proxy values (that is, variables representing these abstract concepts that can be clearly characterized and possibly quantified), from which indicators of vulnerability and adaptive capacity can be built. For many studies, the scope is narrowly defined by a few "direct" impacts of climate change, without adequate consideration of the total social dimensions and indirect effects of a changing climate, for example, on capital and migration.

For example, although social welfare is important, it cannot be measured directly. GDP per capita, often used as a proxy at the country level, is an incomplete and flawed proxy for welfare. It neglects the value of unpaid work, people's satisfaction with their occupations, and many other aspects of welfare. It does not measure household income or real wages, and so does not capture a household's ability to meet its needs. However, as a measure of economic productivity, GDP per capita is an accepted approximation that can be observed and measured.

Desirable proxies fulfill three criteria. They: (1) summarize or otherwise simplify relevant information; (2) make visible or perceptible phenomena of interest; and (3) quantify, measure, and communicate relevant information. Proxies may be qualitative, quantitative, or both. A primary consideration in developing storylines and choosing proxies is their usefulness for policymaking.

To construct quantitative scenarios of the future relevant to climate change vulnerability and adaptive capacity, analysts select relevant proxies, collect or locate appropriate data, and estimate future values for those proxies. (See Box 2 for the steps involved in developing proxy indicators.)

In this guidance, we proceed from a local, sectoral analysis to the country level, with emphasis on key sectors. At each level, the first task is to characterize current conditions. Next comes the identification of proxies for dimensions of current and future vulnerability, followed by collection of data on these proxies. Alternative storylines for the future should include these dimensions. Projecting values for the chosen proxies into alternative futures is the last step in scenario development, followed by their use in vulnerability assessment.

Box 2: Identifying Proxies

Proxies are used to represent concepts and values that cannot be measured directly, such as human welfare.
There are four steps involved:

1. Identify categories of interest for policy-relevant analysis, such as settlements, food security, human health, water, and economic activity.
2. Within each category, explore various ways to measure human well-being. For example, settlement sensitivity could include markets, infrastructure, sea level rise, water quality, etc. The number of measures used should be large enough to capture the essential elements, yet small enough to not overwhelm the analysis with information.
3. Choose proxies, explicitly stating what they are proxies for. As an example, Table 6 (p 19) lists "GDP (market) per capita" and "Gini Index" as proxies for "distribution of access to markets, technology, and other resources useful for adaptation." These choices should always be considered provisional until they have been tested through use.
4. Define the functional relationship of changes in the proxies to changes in the "proxy for." In the previous example, the functional relationship of "GDP (market) per capita" is defined as "adaptive capacity increases as GDP per capita increases." This step, also, should be subject to revision in use. For example, a proxy value may be positive up to a certain point and negative thereafter in relation to sensitivity to climate (see Table 1, p 11), to vulnerability, or to adaptive capacity (see Table 6, p 19). For example, industrial development might produce wealth effects that enhance adaptive capacity, but might also create emissions that both pollute and increase local climate sensitivities.

GUIDANCE IN DEVELOPING SOCIO-ECONOMIC SCENARIOS

This guidance is aimed at country-level analysts and teams involved in preparing Second National Communications and adaptation projects under the UNFCCC. The guidance may also be useful to others engaged in development planning, environmental policy, and decision-making that involves natural resources. This portion of the guidance will use "you" to address such readers.

The goal of scenario development is to explore alternative futures both qualitatively and (if possible) quantitatively so that you can assess the implications of current decisions and long-range policy for vulnerability and adaptation to climate change. Scenarios can assist you in looking at the international context of planning for climate change as well as decision-making aimed at reducing vulnerability and increasing adaptive capacity.

Thus, a useful product from your scenario development process should:

- Reflect sufficient input from stakeholders to ensure usefulness of the scenarios
- Represent the important factors in society and economy
- Account for the effects of climate variability and longer-term climate change on society and the economy
- Be consistent across sectoral, national, and global scales (but, note that a single global scenario can be consistent with many different national and sectoral scenarios)
- Support exploration of at least two different, coherent directions for the future (i.e., alternative storylines).

Setting Boundaries

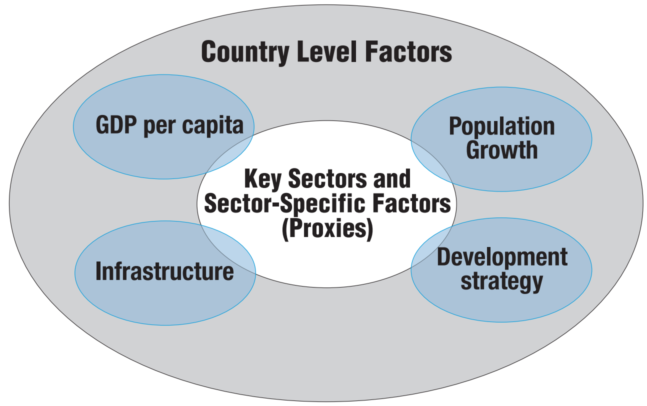
Analysts, in consultation with stakeholders, must set the boundaries of the area to be analyzed and identify the area's connections with activities outside it. For example, the area to be analyzed may be a country, an urban area, an important agricultural area, or a watershed. Connections with activities outside an area might concern trade (domestic and international), migration, upstream water withdrawals (and other water management), agricultural subsidies, and agricultural runoff (and other agricultural practices).

Via boundary setting and identification of connections, analysts should incorporate national- and global-level factors and data in scenarios, even those focusing on the local and/or sectoral level (see Figure 1). The phenomenon of climate change, as well as other major social and economic forces such as globalization, entail global and regional trends that will be important for any analysis of vulnerability or adaptation. Similarly, national trends and policies will have a large effect on future social and economic conditions. Neglecting these large-scale processes would skew local-level analysis.

Characterizing Sector-Specific Factors in Socioeconomic Scenarios

This section describes several approaches for developing sector-specific scenarios, including discussion of and examples for two sectors, namely agriculture and water. The sector-specific analysis is intended to help you think through and construct future socioeconomic scenarios at sub-national sectoral levels consistent with more comprehensive analysis. The interdependence of the various elements is also important to consider. For example, in constructing scenarios focusing on agriculture and/or water resources, you should account for the relationships among crop production, water availability, and settlements.

Figure 1: *Incorporating Country-Level Factors in Sector-Specific Socioeconomic Scenarios*



As time and resources will likely limit the scope of your analysis, you should select those sectors that are crucial for your country's future economic and social development. For one country, fisheries may be in the "crucial" category, but for another country fisheries are unimportant. Moreover, a sector such as industry may be unimportant now but judged crucial for your country's future. The discussions below of agriculture and water illustrate the process and the types of issues, data, and indicators that are useful in constructing socioeconomic scenarios. The process of thinking through each scenario and inferring the key implications for vulnerability at the sectoral level is far more important than focusing exclusively on specific indicators. In this process, stakeholder input will be invaluable. With insights gained from stakeholders, you can determine how to adapt and refine the process as appropriate to the available data and circumstances of the country or region.

Table 1 (next page) lists five sectors that are sensitive to climate variability and longer-term climate change, demonstrating some of the key issues and indicators that other researchers have found to be important. The indicators presented here are only suggestive, and each practitioner must decide which indicators and factors (including those not listed) are appropriate for a given country. These data may be available from case studies (e.g., Kasperson et al. 1995, Riebsame et al. 1991, and Smith et al. 1996) and from literature and databases at the country, state, and local levels from a variety of sources.

Table 1: *Sector-Level Factors for Use in Socioeconomic Scenarios*

Category	Proxy variables	Proxy for:	Functional relationship
Sensitivity of settlements and infrastructure	Population or property at flood risk from sea level rise Population without access to clean water and/or sanitation	Potential extent of disruption from sea level rise Access of population to basic services to buffer against climate variability and longer term climate change	Sensitivity ↑ as population at risk ↑ Sensitivity ↑ as population without access ↑
Food sensitivity	Cereals production per hectare Consumption of animal protein per capita	Degree of modernization in the agriculture sector; access of farmers to inputs to buffer against climate variability and longer term climate change Population with access to markets and other mechanisms (e.g., consumption shift) to compensate for shortfalls in production	Sensitivity ↓ as production ↑ Sensitivity ↓ as consumption ↑
Sensitivity of ecosystems	Proportion of land that is managed (versus wild lands) Fertilizer use	Degree of human intrusion into the natural landscape; land fragmentation Nitrogen/phosphorus loading of ecosystems; stresses from pollution	Sensitivity ↑ as % land managed ↑ 60-100 kg/ha is optimal. X<60 kg/ha, sensitivity ↑ due to nutrient deficits and potential cultivation of adjacent ecosystems. X100 kg/ha (capped at 500 kg/ha), sensitivity ↑ due to increasing runoff
Sensitivity of human health	Completed fertility Life expectancy	Composite of conditions that affect human health, including nutrition, exposure to disease risks, and access to health services	Sensitivity ↓ as fertility ↓ Sensitivity ↓ as life expectancy ↑
Sensitivity of water resources	Renewable supply and inflow Water use	Supply of water from internal renewable resources and inflow from rivers Withdrawals to meet current or projected needs	Sensitivity calculated using ratio of water used to total water available; sensitivity ↑ as % water used ↑

Source: Moss et al. 2001.

Of course, it is impossible to include all *relevant* data from all sectors — or even all relevant proxies. The choice of proxy variables must reflect their importance to the future of the region. Ultimately, there is a tradeoff between the number and complexity of variables used and the difficulty and complexity of conducting the analysis.

Example 1: Agriculture/food security sector

Agriculture and food security are inherently linked to socioeconomic changes. As populations grow, the quantity of food and fiber required to meet society's needs necessarily grows. In addition, as communities develop, increase their income and wealth, and improve their technologies, their capacity to shift labor from agriculture to other sectors increases, along with changes in consumption patterns, including preferences for types of food. These changes lead to specialization, trade, and diversification of developing economies.

Socioeconomic conditions can greatly affect and determine the vulnerability and adaptive capacity of human settlements to climate change. This explains how vulnerability can be vastly different between regions with otherwise comparable agricultural systems and which experience similar climates. Economic development and wealth, for example, can enhance adaptive capacity by enabling greater resilience and a more robust recovery after an adverse event, increasing capability to insure against potential losses, and creating a safety net via food imports. In addition, reform and development of social institutions and relationships also contributes to adaptive capacity by creating social bonds and obligations between families, communities, and countries. These relationships foster aid and reciprocal sharing when adverse events arise.

As socioeconomic conditions change, the methods for maintaining and enhancing a society's food security typically change. The balance of domestic food production and food imports may shift. Countries may choose to specialize in certain crops and develop non-farm industries to improve export earnings, while others may seek self-reliance and crop diversity.

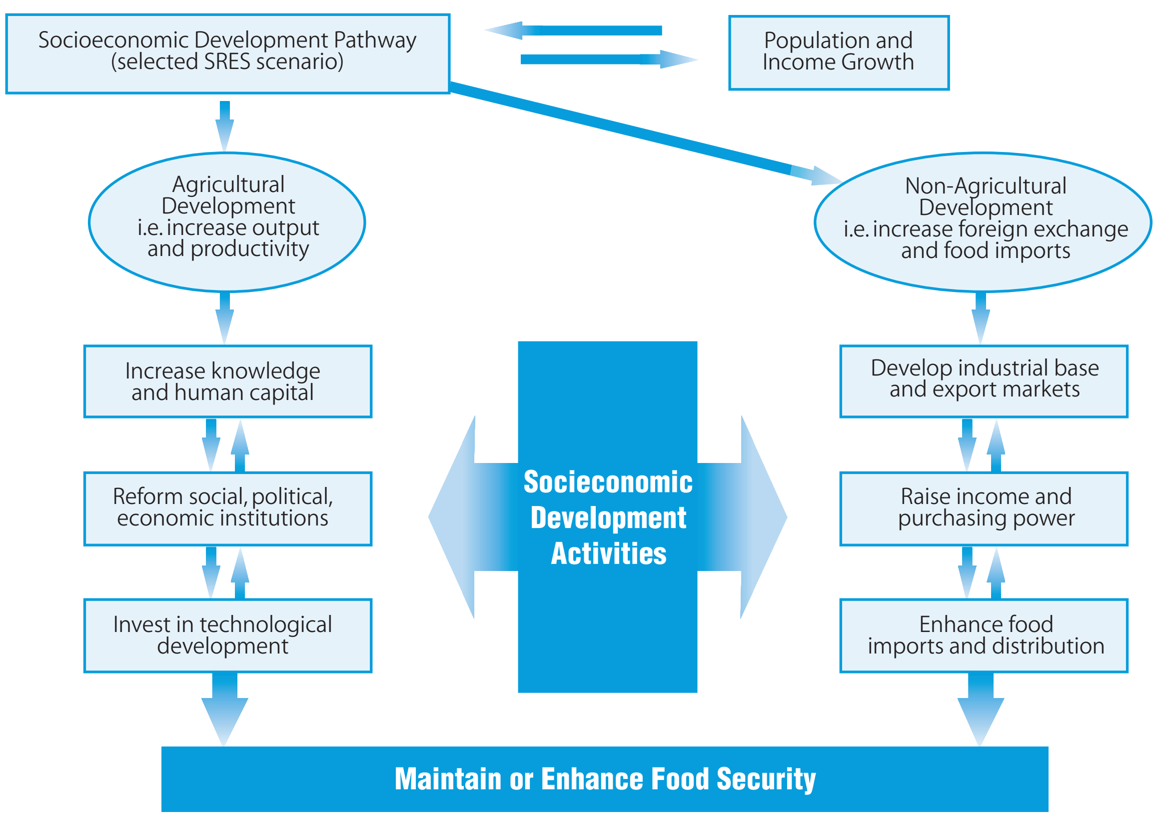
Such changes may either increase or decrease vulnerability and adaptive capacity. For example, population and income growth can and have put significant pressure on agricultural systems to continually expand production and yields. In response, agricultural technology has created hybrids that under carefully controlled conditions are highly efficient at converting sunlight, nutrients, and water into edible product. In an ideal world (one without variability), these crops could result in tremendous increases in agricultural productivity to feed a growing population. However, many of these hybrids have not been selected for reduced sensitivity to climate variability, and thus they may not be very tolerant of increased frequency and magnitude of extreme events. If your country encourages monocropping, food production could be at greater risk than if a variety of crops is grown, though the potential for trade may be larger.

The framework depicted in Figure 2 shows the relationship between socioeconomic scenarios, development pathways, and food security. The framework highlights the existence of multiple strategies — agricultural and nonagricultural — for achieving food security. It also illustrates the potential for important socioeconomic activities to be common to both pathways. For example, increasing knowledge and human capital is likely to be necessary for either pathway. Also, increasing nonagricultural development will provide some of the necessary financial resources for improving agricultural development. The reality is that both pathways are critically linked and, depending on particular scenario characteristics (i.e., consistency with the selected storyline), one pathway may receive more emphasis than the other in achieving food security.

Questions relevant to the development of a storyline for the food and agriculture sector include:

- What development and investment choices will your country make in order to meet its projected food security needs?
- What mix of agricultural production and food imports is desired, and how does this mix enhance or detract from adaptation capacity, vulnerability, and food security of the country?
- Will development emphasize globalization and increased reliance on imported food? If so, what type of industrialization is desired and are the resources available to undertake that pathway?

Figure 2: *Socioeconomic Scenarios and Food Security*



- What measures can be taken to increase crop yields and agricultural output? Can acceptable technologies be identified and applied?
- Will more free trade and reduced subsidies make the agricultural system more or less vulnerable to climate?

First, two possible scenarios of the future will be outlined, then applied via proxy values to the food security sector. Here, using as examples the storylines (Nakicenovic et al. 2000) and data available for a developing country in sub-Saharan Africa (referred to as D1), we develop some quantitative and qualitative approaches to developing aspects of a socioeconomic scenario relevant to characterizing the vulnerability of food and agricultural systems.

Scenario 1:[1] Economic growth and regional identity and self-sufficiency are emphasized. Population growth is rapid, while technology and economic development are somewhat fragmented and, overall, grow more slowly than population. For a country with a relatively large and nationally important agricultural sector, emphasis under this scenario might be given to efforts to further increase agricultural output, and continued reliance on agricultural labor and extensive production methods (i.e., using more land and labor rather than nonlabor inputs, such as irrigation and chemicals).

Scenario 2:[2] The country chooses a globally centered pathway with lower population growth and higher economic growth. This pathway would likely emphasize greater nonagricultural development, enhancing the capability for economic trade and greater food imports, while de-emphasizing self-sufficiency. Slower population growth rates might encourage intensification of agricultural systems using some of the income growth to finance investments in agricultural technology and human capital, which will free more of the population to move into nonagricultural jobs and lifestyles.

Agricultural Indicators

Agriculture provides two principal benefits to a country: food and trade income. Countries with insufficient production require imports and food aid to meet the food demands of their populations. However, if robust trade (including food exports and/or imports) entails well-functioning markets, both domestic and international, the diversity of economic activity may imply low vulnerability and high adaptive capacity.

Given socioeconomic scenarios such as those briefly described above, what types of changes might be anticipated in the food and agricultural sector? How might food security be affected? Can we identify a relatively small and focused set of indicators to provide insight on these questions, and which satisfy the criteria given in the Box 3 (General Criteria for Developing Indicators)?

> **Box 3 General Criteria for Developing Indicators**
>
> The following criteria provide useful guidelines for selecting and developing indicators:
>
> - Appropriateness and relevance: The indicator should describe a meaningful characteristic of the sensitivity, vulnerability, or adaptive capacity of the system.
> - Transparency: The formula and data for calculating the indicator should not be unduly complex or difficult to interpret.
> - Feasibility: Indicators are based on data. These data must be available to the practitioner or else suitable substitutes need to be identified.
> - Relationship to national scenario: For the purposes of this guidance, either the underlying data or the indicator itself should be linked to key variables or attributes of an overall socioeconomic scenario. This criterion enables the indicator and sector storyline to be consistent with the overall scenario assumptions.

Based on those criteria, study goals, a brief survey of data availability, and the data and storylines from Nakicenovic et al. (2000), a short list of indicators for the food and agricultural sector is presented in Table 2 (next page). These indicators may not be the most appropriate for each and every case, but they are quite general and may be sufficient in most cases.

Food Security. A country's food demand is driven fundamentally by its population size and, to a lesser degree, its income and wealth. People require a basic level of food consumption (i.e., subsistence), which is met through direct production from agriculture and/or from market purchases using available income and wealth. Primary food requirements (expressed in terms of kilocalories) are, for many countries, satisfied to a large extent by consuming cereal grains. Once subsistence levels are reached, income and wealth contribute not only to increasing consumption but also to satisfying demands for a more diverse diet.

To examine food security, the analyst can construct an indicator of basic food demand that, for example, measures the total amount of cereal needed to satisfy a country's basic nutritional needs. Using population estimates from selected

[1] The elements of this scenario are based on the A2 family of scenarios found in Nakicenovic et al. (2000).
[2] The elements of this scenario are based on the B1 family of scenarios found in Nakicenovic et al. (2000).

Table 2: *Basic Food Demand for D1 under Two Scenarios*

	2010	2020	2030	2040	2050
Population change (%), Scenario 1	+58	+94	+133	+172	+212
Population change (%), Scenario 2	+51	+81	+104	+124	+141
GDP change (%), Scenario 1	+126	+226	+421	+673	+989
GDP change (%), Scenario 2	+147	+289	+657	+1,147	+1,773
Cereal need (000s metric tons), Scenario 1	2,348	2,883	3,462	4,042	4,636
Cereal need (000s metric tons), Scenario 2	2,244	2,690	3,031	3,329	3,581
Cereal imports (%), Scenario 1	43	43	42	41	40
Cereal imports (%), Scenario 2	43	43	43	43	41
Domestic production (000s metric tons), Scenario 1	1,338	1,643	2,008	2,385	2,782
Domestic production (000s metric tons), Scenario 2	1,279	1,533	1,728	1,931	2,113
Crop yield (kg/ha), Scenario 1	1,136	1,395	1,705	2,025	2,362
Crop yield (kg/ha), Scenario 2	1,086	1,301	1,467	1,639	1,794
Increase in crop yields relative to 1995 (%), Scenario 1	+58	+94	+137	+182	+229
Increase in crop yields relative to 1995 (%), Scenario 2	+51	+81	+104	+128	+150

socioeconomic scenarios, an estimate of total food demand can be developed. This measure assumes at least minimally sufficient levels of caloric intake are achieved and that total food needs rise linearly with population.

Based on available country-level data from WRI (2000) and the population estimates given for Scenario 1, Table 2 shows a side-by-side comparison of food needs for D1's growing population and the share of that need to be met by in-country production. Details of the calculations and assumptions are given in Annex 1, Tables A-1 and A-2, with the associated text box. The assessment begins by using the estimates of population and income change for each socioeconomic scenario. Given current production and import levels, an estimate of total food demand is calculated and is assumed to grow at the same rate as population. (Note that, as GDP increases, some further increase in food demand might be expected; however, the income effect is not likely to be linear and would level off at some point.)

As shown, Scenario 1 (shaded rows) for D1 shows population more than tripling by 2050. Assuming that food need grows proportionately, demand rises to over 4.6 million metric tons of cereal by 2050, of which almost 2.8 million metric tons (59 percent) must be imported. If crop yields rise as forecasted, domestic production should be able to keep pace with cereal demand.

An aspect of Scenario 1 is increasing self-reliance along with economic growth. This scenario, therefore, suggests that countries may strive for more domestically-centered development and less emphasis on global and regional trade. Under this scenario, D1 may plan to reduce the share of food consumption in imports. In this case, in order for imports to fall, domestic agricultural production must rise by *more* than the increase in population. Reducing the share in imports will require rapid annual increases in crop yields over an extended period. Each analysis team must assess carefully the extent of this capacity in its own country.

The parallel assessment for Scenario 2 (non-shaded rows), in which population grows more slowly, material intensity diminishes, and trade and global cooperation are emphasized. In this case, slower population growth results in a more modest increase in total food demand than in Scenario 1. There is also less need to limit food imports as a share of total demand. As a result, this scenario involves less pressure on the agricultural sector for rapid and intensive development of production capacity, and allows a greater share of resources to flow into nonagricultural development, thus furthering overall growth in national income. Under this scenario, crop yields may increase more slowly than in Scenario 1.

Example 2: Water resources

Fundamental to many important socioeconomic and ecological systems, water is a vital resource. For many countries, it is considered a security issue every bit as important as food. Water shares many characteristics with other commodities. For example, water can often be stored in order to equalize periods of natural abundance with periods of natural shortfalls; in some cases, it can be traded with other users; and where demand is high enough, it can even be "manufactured"—in the sense that desalination technologies can produce high quality water from low-grade sources such as seawater. However, water is in many ways unique and difficult to replace. Quality drinking water, for example, is absolutely necessary and there are no substitutes. Fields cannot be irrigated with anything other than freshwater.

Via the hydrologic cycle, water is integrally linked to climate and landscape. Furthermore, quality and availability are affected by upstream users and natural conditions. Laws, regulations, treaties, and institutions can exert some influence over water conditions, but influences resulting from upstream socioeconomic conditions frequently dominate. For example, under drought conditions, downstream users often suffer losses in both water quality and availability, regardless of their own conservation efforts. In some cases, the enforceability of certain regulations and agreements may be questioned. In this section, we identify some of the key indicators relating to water resources, describe how socioeconomic trends and scenarios may alter water resource conditions — both positively and negatively — and, where appropriate, identify linkages of these indicators to scenarios of economic development and adaptive capacity.

Throughout much of the world, agriculture, or rather irrigation, is the principal use of water. However, countries differ markedly in their water use (see Table 3). Globally, irrigation accounts for almost 71 percent of water consumption, followed by industry at 20 percent, and domestic use at 9 percent (WRI 2000). In many countries, therefore, agriculture is critically linked to water resources and their use and development. In these countries, it will be important to recognize these linkages and develop consistent scenarios of socioeconomic change and development. For example, some water-scarce countries may choose to focus economic development in industrial and commercial directions, diverting water from agriculture and, perhaps from a self-reliant food security system. In such a case, a consistent storyline would be that decreased availability of water for irrigation and agricultural production implies a rise in food imports. It may be interesting to note that by shifting food reliance toward trade and exchange, the effect is also toward indirectly increasing imports of water in the form of food. This development path presumably rewards both importers and exporters, allowing water-intensive food production to shift from relatively water-scarce regions to those that are relatively water-rich.

Based on available country-level data from WRI (2000) and estimates of population and income given for Scenarios 1 and 2, Table 4 presents a side-by-side assessment of key water-sector indicators for D1. (See Annex 1, Tables A-3 and A-4 with the associated text box for a complete description of data sources and construction.) A key indicator is the level of development, which is the ratio of current water withdrawals to mean annual internal renewable water resources.

Table 3: *Examples of Country Differences in Water Use*

	Agriculture (%)	Domestic (%)	Industry (%)
Finland	1	17	82
United Kingdom	2	65	8
Estonia	5	56	39
Lithuania	3	81	16
Kuwait	60	37	2
Switzerland	0	42	58
Senegal	92	5	3
Pakistan	97	2	2
Afghanistan	99	1	0
Sudan	94	5	1
Guyana	98	1	0

Source: WRI 2000.

An initial estimate for 1990 is given in WRI (2000) as the percentage of water resources withdrawn annually. This indicator can show where water scarcity and competing demands are greatest. Countries where development is high relative to endogenous water availability are potentially vulnerable to both natural climate variability and longer-term climate change, and to the actions of upstream countries that may affect the levels and distribution of stream flow and/or water quality. Should climate change result in stream flow reductions (perhaps just seasonal changes, for example, during the summer growing season), curtailment of both off-stream and in-stream water uses is more likely in a watershed with a high level of development than in one with a low level of development.

On the other hand, as shown in Table 4 (next page), D1, a country with a relatively low level of development, has a significant potential to increase development and thus raise the overall level of water use (depending on downstream commitments). Here, based on the movement toward self-reliance indicated by Scenario 1 (shaded rows), and the subsequent need for both increased agricultural production and economic development, the D1 government might project a target of 40 percent for the level of development by 2100. The capacity to develop water resources is strongly tied to income growth. As a result, the level of development for the intervening decades is interpolated between 6 percent and 40 percent, reaching a rate of 15 percent by 2050.

Annual average withdrawals will depend on the level of development. As development proceeds, demand for water and capacity to withdraw water both increase. Therefore, the table indicates that withdrawals rise from their initial level of 1.5 km^3 in 2000 (see Annex 1, Table A-3) to a level of 4.0 km^3 per year in 2050. During this period, withdrawals on a

Table 4: *Water Resource Situation for D1 under Two Scenarios*

	2010	2020	2030	2040	2050
Population change (%), Scenario 1	+58	+94	+133	+172	+212
Population change (%), Scenario 2	+51	+81	+104	+124	+141
GDP change (%), Scenario 1	+126	+226	+421	+673	+989
GDP change (%), Scenario 2	+147	+289	+657	+1,147	+1,773
Level of development of domestic water resources (%), Scenario 1	7	8	10	12	15
Level of development of domestic water resources (%), Scenario 2	6	6	7	8	9
Annual withdrawals (km^3), Scenario 1	1.8	2.1	2.6	3.2	4.0
Annual withdrawals (km^3), Scenario 2	1.6	1.6	1.8	2.1	2.4
Per capita annual withdrawals (m^3), Scenario 1	120.2	115.3	136.7	125.3	159.9
Per capita annual withdrawals (m^3), Scenario 2	111.8	134.6	93.1	99.8	199.0
Agricultural water use (% of total water use), Scenario 1	91.76	91.46	90.88	90.13	89.19
Agriculture water use (% of total water use), Scenario 2	91.72	91.32	90.30	88.94	87.20
Industrial water use (% of total water use), Scenario 1	3.14	3.31	3.65	4.09	4.64
Industrial water use (% of total water use), Scenario 2	3.25	3.60	4.50	5.70	7.24
Household water use (% of total water use), Scenario 1	5.10	5.22	5.46	5.77	6.16
Household water use (% of total water use), Scenario 2	5.03	5.08	5.20	5.36	5.57

per capita basis at first fall and then rise, reflecting a lag between the growth in population and the level of development (which is tied to income).

Estimates of water use in various sectors should be examined to ensure that they are consistent with the relevant storylines. The implications for water use in sectors such as agriculture and industry should be in agreement with the appropriate storyline, as should the implications for water use by households (which varies with population growth). Again, the judgment of the analyst, with meaningful input from stakeholders, is needed to estimate a target share of water use for each sector in the future, consistent with the relevant storyline. In this case, we assume that the increasing level of development will permit absolute increases in water use in all three sectors, and that with increasing efficiency of water use in agriculture, a greater share of total water use is available to support the needs of the growing population and industrial base.

For Scenario 2 (non-shaded rows), the environmental goals of the B1 scenario, coupled with the slower rate of population growth and focus on global cooperation, serve to limit the level of development that is desired (necessary) to meet the country's water requirements. More modest increases in agricultural production leave more water available for industrial development and more in-stream uses; therefore, the share of water use accounted for by the various sectors may shift. Economic growth enables increases in the efficiency of water use across all sectors, and thus domestic water use, for example, need not increase as rapidly as overall population growth.[3]

Finally, when considering water resources and estimating conditions and vulnerabilities for future populations, you and your stakeholder group can include several indicators in the discussion. Additional insights can be gained by considering the:

- Vulnerability of human settlements to flood risk
- Impacts of development and population growth on water quality
- Vulnerability of aquatic and aquatic dependent ecosystems.

Flood Risk. Significant flood events can cause severe damage and dislocation. Human settlements must frequently weigh the tradeoffs between proximity to and accessibility of water resources, and the flood risks associated with that proximity and accessibility. Increasing economic development in flood-prone areas raises the vulnerability of both

[3] Downing (1992) estimates that D1 would have the resource capacity to feed itself in 2050 if climate change, in the form of drought intensity, did not occur. However, climate change is expected to reduce the productive capacity of rain-fed agricultural production below the level needed to provide for the food needs of the entire rural population.

people and property. In socioeconomic scenarios for flood-prone areas, population trends and growth rates are important for determining vulnerability. To develop a useful indicator of flood risk, the vulnerable area must first be identified. For many regions where settlements are at risk, a floodplain has been defined, typically describing some frequency of flood events, such as a 100-year or 500-year floodplain.[4] Consistent with the population estimates used by Nakicenovic et al. (2000), the flood risk may rise more steeply under Scenario 1 with its higher population growth estimates. However, flood risk could also rise under Scenario 2, depending on where economic development is likely to be located. If development occurs largely within floodplains, potential damages could be greater.

Water Quality. Dissolved oxygen (DO) is vitally important to the health and maintenance of aquatic ecosystems. Depressed levels of DO can indicate areas where pollution levels may be high, for example as a result of insufficient wastewater treatment. DO is naturally lower in warm water, which has less capacity to carry oxygen than cooler water. However, DO can also be depleted when materials that increase biochemical oxygen demand (BOD) are added to water resources, which occurs both naturally and as a result of human activities. As an indicator, DO is intended to highlight water quality; however, this measure is highly region- and river-specific, so depending on data availability, it may be necessary to find alternative or additional measures of water quality. If DO data for key river systems are available for the country of interest, it will be necessary to identify a quality standard. In the United States, the identified standard is 5 milligrams per liter, below which lack of oxygen can adversely affect aquatic ecosystems. Although this critical level may be periodically reached in some parts of the river system, what matters most is the frequency and persistence of violations. Given that the level of water resource development may be considerably lower under Scenario 1 than in Scenario 2, water quality is likely to be higher.

Ecosystems at Risk. Water resources are vital not only to human settlements but also to wildlife and ecosystems. Ecosystems require both sufficient quantity and quality to maintain their health and viability. Development of water resources for human uses often requires diversions of stream flows, which can be particularly stressful during low-flow seasons. Population growth and industrial development not only increase competition for water resources and further reduce stream flows, but also generate waste and pollution that must be assimilated into the riverine system. The combination of these stresses degrades habitat and leads to species loss and reduced biodiversity. An indicator such as the number of species at risk identifies watersheds containing aquatic and wetland plants and animals that may be critically vulnerable to changes in water quality and the hydrologic cycle. A count of the at-risk, water-dependent species within a watershed characterizes the degree of relative stress that a watershed may be currently experiencing from a variety of sources, including habitat loss and encroachment, pollution, predation, and disease. Similarly, a lower level of water resource development permits more water to remain available for use by ecosystems. Therefore, although the level of development may rise under both scenarios, the increase in ecosystem risk due to changes in water quality and availability could be much less under Scenario 2.

Connections between Water and Agriculture. Where water is used mainly for irrigation or where agriculture depends almost exclusively on uncertain rainfall, the links between water use and food security should be made explicitly. For example, in sub-Saharan Africa, food security depends upon an agricultural production system that is 90 percent rain-fed, and per capita production is close to per capita consumption. Therefore, drought is the key factor for agriculture and food security. Proxy variables should include the choice of production systems, ratio of rain-fed to irrigated agriculture, availability of alternative food sources, and so forth.

Adding Country-Level Storylines and Indicators to the Socioeconomic Scenario

This section discusses national-level storylines and indicators that will delineate two or more directions for the future. Storylines may be based on Nakicenovic et al. (2000), other studies, or your own analysis (with input from stakeholders). Annex 4 provides data you could use, including projections of land use, energy use, emissions of sulfur oxides, and nuclear energy. The primary concern is to keep your country's future development choices consistent with its current policy directions. Your storylines of the future will help you determine the elements that most influence that future and construct ways to represent—and, if possible, to quantify—those elements.

As an example, Korzeniewicz and Smith (1999) discuss three qualitative scenarios for Latin American countries, which they term the "low road," "middle road," and "high road" scenarios. In the low-road scenario, power remains concentrated in the state and high-status groups, high levels of inequality persist, and poverty is likely to rise. This scenario is "often accompanied by a lack of transparency, a deterioration of accountability, and widespread corruption among office-holders (features that become major obstacles to sustained economic growth)" (Korzeniewicz and Smith 1999:21). The middle-road scenario is characterized by market reforms and sustained economic growth in a stable democratic regime. Although significant power remains with historically dominant groups, there are also consistent decreases in un-

[4] Such floodplain definitions are based on an assumed "stationary" or unchanging distribution of flood events. Climate change, however, could affect the frequency and magnitude of flood events, which over the long run may result in redefinition of the vulnerable regions.

Table 5: *SRES Scenarios Downscaled to East Anglia*

World Markets (A1)	Provincial Enterprise (A2)	Global Sustainability (B1)	Local Stewardship (B2)
Responsibility for action at enterprise level under market forces. Fast-growing sectors: health care, leisure, financial. Declining sectors: manufacturing, agriculture. Annual country GDP growth: high (% see region; modify for country or location). Global carbon emissions: medium increase (cf. 1990 levels).	Responsibility for action at individual level. Fast-growing sectors: private health care, defense, maintenance services. Declining sectors: high-tech specialized services, finance. Annual GDP increases moderate. Global carbon emissions: high increase (cf. 1990 levels).	Responsibility for action at state level, dictated by international government. Fast-growing sectors: renewable energy, business services, clean technology. Declining sectors: fossil-fuel based and resource-intensive systems. High GDP growth. Global carbon emissions: low increase (cf. 1990 levels).	Responsibility for action at collective level, supportive governmental framework. Fast-growing sectors: small-scale manufacture and agriculture, local enterprises. Declining sectors: retailing, leisure, tourism. Low annual GDP increases. Global carbon emissions: medium low increase (cf. 1990 levels).
Weak international climate regime. Voluntary reduction of emissions. Emissions trading through markets.	Very weak climate regime. Increased emissions. No controls. Voluntary action.	Strong international climate regime. Stringent reduction of emissions. Regulatory approach.	Strong/weak climate regime. Uneven emission controls. Fragmented regulatory approach.

Source: Lorenzoni et al. 2000.

employment and poverty, increases in transparency and accountability, and efforts to combat corruption and clientelism. In the high-road scenario, a country exhibits strong economic growth, movement toward equality in income and wealth, and advances toward democracy and accountability.

Lorenzoni et al. (2000) provide an example of developing storylines for a sub-national area. They use the modified storylines (Nakicenovic et al. 2000) for assessing climate change impact in East Anglia, a region of the United Kingdom. In their assessment work, they emphasize the integration (co-evolution) of drivers of socioeconomic and climate change. Scenarios are depicted using an axis for governance representing globalization (1) versus localization (2), while the other axis represents consumerism (A) versus community/conservation (B). Table 5 lists the implications of the differences in scenarios.

Besides the variables adapted from sources of socioeconomic scenarios, additional data for scenarios to be used in vulnerability and adaptation analyses should be gathered from the literature (studies done about your particular country) and relevant databases (e.g., World Bank 1998) to describe the social, economic, and institutional contexts in which climate variability and longer-term climate change will take place in your country. The important factors for the country's social future must be represented in its socioeconomic scenarios.

You should add national demographic and wealth or income data to complement local or sectoral data and to highlight differences and differential vulnerability. For example, your population projections within any specific sector should make sense in the context of national-level population projections. (Declining population in the agricultural sector may be situated within a rising national population, for instance.) For the present and projections into the future, include elements that capture important dimensions of overall development and the variations as well as the averages, whether or not these can be quantified.

Features of the current governmental structure can be key to future conditions. Indicators that can be used include the continuity or stability of government, the extent of democracy, existing environmental policy and legislation, corporate responsibility, innovation and technological change, and the extent of investment and institutions. Very important for the purposes of scenarios is the country's current economic development plan; this may be either a formal plan or directions embodied in laws and regulations governing privatization, trade, subsidies and tariffs, and so forth.

Well-being should be represented beyond the incomplete measure of GDP per capita. It is possible to develop a specific and highly detailed set of indicators of national well-being. (See, for example, Douglas et al.1998 (particularly Box 3.1) for descriptions of human needs.) Or you can use the UNDP's Human Development Index (HDI) (World Bank 1998). The HDI is constructed from three indicators:

- life expectancy at birth,
- literacy rates, and
- purchasing-power-adjusted GDP per capita (in logarithmic form).

The first two indicators capture the supporting infrastructure for an individual's life. Life expectancy is a good indicator of public health, encompassing the availability of clean water, sanitation, and health care, as well as nutritional status. Literacy indicates the spread of education and access to information. The third indicator, purchasing power, indicates the individual's ability to acquire goods and services.

An overall HDI is calculated from the average of the three indicators, which is then subtracted from 1. The resulting statistic places the area under consideration (whether a country or a subnational area) along a continuum of human deprivation (0 to 1).

Table 6 demonstrates an approach midway between an elaborate set of country-specific indicators, and the three indicators incorporated in the HDI. This approach is multidimensional, with indicators for economic capacity, human and civic resources, and environmental capacity. Within each category, a selection of proxy variables has been made, the relationship between the proxy and the category has been specified, and the functional relationship has been defined.

Deriving Country Data from Regional and Global Analyses

One method for constructing country-level scenarios with only a few indicators is to "downscale" from highly aggregated studies. This section provides guidance for downscaling from the global and/or regional levels. Downscaling has two principal advantages:

- The results will help account for global factors that have been analyzed and, in the case of the SRES scenarios (Nakicenovic et al. 2000), approved by the IPCC. The rationale for using the SRES scenarios is that a large number of climate scenarios are being generated from them at the global and regional scales; using these climate and emissions scenarios together will ensure that your national communications and other analyses are consistent with other analyses being developed (Hulme et al. 1995).
- Downscaling may help you establish general directions for and limits to scenarios so that you can develop internally consistent storylines at global, regional, national, and local levels. Note that this does not mean mere repetition at smaller scales; a country may be following a different development path than others in its region, but it still must take general trends into account.

Using existing scenarios

Socioeconomic scenarios that can be used in climate change analyses exist at global and regional (multinational) levels; these can be adapted for use in more localized vulnerability analyses. Tol et al. (1996) give information and references for five socioeconomic scenarios generated by the World Bank, IPCC, and integrated assessment modeling groups. Many projections of climate change make use of the IPCC's IS92 scenarios (Pepper et al. 1992). Each of these may be used in downscaling exercises.

This section focuses on the new SRES scenarios (Nakicenovic et al. 2000). The authors of the SRES define and elaborate the socioeconomic scenarios now used by the IPCC to project various emissions pathways. Downscaling from the SRES is a straightforward process explained in the next few pages. It may be advantageous to use at least one of the SRES scenarios so that you have a comparative basis for scenarios that you develop with national and sector-specific data. However, downscaling from a more highly aggregated level is likely to be less accurate than using country-level data and projected rates of change. Taking both approaches facilitates comparisons and explanations of the differences.

***Table 6:** Country-Level Factors for Use in Socioeconomic Scenarios*

Category	Proxy variables	Proxy for:	Functional relationship
Economic capacity	GDP(market)/capita Gini index	Distribution of access to markets, technology, and other resources useful for adaptation	Adaptive capacity ↑ as GDP/capita ↑ at present Gini held constant
Human and civic resources	Dependency ratio Literacy	Social and economic resources available for adaptation after meeting other present needs Human capital and adaptability of labor force	Adaptive capacity ↓ as dependency ↑ Adaptive capacity ↑ as literacy ↑
Environmental capacity	Population density SO_2/area % land unmanaged	Population pressure and stresses on ecosystems Air quality and other stresses on ecosystems Landscape fragmentation and ease of ecosystem migration	Adaptive capacity ↓ as density ↑ Adaptive capacity ↓ as SO_2 ↑ Adaptive capacity [of the environment] ↑ as % unmanaged land ↑

Source: Moss et al. 2001.

The SRES features four alternative storylines developed by Nakicenovic et al. (2000):

- The A1 storyline and family of scenarios describe a future world of very rapid economic growth, global population that peaks mid-century and declines thereafter, and rapid introduction of new and more efficient technologies. Major underlying themes are economic and cultural convergence and capacity building, with a substantial reduction in regional differences in per capita income. The A1 family contains three groups of scenarios that describe alternative directions of technological change in the energy system: fossil intensive (A1F1), non-fossil energy sources (A1T), and a balance across all sources.
- The A2 storyline and family of scenarios describe a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines.
- The B1 storyline and family of scenarios describe a convergent world with a global population that peaks in mid-century and declines thereafter (as in the A1 storyline), but with rapid changes in economic structures toward a service and information economy, reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to support economic, social, and environmental sustainability, including improved equity, but without additional climate change initiatives.
- The B2 storyline and family of scenarios describe a world in which the emphasis is on local solutions for economic, social, and environmental sustainability. It is a world with continuously increasing global population at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the storyline is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

Note, however, that the SRES scenarios were developed for the specific purpose of projecting future emissions of greenhouse gases. This means that they are not ready-made for developing socioeconomic scenarios for vulnerability and adaptation analyses. They are a good starting point for considering such important factors as population growth and composition, economic conditions, and technological change. They do not explicitly represent other social institutions, such as farming, labor organizations, or the ways in which a country's government provides for the welfare of its citizens.

Adapting storylines and projections from SRES scenarios

This section will help you choose the appropriate storylines, data, and projections for your socioeconomic scenarios. A country or a region, such as an urban area or watershed, exhibits its own variety of linked environmental and social conditions; the challenge is to represent these in the context of a global socioeconomic scenario. A region may have fragile ecosystems, major pollution problems (particularly air and water), and a growing population and economy. International differences may further complicate the situation. Future developments in society hinge on the types of choices that are made, so that many paths to the future are possible.

Using the SRES data and projections, you can review, at a minimum, data on population and GDP projections. Annex 3 provides population data, disaggregated by region and storyline. (Annex 5 provides additional demographic information; historical data are available in UNDP 1999 and World Bank 1998.) For example, for a country in the ALM region (Africa and Latin America – see Annex 2 for a list of countries in the SRES regions), data drawn from the Annex tables are illustrated in Tables 7 and 8. Table 7 gives a wide range of possible population growth trajectories. For 2050, estimates of population growth range from 40 percent to more than 100 percent. Note that these pathways to the future are not simply linear extrapolations of current population trends; in the A1 and B1 scenarios, for example, population grows and then declines.

Table 7: *Percentage Increases in Population in SRES Africa and Latin America Region*

	2000	2010	2020	2030	2040	2050
A1 Scenario	24%	51%	81%	104%	124%	141%
A2 Scenario	26%	58%	94%	133%	172%	212%
B1 Scenario	24%	51%	81%	104%	124%	141%
B2 Scenario	25%	55%	88%	120%	151%	180%

Notes: Based on a reference year of 1990. Calculated by MiniCAM, an integrated assessment model and one of six models used in SRES calculations. See Nakicenovic et al. 2000.

Table 8: *Percentage Increases in GNP/GDP (mex) in SRES Africa and Latin America Region*

	2000	2010	2020	2030	2040	2050
A1 Scenario	47%	147%	289%	710%	1,331%	2,142%
A2 Scenario	47%	126%	226%	421%	673%	989%
B1 Scenario	47%	147%	289%	657%	1,147%	1,773%
B2 Scenario	47%	136%	257%	521%	868%	1,310%

Notes: Based on a reference year of 1990. Projections calculated using MiniCAM model.

All of these are *possible* paths; your task is to choose two or more *likely* paths, given your current understanding. Since, of course, yours is only one country among many in the region, you will use country-specific projections if you have them. Comparisons among different data sources will provide a sound basis for thinking through the factors that may affect population growth and determining two or more alternative pathways at the country level, based upon the storylines you have developed.

For GDP projections, you could use the SRES data or adjust them based on your country-specific storylines. In using your own region- or country-specific projections, you can identify which SRES storylines most closely match the assumptions behind your projections. This will make it easier to associate (or differentiate) the national and/or regional storyline with sectoral storylines. The SRES projections for Region ALM are given in Table 8 and Annex 3; they are calculated from the website http://sres.ciesin.org/OpenProcess/.

For example, examining the storylines and the projections, you might decide that the two most likely storylines to elaborate for your country are A2 (the basis for Scenario 1, discussed earlier) and B1 (basis for Scenario 2, discussed earlier). The differences in these storylines imply that your country would alternatively:

- Work to feed its own people, emphasize regional trade and political alliances, and try to preserve its national character and culture (A2 "self reliance" scenario)

- Emphasize production of goods for the international market, increased efficiency and prosperity through global trade, and rapid completion of technological transformations (B1 "global solutions" scenario)

The population and GDP projections in these two scenarios are significantly different. In the self-reliance scenario (A2), the ALM regional projections of population rise rapidly over an extended period. In the global solutions scenario (B1), population rises much more slowly (and, as Annex 3 shows, declines thereafter for a net 123 percent increase by 2100).

The GDP projections also differ, though both scenarios feature rising wealth. The self-reliance scenario exhibits slower growth than the global solutions scenario but projects a more than 40-fold increase by 2100, compared to the over 60-fold increase by 2100 in the global solutions scenario.[1]

Example: Two country-level scenarios and projections

In this section, we present and discuss results of two country-level scenarios (one Asian country and one African country) constructed using SRES storylines and proxies listed in Table 6.

For the proxies listed in Table 6, data are available from various sources. The data in Table 9 (next page, graphed in Figures 3 and 4, p23) are drawn from Nakicenovic et al. (2000) and from the MiniCAM model's postprocessor, Sustain (Pitcher 1997). The Sustain postprocessor provides information at a more disaggregated regional level (i.e., Africa instead of Africa/Latin America) than the data tables presented in the Annex. It also provides projections on changing demographics. Here, the sample countries are a developing country in Asia (D2) and the previously mentioned country in Africa (D1), which have very different initial conditions. In 1990 D2 was much more densely populated, with a lower per capita income, lower income inequity, a larger number of people dependent on those people in the work force between ages 15 and 65, and a considerably higher level of industrial pollution in the form of sulfur dioxide compared to D1.

The Annex lists changes in those variables that are the foundation of the SRES scenarios. Changes are expressed as percentage changes relative to 1990 baseline information. After collecting relevant information for a country (e.g., from FAO 1999, World Bank 1998, WRI 1994, expert opinion, country studies, and other sources), we developed projections by applying the change factors directly through the equation listed in Box 4.

By 2020, the A2 and B1 scenarios project quite different levels of income in these countries. However, the differences in per capita income are more scenario-dependent than country-dependent. Another way these scenarios differ markedly

Box 4: Developing Country-Specific Projections

To use the data in the appendices to develop country-specific projections, collect the appropriate baseline data for your country, the global region in which it is located, and/or for a smaller-scale entity. Substitute those baseline data and the appropriate D from the table or appendices in the following equation:

baseline data*(1+D/100) where D stands for the percentage change from the 1990 regional data

This will calculate country-specific projections as shown in Figures 3 and 4.

Table 9: *Projections of National Data for D1 and D2*

	Per Capita Income (constant US$ for 1987)	Working Age Population (as fraction of total population) (15<working age<65)	Population Density (popn per km^2)	Literacy (%)	Gini Coefficient (equity)	Unmanaged Land (%)	SO_2 Emissions (kg/km^2)
D1							
1990	**680**	**0.94**	**38**	**38**	**54.10**	**58**	**30**
A2 Scenario							
2000	717	0.89	49	39		57	30
2020	1,115	0.83	78	45		53	33
2050	3,428	0.52	125	54		47	57
B1 Scenario							
2000	723	0.87	48	39		57	25
2020	1,349	0.77	75	47		53	22
2050	8,770	0.40	104	58		50	17
D2							
1990	**350**	**0.85**	**146**	**35**	**31.15**	**66**	**198**
A2 Scenario							
2000	529	0.73	173	40		65	201
2020	1,118	0.63	235	47		59	221
2050	2,512	0.52	320	51		51	379
B1 Scenario							
2000	535	0.71	170	40		65	169
2020	1,611	0.55	222	49		61	146
2050	6,752	0.37	258	55		60	112

is in the expected level of technological and industrial development (represented by the proxy of SO_2 emissions). In the global convergence scenario (B1), sulfur emissions decline, while they increase in the self-reliance scenario (A2). Literacy rates are expected to increase to more than 50 percent by 2050 in both countries, while population is expected to increase steadily, especially in scenario B1 in country D1.

Gini coefficients are a measure of equality with regard to income and expenditure (Deininger and Squire 1996, 1998; www.worldbank.org/research/growth/dddeisqu.htm). Globally, Gini coefficients average 35.6; for all Asian countries, the average value is 35.7, for African countries, it is 44.3. For D2, the reported Gini coefficient is 31.15, and for D1, it is 54.10. In the B1 scenario, these equity coefficients may be expected to move faster to the world average, compared to the A2 scenario. For D2, this move would be to somewhat higher levels of inequality, while for D1 the move would be to greater equality.

None of these individual projections can fully represent capacity to adapt to climate variability or longer-term climate change. That projection requires an integration of, at a minimum, the elements listed and discussed above. Researchers involved in developing the SRES scenarios carefully considered the interactions and mutual dependencies of these pathways and accounted for these effects, at least in part, in their assessment modeling.

The discussions above should give you a picture of the methodology that you and your stakeholders can adapt to develop projections, again using the storylines you have selected to provide a basis for your determination of rates of change. For example, access to health care may increase more under the global solutions scenario than under the self-reliance scenario, since presumably your country would be able to obtain medical services and products on the global market more easily than by developing them in-country (although cost may continue to be a barrier). Conversely, a self-reliance scenario would indicate that your country would have more development of national programs to address climatic and other extreme events. Again, stakeholder input will help you determine the most likely outcomes and tradeoffs.

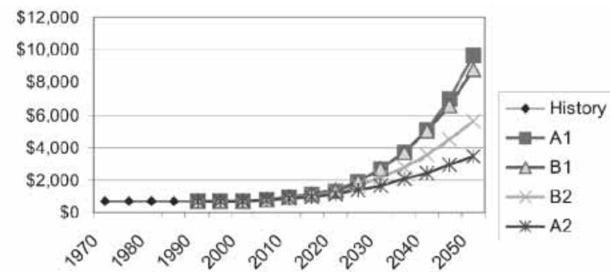


Figure 3: *D1's historic and projected income per capita*

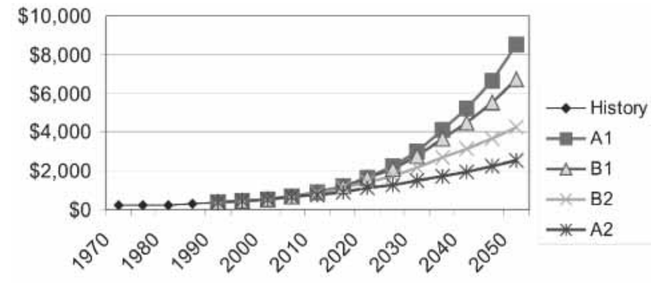


Figure 4: *D2's historic and projected income per capita*

Each choice you make of projected values should have an underlying rationale. Remember that a straight-line extrapolation will rarely be defensible. For example, literacy rates cannot improve indefinitely, and increasing calories over the amount to ensure adequate nutrition actually decreases well-being if this results in an unbalanced diet or widespread obesity. Also remember that the projections must be realistic; projected reductions in income inequality—difficult for any country to attain—must be based on a society's potential to achieve them. Finally, many proxies can reinforce each other—for instance, increased GDP may have implications for educational advancement and technological change—another reason to be very selective in choosing proxies.

The national characteristics will provide a context for the detailed picture you have drawn of a local or sectoral scenario. Next, you can check consistency within a global framework in an analogous procedure.

The global storylines will provide some of the limiting and enabling conditions for national, local, and sectoral scenarios, and they will provide links to the IPCC and other international processes and products.

[5] The percentages are large, but the base GDP on which the calculations are made is relatively small (e.g., a 40-fold increase in $100 of income would be $4,000). Moreover, in general, GDP increases are expressed on an annual basis; the increases in the Tables and Appendices are relative to the 1990 baseline data. You may want to recalculate, for example, the 10-year increases back to annual increases by dividing by the appropriate number of years and obtain an averaged annual rate of increase relative to the baseline value. The actual year-by-year rates are, of course, based on a compound function for which we do not have the exact information.

CONCLUSION

The sector-specific examples presented above show the impact of alternative assumptions about socioeconomic conditions in assessing a country's vulnerability and capacity to adapt to climate change. As stated at the beginning of this guidance, building socioeconomic scenarios is an exercise in creating alternative visions of the future—visions that can be informed and differentiated by critically assessing key features of the socioeconomic system and drawing out the implications. Population and income growth, economic development, social institutions, preferences about the environment and globalization—all can significantly influence the type of future that evolves.

This guidance serves as a beginning for analysts who, it is hoped, will take from these examples a structure and process for initiating their own analysis of the implications of different development paths for vulnerability to climate change. It will prove successful if analysts can build on and adapt these ideas to fit their specific country situations, and develop suitable storylines of their own that are internally and externally consistent with the broader set of scenarios developed to assess climate change vulnerability and adaptation.

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ANNEX 1: TABLES TO CALCULATE SECTORAL INDICATORS

Table A1-1: *Estimated Basic Food Demand for D1: SRES A2 Scenario*

D1	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Population (% change from 1990; from Table 1)	26	58	94	133	172	212	248	281	309	329	349
Estimated change in GDP (% change from 1990, from Table 2)	47	126	226	421	673	989	1,452	1,978	2,578	3,284	4,073
Estimated change in total food consumption from 1990	26	58	94	133	172	212	248	281	309	329	349
Estimated Total Cereal Needs (000's metric tons)	1,872	348	2,883	3462	4,042	4,636	5,171	5,662	6,078	6,375	6,672
Estimated import and food aid share (%) [(1)]	43	43	43	42	41	40	38	36	33	30	25
Estimated in-country production (000's metric tons)	1,067	1,338	1,643	2,008	2,385	2,782	3,206	3,624	4,072	4,463	5,004
Average Cereal Crop Yields (kg/ha) [(2)]	906	1,136	1,395	1,705	2,025	2,362	2,722	3,076	3,457	3,789	4,248
Estimated percentage increase in crop yields from 1995	26	58	94	137	182	229	279	328	381	427	491

Notes:

Average production of cereals, 1996-1998 (WRI 2000): D1: 847 (000 metric tons)

Net cereal imports and food aid as a percent of total cereal consumption, 1995-1997 (WRI 2000): D1: 43%

(1) Estimated import and food aid share is based on taking current share and using subjective judgment to estimate the target share for 2100 under the given SRES scenario. In this case, the A2 scenario suggests greater self-reliance. Therefore, a goal might be to reduce food imports from 43% to 10% by 2100. Capacity to reduce imports is a function of income; therefore, estimated shares in food imports are scaled by the percent change in projected income. For example, 2% of the overall increase in income occurs between 2000 and 2010; therefore, we estimate that 2% of the total 33% change in import share (i.e., -0.6%) occurs in this decade. Caution must be used here to ensure overall consistency: falling import shares must be matched by increasing in-country agricultural production, which implies an increase in the intensity of agricultural production and/or an increase in the cultivated land area.

(2) Cereal crop yields are estimated based on required in-country production and assume that planted area is constant. Cereal crop planted area is estimated from data in WRI (2000) in which total cereal production in 1996-98 is 847,000 metric tons, and average cereal crop yields are given as 719 kg/ha. Therefore, estimated planted area in D1 in 1996-98 is 1.18 million hectares. Production levels, however, are also subject to increases by increasing the land base.

Table A1-2: *Estimated Basic Food Demand for D1: SRES B1 Scenario*

D1	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Population (% change from 1990; from Table 1)	24	51	81	104	124	141	148	150	147	135	123
Estimated change in GNP/GDP (% change from 1990, from Table 2)	47	147	289	657	1,147	1,773	2,636	3,510	4,405	5,242	6,152
Estimated change in total food consumption from 1990	24	51	81	104	124	141	148	150	147	135	123
Estimated Total Cereal Needs (000's metric tons)	1,843	2,244	2,690	3,031	3,329	3,581	3,685	3,715	3,670	3,492	3,314
Estimated import and food aid share (%)(1)	43	43	43	43	42	41	40	39	38	37	35
Estimated in-country production (000's metric tons)	1,051	1,279	1,533	1,728	1,931	2,113	2,211	2,266	2,275	2,200	2,154
Average Cereal Crop Yields (kg/ha) (2)	892	1,086	1,301	1,467	1,639	1,794	1,877	1,924	1,931	1,868	1,829
Estimated percentage increase in crop yields from 1995	24	51	81	104	128	150	161	168	169	160	154

Notes:
Average production of cereals, 1996-1998 (WRI 2000): D1: 847 (000 metric tons)

Net cereal imports and food aid as a percent of total cereal consumption, 1995-1997 (WRI 2000): D1: 43%

(1) Estimated import and food aid share is based on taking current share and using subjective judgment to estimate the target share for 2100 under the given SRES scenario. In this case, the A2 scenario suggests greater self-reliance. Therefore, a goal might be to reduce food imports from 43% to 10% by 2100. Capacity to reduce imports is a function of income; therefore, estimated shares in food imports are scaled by the percent change in projected income. For example, 2% of the overall increase in income occurs between 2000 and 2010; therefore, we estimate that 2% of the total 33% change in import share (i.e., -0.6%) occurs in this decade. Caution must be used here to ensure overall consistency: falling import shares must be matched by increasing in-country agricultural production, which implies an increase in the intensity of agricultural production and/or an increase in the cultivated land area.

(2) Cereal crop yields are estimated based on required in-country production and assume that planted area is constant. Cereal crop planted area is estimated from data in WRI (2000) in which total cereal production in 1996-98 is 847,000 metric tons, and average cereal crop yields are given as 719 kg/ha. Therefore, estimated planted area in D1 in 1996-98 is 1.18 million hectares. Production levels, however, are also subject to increases by increasing the land base.

Steps for Developing the Socioeconomic Scenarios for Agriculture (Tables A1-1 and A1-2)

Step 1: Use SRES scenarios to develop estimates of population and GDP percentage changes from base year (e.g., 1990).

Step 2: Estimate percentage changes in total food consumption from base year. This is likely to follow population changes, but may be adjusted up or down to reflect anticipated improvements or decreases in overall diet and nutrition. Tables 9 and 10 show no adjustment.

Step 3: Estimate total cereal needs in thousands of metric tons. WRI (2000) reports, by country, the "average production of cereals" and the "net cereal imports and food aid as a percent of total cereal consumption." Together, these two measures can be used to estimate total cereal needs, assuming that if there are imports, all the country's production is consumed internally. For example, the estimates for D1 are given as 847,000 metric tons produced, and 43% of consumption met with imports in 1995. Therefore, the share met by internal production is 57%, which divided into total production yields, 1,486,000 metric tons of cereal needed in 1995. This number is then adjusted by population growth to reflect demand in 2000 and is estimated at 1,872,000 as shown in Table 8. (Here we assume the full amount of growth between 1990 and 2000, even though production and import estimates are for 1995-1998. In all cases, use the most accurate information available.)

Step 4: Estimate import and food aid shares. Tables 9 and 10 show food imports beginning at 43% for D1 as reported in WRI (2000) for 1995. One way to proceed (as in Tables 9 and 10) is to choose a target import share for 2100 that is consistent with the relevant SRES storyline. These targets were set at 25% and 35% in Tables 9 and 10, respectively. The authors estimated these particular estimates subjectively; they are intended to be illustrative of consistency with the SRES scenarios, but are not necessarily accurate or consistent with the situation in D1. Using both endpoints (i.e., estimates for 2000 and 2100), the intervening years can be estimated by proportional scaling with the estimated changes in income (based on the assumption that changes in either agricultural production or imports is enabled by GDP growth). For example, the following equation is used to interpolate import shares:

$I_{2010} = I_{2000} - (I_{2000}\ \ I_{2100}) * [\ (GDP_{2010}\ \ GDP_{2000})/(GDP_{2100}\ \ GDP_{2000})\ ]$

where:

I_{2000} , I_{2010}, and I_{2100} = estimated import/food aid share in 2000, 2010, and 2100, respectively

GDP_{2000} , GDP_{2010} , and GDP_{2100} = estimated GDP percentage changes from 1990 for 2000, 2010, and 2100, respectively.

Step 5. Estimate in-country production. This estimate is calculated by subtracting from 1, the import share calculated in Step 4. This gives the share of total cereal needs that are met by in-country production. This number is then multiplied by estimated total cereal needs to give the estimated level of agricultural production implied by the scenario.

Step 6. Estimate crop yields and percentage changes. Cereal crop yields are estimated based on required in-country production and assume that planted area is constant. Cereal crop planted area is estimated from data in WRI (2000) in which total cereal production in 1996-98 is 847,000 metric tons, and average cereal crop yields are given as 719 kg/ha. Therefore, estimated planted area in D1 in 1996-98 is 1.18 million hectares. Using this land base and dividing into the estimated production level gives the required crop yield. The percentage change in crop yields is then estimated using 719 kg/ha in 1995 as the base. An estimate of annualized yield changes is also helpful. The example shown in Table 8, in which yields rise by 491% by 2100, implies an annual rate of change of 1.6%. Note that production levels are also subject to change by changes the planted area.

Table A1-3: *Estimated Water Resource Situation for D1: SRES A2 Scenario*

D1	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Population (% change from 1990; from Table 1)	26	58	94	133	172	212	248	281	309	329	349
Estimated change in GNP/GDP (% change from 1990, from Table 2)	47	126	226	421	673	989	1,452	1,978	2,578	3,284	4,073
Level of development of internal renewable water resources (share of annual internal renewable water resources)	6	7	8	10	12	15	19	23	28	34	40
Annual withdrawals (km3)	1.5	1.8	2.1	2.6	3.2	4.0	5.0	6.1	7.4	9.0	10.6
Per capita annual withdrawals (m3)	125.6	120.2	115.3	136.7	125.3	159.9	174.0	195.2	197.8	242.9	249.0
Sector Water Use (%)											
Agriculture	92	91.76	91.46	90.88	90.13	89.19	87.81	86.24	84.45	82.35	80
Industry	3	3.14	3.31	3.65	4.09	4.64	5.45	6.36	7.40	8.63	10
Domestic	5	5.10	5.22	5.46	5.77	6.16	6.74	7.39	8.14	9.02	10

Notes:
Average annual internal renewable water resources (WRI 2000): Total 26.4 (km^3); per capita 2,784 (m^3).

The level of development is a key indicator that estimates the share of available internal renewable resources that are withdrawn for use. In this case, similar to the import share for food, analysts must use their own judgment to estimate how the level of development may evolve over time. In this example, we assumed that D1 had sufficient potential to increase the level of development from 6% to 40%. The pace and timing of development is tied to the rate and timing of income growth.

Per capita annual withdrawals are estimated as the ratio of estimated annual withdrawals, which is adjusted upwards as the level of development increases, and the population that is assumed to follow the given SRES scenario.

Initial water shares by sector are those given in WRI (2000). Shares in 2100 are estimated based on expert judgment and consistency with the SRES scenario and agriculture sector storyline. Intervening years are interpolated based upon the rate and timing of income growth that may enable improvements in agricultural water use efficiency.

Table A1-4: *Estimated Water Resource Situation for D1: SRES B1 Scenario*

D1	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Population (% change from 1990; from Table 1)	24	51	81	104	124	141	148	150	147	135	123
Estimated change in GNP/GDP (% change from 1990, from Table 2)	47	147	289	657	1,147	1,773	2,636	3,510	4,405	5,242	6,152
Level of development of internal renewable water resources (share of annual internal renewable water resources)	6	6	6	7	8	9	10	11	12	13	15
Annual withdrawals (km^3)	1.5	1.6	1.6	1.8	2.1	2.4	2.6	2.9	3.2	3.4	4.0
Per capita annual withdrawals (m^3)	127.6	111.8	134.6	93.1	99.8	119.0	110.6	122.3	150.7	180.9	189.2
Sector Water Use (%)											
Agriculture	92	91.72	91.32	90.30	88.94	87.20	84.80	82.37	79.88	77.55	75
Industry	3	3.25	3.60	4.50	5.70	7.24	9.36	11.51	13.71	15.77	18
Domestic	5	5.03	5.08	5.20	5.36	5.57	5.85	6.14	6.43	6.70	7

Notes:
Average annual internal renewable water resources (WRI 2000): Total 26.4 (km^3); per capita 2,784 (m^3).

The level of development is a key indicator that estimates the share of available internal renewable resources that are withdrawn for use. In this case, similar to the import share for food, analysts must use their own judgment to estimate how the level of development may evolve over time. In this example, we assumed that D1 desired to increase the level of development from 6% to 15%, and thus ensure the viability of many of its aquatic ecosystems consistent with the B1 storyline. The pace and timing of development is tied to the rate and timing of income growth.

Per capita annual withdrawals are estimated as the ratio of estimated annual withdrawals, which is adjusted upwards as the level of development increases, and the population that is assumed to follow the given SRES scenario.

Initial water shares by sector are those given in WRI (2000). Shares in 2100 are estimated based on expert judgment and consistency with the SRES scenario and agriculture sector storyline. Intervening years are interpolated based upon the rate and timing of income growth that may enable improvements in agricultural water use efficiency.

Steps for Developing the Socioeconomic Scenarios for Water (Tables A-3 and A-4)

Step 1: Use SRES scenarios to develop estimates of population and GDP percentage changes from base year (e.g., 1990).

Step 2: Estimate the level of development.. Tables 10 and 11 show the level of development beginning at 6% for D1/Senegal as reported in WRI (2000) for 1990. One way to proceed (as in Tables 10 and 11) is to choose a target level of development for 2100 that is consistent with the relevant SRES storyline. These targets were set at 40% and 15% in Tables 10 and 11, respectively. These particular targets were estimated subjectively by the authors; they are intended to be illustrative of consistency with the SRES scenarios and not necessarily accurate or consistent with the situation of Senegal/D1. Using both endpoints (i.e., estimates for 2000 and 2100), the intervening years can be estimated by proportional scaling with the estimated changes in income (based on the assumption that changes in the level of development are enabled by GDP growth). For example, the following equation is used to interpolate the level of development:

$$L_{2010} = L_{2000} + (L_{2100} \; L_{2000}) * [(GDP_{2010} \; GDP_{2000})/(GDP_{2100} \; GDP_{2000})]$$

where:

L_{2000} , L_{2010}, and L_{2100} = estimated import/food aid share in 2000, 2010, and 2100, respectively

GDP_{2000} , GDP_{2010} , and GDP_{2100} = estimated GDP percentage changes from 1990 for 2000, 2010, and 2100, respectively.

Step 3. Estimate annual withdrawal. WRI (2000) provides an estimate of "average annual internal renewable water resources," which for Senegal/D1 is given as 26.4 km^3, and an estimate of "total annual withdrawals," which for Senegal/D1 in 1990 is estimated at 1.5 km^3. The ratio of withdrawals to available resources is the level of development, in this case, equal initially to 6%. Therefore, to estimate annual withdrawals to 2100, multiply the level of development times the amount of internal renewable resources (e.g., 26.4 km^3 in Senegal/D1).

Step 4. Estimate per capita annual withdrawals. Per capita withdrawal estimates need to reflect both growth in the level of development and growth in population, and the conversion from km^3 to m^3. This estimate is made by multiplying the estimate of annual withdrawals times 1 billion (i.e., the number of m^3 in a km^3). This number is then divided by population, which grows each decade according to the SRES scenario estimates. For example, per capita water withdrawals in Senegal/D1 in 2010 are estimated by multiplying estimated withdrawals in 2010 of 1.8 km^3 by 10^9 and dividing by estimated population in 2010, which is 9,481,000 in 1990 times 1.58 to reflect the 58% growth between 2010 and 1990.

Step 5. Estimate shares of water use by sector. Similar to estimating the level of development above and the import share of food in the agriculture section, these estimates are based on an initial value given, for example, in WRI (2000), and a target value that is determined by the judgment of the analyst such that it is consistent with the SRES scenario and the country's overall development objectives. Once initial and target values are set for each sector (note that the sum across sectors should be 100%), then the intervening years can be estimated in a similar fashion using the above formula to scale these changes by changes in GDP, which is assumed to enable the changes, for example, allowing industry shares to rise with increases in economic development.

ANNEX 2. COUNTRIES BELONGING IN SRES REGIONS

ALM Region

(LAM= Latin America; SSAFR=Sub-Sahara Africa; MEA=N-Africa)

ALM(LAM)	Antigua Barbados	ALM(LAM)	St Kitts Nev	ALM(SSAFR)	Guinea Bissau
ALM(LAM)	Argentina	ALM(LAM)	St Lucia	ALM(SSAFR)	Kenya
ALM(LAM)	Bahamas	ALM(LAM)	St Pierre Mq	ALM(SSAFR)	Lesotho
ALM(LAM)	Barbados	ALM(LAM)	St Vincent	ALM(SSAFR)	Liberia
ALM(LAM)	Belize	ALM(LAM)	Suriname	ALM(SSAFR)	Madagascar
ALM(LAM)	Bermuda	ALM(LAM)	Trinidad Tobago	ALM(SSAFR)	Malawi
ALM(LAM)	Bolivia	ALM(LAM)	Uruguay	ALM(SSAFR)	Mali
ALM(LAM)	Brazil	ALM(LAM)	Venezuela	ALM(SSAFR)	Mauritania
ALM(LAM)	Chile	ALM(SSAFR)	Angola	ALM(SSAFR)	Mauritius
ALM(LAM)	Colombia	ALM(SSAFR)	Benin	ALM(SSAFR)	Mozambique
ALM(LAM)	Costa Rica	ALM(SSAFR)	Botswana	ALM(SSAFR)	Namibia
ALM(LAM)	Cuba	ALM(SSAFR)	Burkina Faso	ALM(SSAFR)	Niger
ALM(LAM)	Dominica	ALM(SSAFR)	Burundi	ALM(SSAFR)	Nigeria
ALM(LAM)	Dominican Rep	ALM(SSAFR)	Cameroon	ALM(SSAFR)	Niue
ALM(LAM)	Ecuador	ALM(SSAFR)	Cape Verde	ALM(SSAFR)	Palau
ALM(LAM)	El Salvador	ALM(SSAFR)	Central African Republic	ALM(SSAFR)	Réunion
ALM(LAM)	Grenada	ALM(SSAFR)	Chad	ALM(SSAFR)	Rwanda
ALM(LAM)	Guadeloupe	ALM(SSAFR)	Comoros	ALM(SSAFR)	Senegal
ALM(LAM)	Guatemala	ALM(SSAFR)	Congo, Dem R	ALM(SSAFR)	Seychelles
ALM(LAM)	Guyana	ALM(SSAFR)	Congo, Rep	ALM(SSAFR)	Sierra Leone
ALM(LAM)	Haiti	ALM(SSAFR)	Côte d'Ivoire	ALM(SSAFR)	Somalia
ALM(LAM)	Honduras	ALM(SSAFR)	Djibouti	ALM(SSAFR)	South Africa
ALM(LAM)	Jamaica	ALM(SSAFR)	Equatorial Guinea	ALM(SSAFR)	Swaziland
ALM(LAM)	Martinique	ALM(SSAFR)	Eritrea	ALM(SSAFR)	Tanzania
ALM(LAM)	Mexico	ALM(SSAFR)	Ethiopia	ALM(SSAFR)	Togo
ALM(LAM)	Netherlands Antilles	ALM(SSAFR)	Ethiopia PDR	ALM(SSAFR)	Uganda
ALM(LAM)	Nicaragua	ALM(SSAFR)	Gabon	ALM(SSAFR)	Western Sahara
ALM(LAM)	Panama	ALM(SSAFR)	Gambia	ALM(SSAFR)	Zambia
ALM(LAM)	Paraguay	ALM(SSAFR)	Ghana	ALM(SSAFR)	Zimbabwe
ALM(LAM)	Peru	ALM(SSAFR)	Guinea		

REForm Region

(countries undergoing economic reform: EEU=Eastern Europe; NIS-FSU=Nations in Transition and the Former Soviet Union)

REF(EEU)	Albania	REF(EEU)	Slovakia	REF(NIS-FSU)	Kyrgyz Republic
REF(EEU)	Bosnia Herzegovina	REF(EEU)	Slovenia	REF(NIS-FSU)	Latvia
REF(EEU)	Bulgaria	REF(EEU)	Yugoslav SFR	REF(NIS-FSU)	Lithuania
REF(EEU)	Croatia	REF(EEU)	Yugoslavia	REF(NIS-FSU)	Moldova Rep
REF(EEU)	Czech Rep	REF(NIS-FSU)	Armenia	REF(NIS-FSU)	Russian Federation
REF(EEU)	Czechoslovakia	REF(NIS-FSU)	Azerbaijan	REF(NIS-FSU)	Tajikistan
REF(EEU)	Hungary	REF(NIS-FSU)	Belarus	REF(NIS-FSU)	Turkmenistan
REF(EEU)	Macedonia	REF(NIS-FSU)	Estonia	REF(NIS-FSU)	Ukraine
REF(EEU)	Poland	REF(NIS-FSU)	Georgia	REF(NIS-FSU)	USSR
REF(EEU)	Romania	REF(NIS-FSU)	Kazakhstan	REF(NIS-FSU)	Uzbekistan

ALM Region

(MEA=N-Africa)

ALM(MEA)	Algeria	ALM(MEA)	Kuwait	ALM(MEA)	Sudan
ALM(MEA)	Bahrain	ALM(MEA)	Lebanon	ALM(MEA)	Syria
ALM(MEA)	Egypt	ALM(MEA)	Libya	ALM(MEA)	Tunisia
ALM(MEA)	Iran	ALM(MEA)	Morocco	ALM(MEA)	United Arab Emirates
ALM(MEA)	Iraq	ALM(MEA)	Oman	ALM(MEA)	Yemen
ALM(MEA)	Israel	ALM(MEA)	Qatar		
ALM(MEA)	Jordan	ALM(MEA)	Saudi Arabia		

ASIA Region

(CPA= Centrally Planned Asia ; SAS=Southeast Asia; PAS=Pacific Asia)

ASIA(CPA)	Cambodia	ASIA(SAS)	Pakistan	ASIA(PAS)	New Caledonia
ASIA(CPA)	China, Hong Kong	ASIA(SAS)	Sri Lanka	ASIA(PAS)	Papua N Guinea
ASIA(CPA)	Korea D P Rep	ASIA(PAS)	American Samoa	ASIA(PAS)	Philippines
ASIA(CPA)	Laos	ASIA(PAS)	Brunei	ASIA(PAS)	Singapore
ASIA(CPA)	Mongolia	ASIA(PAS)	Fiji Islands	ASIA(PAS)	Solomon Islands
ASIA(CPA)	Viet Nam	ASIA(PAS)	Fr Polynesia	ASIA(PAS)	St Helena
ASIA(SAS)	Afghanistan	ASIA(PAS)	Indonesia	ASIA(PAS)	Thailand
ASIA(SAS)	Bangladesh	ASIA(PAS)	Kiribati	ASIA(PAS)	Tonga
ASIA(SAS)	Bhutan	ASIA(PAS)	Korea Rep	ASIA(PAS)	Vanuatu
ASIA(SAS)	India	ASIA(PAS)	Malaysia		
ASIA(SAS)	Nepal	ASIA(PAS)	Myanmar		

OECD Region

WEU=Western Europe; NAM= North America; PAO=Pacific OECD countries)

Andorra	OECD(WEU)	Greenland	OECD(WEU)	Switzerland	OECD(WEU)
Austria	OECD(WEU)	Iceland	OECD(WEU)	Turkey	OECD(WEU)
Belgium	OECD(WEU)	Ireland	OECD(WEU)	UK	OECD(WEU)
Belgium-		Italy	OECD(WEU)	Canada	OECD(NAM)
Luxemburg	OECD(WEU)	Liechtenstein	OECD(WEU)	Guam	OECD(NAM)
Cyprus	OECD(WEU)	Luxembourg	OECD(WEU)	Puerto Rico	OECD(NAM)
Denmark	OECD(WEU)	Malta	OECD(WEU)	US Virgin Is	OECD(NAM)
Faeroe Is	OECD(WEU)	Monaco	OECD(WEU)	USA	OECD(NAM)
Finland	OECD(WEU)	Netherlands	OECD(WEU)	Australia	OECD(PAO)
France	OECD(WEU)	Norway	OECD(WEU)	Japan	OECD(PAO)
Germany	OECD(WEU)	Portugal	OECD(WEU)	New Zealand	OECD(PAO)
Gibraltar	OECD(WEU)	Spain	OECD(WEU)		
Greece	OECD(WEU)	Sweden	OECD(WEU)		

ANNEX 3. GDP AND POPULATION CHANGES*

***Table A3-1:** Percentage increases/decreases in GNP/GDP (mex) in the SRES regions, relative to 1990*

A1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	47%	147%	289%	710%	1,331%	2,142%	3,426%	4,852%	6,410%	8,068%	9,915%
Asia	0%	121%	364%	735%	1,607%	2,785%	4,278%	6,071%	7,921%	9,835%	11,757%	13,850%
OECD	0%	25%	57%	93%	111%	174%	228%	288%	356%	431%	526%	628%
REForm	0%	0%	27%	90%	218%	363%	536%	809%	1,136%	1,518%	1,881%	2,290%
World	0%	32%	84%	155%	287%	466%	694%	995%	1,322%	1,674%	2,050%	2,463%
A2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	47%	126%	226%	421%	673%	989%	1,452%	1,978%	2,578%	3,284%	4,073%
Asia	0%	121%	292%	521%	828%	1,207%	1,657%	2,257%	2,978%	3,814%	4,835%	5,985%
OECD	0%	25%	50%	73%	81%	109%	135%	160%	192%	230%	282%	339%
REForm	0%	0%	9%	36%	63%	100%	145%	236%	345%	490%	654%	854%
World	0%	32%	71%	115%	168%	235%	317%	425%	553%	701%	885%	1,091%
B1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	47%	147%	289%	657%	1,147%	1,773%	2,636%	3,510%	4,405%	5,242%	6,152%
Asia	0%	121%	357%	721%	1,450%	2,335%	3,371%	4,421%	5,442%	6,435%	7,321%	8,264%
OECD	0%	25%	53%	84%	96%	138%	173%	208%	246%	287%	335%	386%
REForm	0%	0%	27%	81%	172%	272%	381%	545%	736%	945%	1,118%	1,318%
World	0%	32%	81%	146%	252%	386%	547%	734%	923%	1,116%	1,300%	1,498%
B2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	47%	136%	257%	521%	868%	1,310%	1,926%	2,589%	3,300%	4,052%	4,884%
Asia	0%	121%	335%	635%	1,150%	1,750%	2,442%	3,228%	4,071%	4,971%	5,935%	6,992%
OECD	0%	25%	50%	74%	80%	103%	122%	135%	150%	168%	190%	214%
REForm	0%	0%	18%	63%	109%	163%	209%	309%	418%	536%	654%	790%
World	0%	32%	75%	128%	200%	287%	392%	517%	653%	800%	958%	1,132%

Notes:
Percentage change relative to 1990 values.

Each column represents an additional five-year increment. For example, by 2020 the OECD is assumed to experience almost a doubling of its total 1990 GDP in the A1 fast-economic growth scenario.

*or GNP when not available

Table A3-2: *Percentage increases/decreases in population (relative to 1990) in the SRES regions and scenarios*

A1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	24%	51%	81%	104%	124%	141%	148%	150%	147%	135%	123%
Asia	0%	15%	29%	41%	47%	50%	51%	45%	38%	28%	16%	4%
OECD	0%	8%	15%	20%	22%	27%	28%	29%	30%	31%	31%	32%
REForm	0%	0%	0%	1%	1%	0%	-1%	-4%	-8%	-12%	-16%	-20%
World	0%	15%	29%	43%	53%	60%	64%	62%	59%	53%	43%	34%
A2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	26%	58%	94%	133%	172%	212%	248%	281%	309%	329%	349%
Asia	0%	18%	36%	54%	72%	90%	106%	121%	135%	147%	155%	164%
OECD	0%	9%	16%	22%	25%	33%	37%	42%	49%	57%	67%	78%
REForm	0%	0%	2%	6%	10%	15%	21%	28%	36%	45%	55%	65%
World	0%	17%	35%	54%	74%	94%	113%	131%	147%	162%	174%	185%
B1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	24%	51%	81%	104%	124%	141%	148%	150%	147%	135%	123%
Asia	0%	15%	29%	41%	47%	50%	51%	45%	38%	28%	16%	4%
OECD	0%	8%	15%	20%	22%	27%	28%	29%	30%	31%	31%	32%
REForm	0%	0%	0%	1%	1%	0%	-1%	-4%	-8%	-12%	-16%	-20%
World	0%	15%	29%	43%	53%	60%	64%	62%	59%	53%	43%	34%
B2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	25%	55%	88%	120%	151%	180%	202%	219%	232%	236%	239%
Asia	0%	16%	32%	47%	59%	69%	77%	80%	81%	81%	76%	72%
OECD	0%	8%	14%	18%	19%	22%	22%	20%	20%	19%	19%	19%
REForm	0%	0%	0%	1%	2%	2%	1%	0%	-1%	-2%	-3%	-4%
World	0%	16%	32%	48%	63%	75%	86%	93%	97%	99%	98%	96%

Table A3-3:

Percentage increases/decreases from 1990 data in the SRES regions in Rural Population calculated from FAO98 country information											
	1990	1995	2000	2005	2010	2015	2020	2025	2030		
ALM	0%	7%	15%	23%	30%	37%	44%	49%	52%		
Asia	0%	4%	6%	8%	8%	8%	7%	5%	2%		
OECD	0%	-2%	-4%	-8%	-12%	-16%	-20%	-25%	-30%		
REForm	0%	-4%	-9%	-13%	-17%	-21%	-25%	-30%	-34%		
World	0%	4%	7%	9%	10%	11%	11%	10%	8%		
Percentage increases/decreases from 1990 data in the SRES regions in Urban Population calculated from FAO98 country information											
	1990	1995	2000	2005	2010	2015	2020	2025	2030		
ALM	0%	18%	37%	59%	82%	108%	134%	162%	190%		
Asia	0%	19%	41%	63%	87%	112%	138%	164%	190%		
OECD	0%	5%	9%	13%	17%	21%	24%	28%	29%		
REForm	0%	4%	6%	9%	12%	15%	17%	19%	21%		
World	0%	13%	27%	41%	57%	74%	90%	108%	124%		
Percentage increases/decreases from 1990 data in the SRES regions in Total Population calculated from FAO98 country information											
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
ALM	0%	13%	26%	40%	56%	72%	89%	105%	121%	136%	149%
Asia	0%	8%	16%	23%	30%	37%	43%	49%	54%	58%	62%
OECD	0%	3%	6%	8%	10%	12%	14%	15%	15%	15%	14%
REForm	0%	0%	0%	0%	0%	1%	1%	0%	0%	-1%	-1%
World	0%	8%	15%	23%	30%	38%	45%	52%	58%	64%	69%
Percentage increases/decreases from 1990 data in the World Population calculated from World Bank world population information											
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
World	0%	7%	15%	22%	28%	35%	42%	48%	53%	58%	62%

Table A3-4: *Percentages of the total population that are rural, urban, agrarian or non-agrarian in 1990 in the SRES regions calculated for 1990*

	AGR	NONAGR	RURAL	URBAN
ALM	45%	55%	51%	49%
Asia	63%	36%	73%	27%
OECD	12%	88%	25%	75%
REForm	21%	79%	37%	63%
World	47%	53%	57%	43%

Table A3-5: *World Development Indicator data of land distribution in 1990*

	Cropland	Grasslands	Forest	Other Lands
ALM	5%	20%	49%	26%
Asia	14%	19%	43%	24%
OECD	13%	25%	29%	32%
REForm	12%	17%	42%	29%
World	11%	24%	32%	33%

ANNEX 4. CHANGES IN LAND-USE, ENERGY USE, SO_x EMISSIONS, AND NUCLEAR ENERGY

as percentage change of 1990 values : each column represents an additional five year increment (e.g., by 2020 the OECD is assumed to experience no change from 1990 in cropland, a 2% loss in forest land, a 16% increase in grassland and a 13% loss of 'other land' in the fast-economic growth, A1, scenario; due to roundoff there is not an exact balance)

Percentage increases/decreases from 1990 data in Land Use in the SRES regions												
A1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
Cropland												
ALM	0%	-7%	-10%	-12%	-13%	-16%	-20%	-28%	-37%	-47%	-54%	-61%
Asia	0%	2%	5%	7%	6%	4%	0%	-10%	-19%	-29%	-39%	-49%
OECD	0%	0%	0%	0%	-1%	-7%	-13%	-24%	-34%	-43%	-51%	-60%
REForm	0%	3%	7%	11%	13%	13%	9%	-3%	-19%	-35%	-44%	-52%
World	0%	0%	0%	1%	0%	-2%	-7%	-17%	-28%	-39%	-47%	-56%
Forest												
ALM	0%	-1%	-4%	-9%	-14%	-19%	-23%	-20%	-16%	-10%	-5%	-1%
Asia	0%	-2%	-5%	-10%	-16%	-20%	-23%	-20%	-16%	-9%	-4%	0%
OECD	0%	1%	0%	-2%	-5%	-13%	-17%	-10%	-1%	8%	11%	14%
REForm	0%	0%	-1%	-6%	-14%	-21%	-26%	-18%	-7%	5%	10%	14%
World	0%	1%	0%	-5%	-13%	-20%	-26%	-20%	-11%	1%	6%	11%
Grassland												
ALM	0%	5%	14%	26%	39%	49%	57%	51%	43%	31%	22%	12%
Asia	0%	3%	9%	18%	27%	34%	39%	38%	36%	31%	26%	20%
OECD	0%	3%	8%	16%	20%	31%	35%	31%	26%	19%	12%	5%
REForm	0%	3%	14%	33%	54%	71%	84%	73%	55%	33%	23%	14%
World	0%	4%	12%	23%	35%	45%	52%	47%	39%	28%	20%	12%
Other land												
ALM	0%	-3%	-8%	-13%	-15%	-16%	-16%	-16%	-15%	-15%	-12%	-10%
Asia	0%	-4%	-9%	-14%	-17%	-17%	-17%	-17%	-16%	-15%	-12%	-9%
OECD	0%	-3%	-8%	-13%	-14%	-15%	-15%	-15%	-14%	-13%	-11%	-9%
REForm	0%	-4%	-9%	-15%	-17%	-18%	-17%	-17%	-16%	-15%	-12%	-9%
World	0%	-4%	-8%	-13%	-15%	-16%	-16%	-16%	-15%	-14%	-12%	-9%
A2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
Cropland												
ALM	0%	-5%	-6%	-1%	3%	5%	6%	3%	0%	-1%	-3%	-4%
Asia	0%	3%	8%	14%	18%	21%	22%	18%	16%	14%	12%	11%
OECD	0%	1%	4%	9%	10%	12%	12%	7%	5%	3%	2%	1%
REForm	0%	4%	11%	21%	29%	34%	36%	29%	24%	21%	22%	23%
World	0%	0%	4%	10%	14%	17%	18%	13%	10%	8%	7%	6%
Forest												
ALM	0%	-1%	-4%	-8%	-13%	-16%	-19%	-19%	-19%	-19%	-20%	-21%
Asia	0%	-2%	-5%	-10%	-15%	-19%	-22%	-23%	-23%	-23%	-24%	-25%
OECD	0%	0%	0%	-3%	-4%	-9%	-9%	-4%	-1%	0%	-2%	-5%
REForm	0%	0%	-1%	-6%	-12%	-16%	-19%	-13%	-10%	-8%	-12%	-16%
World	0%	0%	0%	-5%	-11%	-16%	-18%	-13%	-10%	-9%	-12%	-16%
Grassland												
ALM	0%	5%	13%	22%	31%	38%	44%	42%	41%	40%	42%	44%
Asia	0%	2%	7%	13%	19%	24%	28%	29%	30%	31%	32%	33%
OECD	0%	2%	7%	12%	15%	20%	23%	22%	22%	23%	24%	25%
REForm	0%	3%	12%	26%	38%	48%	54%	48%	45%	44%	50%	55%
World	0%	4%	10%	19%	26%	33%	37%	36%	35%	35%	37%	39%
Other land												
ALM	0%	-4%	-8%	-11%	-13%	-15%	-18%	-21%	-24%	-25%	-24%	-24%
Asia	0%	-5%	-9%	-14%	-16%	-18%	-20%	-24%	-27%	-28%	-27%	-26%
OECD	0%	-4%	-8%	-12%	-13%	-16%	-18%	-22%	-24%	-25%	-24%	-24%
REForm	0%	-5%	-10%	-14%	-16%	-19%	-21%	-25%	-28%	-29%	-28%	-27%
World	0%	-4%	-8%	-12%	-14%	-16%	-19%	-22%	-25%	-26%	-25%	-25%

B1 scenario (MiniCAM)												
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Cropland												
ALM	0%	-7%	-12%	-15%	-20%	-27%	-34%	-42%	-51%	-59%	-65%	-71%
Asia	0%	2%	4%	4%	2%	-2%	-8%	-22%	-34%	-45%	-52%	-58%
OECD	0%	0%	0%	-2%	-5%	-15%	-25%	-36%	-45%	-52%	-61%	-69%
REForm	0%	3%	5%	7%	3%	-2%	-11%	-27%	-41%	-53%	-58%	-64%
World	0%	0%	-1%	-2%	-6%	-12%	-20%	-32%	-43%	-52%	-59%	-66%
Forest												
ALM	0%	-1%	-4%	-8%	-11%	-13%	-14%	-10%	-5%	0%	3%	6%
Asia	0%	-2%	-5%	-9%	-12%	-13%	-12%	-7%	0%	5%	9%	13%
OECD	0%	1%	0%	-2%	-4%	-6%	-5%	5%	12%	18%	21%	24%
REForm	0%	0%	0%	-5%	-11%	-13%	-13%	-1%	8%	15%	13%	11%
World	0%	0%	0%	-5%	-10%	-13%	-14%	-3%	6%	13%	14%	15%
Grassland												
ALM	0%	5%	13%	24%	34%	40%	43%	35%	25%	14%	9%	3%
Asia	0%	3%	9%	18%	26%	32%	36%	32%	27%	21%	16%	12%
OECD	0%	3%	8%	17%	20%	28%	30%	24%	17%	11%	6%	1%
REForm	0%	3%	14%	32%	48%	58%	62%	42%	24%	8%	8%	7%
World	0%	4%	11%	22%	32%	38%	41%	33%	23%	14%	9%	5%
Other land												
ALM	0%	-3%	-7%	-10%	-11%	-11%	-10%	-10%	-9%	-7%	-2%	1%
Asia	0%	-4%	-8%	-12%	-12%	-11%	-10%	-10%	-8%	-5%	0%	5%
OECD	0%	-3%	-7%	-10%	-10%	-10%	-9%	-9%	-7%	-4%	0%	4%
REForm	0%	-4%	-9%	-12%	-12%	-12%	-11%	-10%	-9%	-6%	0%	4%
World	0%	-4%	-7%	-11%	-11%	-11%	-10%	-10%	-8%	-6%	-1%	3%
B2 scenario (MiniCAM)												
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Cropland												
ALM	0%	-6%	-9%	-9%	-10%	-12%	-16%	-23%	-30%	-37%	-42%	-48%
Asia	0%	3%	6%	9%	10%	10%	7%	-2%	-10%	-17%	-22%	-28%
OECD	0%	0%	2%	3%	2%	-2%	-8%	-16%	-24%	-29%	-36%	-42%
REForm	0%	3%	8%	14%	16%	14%	10%	-2%	-13%	-23%	-28%	-33%
World	0%	0%	1%	3%	3%	1%	-2%	-12%	-20%	-27%	-32%	-38%
Forest												
ALM	0%	-1%	-4%	-8%	-12%	-15%	-17%	-14%	-11%	-8%	-7%	-5%
Asia	0%	-2%	-5%	-9%	-13%	-16%	-17%	-14%	-11%	-7%	-4%	-2%
OECD	0%	1%	0%	-2%	-4%	-8%	-7%	0%	6%	10%	10%	10%
REForm	0%	0%	-1%	-6%	-12%	-15%	-16%	-7%	0%	5%	3%	0%
World	0%	0%	0%	-5%	-11%	-15%	-16%	-8%	-1%	3%	2%	1%
Grassland												
ALM	0%	5%	13%	23%	33%	40%	45%	40%	35%	30%	28%	26%
Asia	0%	2%	8%	15%	23%	28%	33%	32%	31%	28%	27%	26%
OECD	0%	3%	8%	15%	18%	25%	28%	25%	22%	19%	18%	17%
REForm	0%	3%	13%	29%	44%	55%	62%	49%	40%	31%	33%	36%
World	0%	4%	11%	21%	30%	36%	41%	36%	32%	27%	26%	25%
Other land												
ALM	0%	-3%	-7%	-11%	-12%	-13%	-13%	-15%	-15%	-14%	-11%	-8%
Asia	0%	-4%	-9%	-13%	-13%	-14%	-14%	-16%	-16%	-15%	-11%	-7%
OECD	0%	-4%	-7%	-11%	-11%	-12%	-13%	-14%	-14%	-13%	-10%	-6%
REForm	0%	-5%	-9%	-13%	-14%	-15%	-15%	-17%	-17%	-16%	-12%	-8%
World	0%	-4%	-8%	-11%	-12%	-13%	-14%	-15%	-15%	-14%	-11%	-7%

Percentage increases/decreases from 1990 in Final Energy Use in the SRES regions												
A1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
Gas												
ALM	0%	41%	125%	250%	550%	841%	1,141%	1,500%	1,808%	2,075%	1,325%	575%
Asia	0%	180%	540%	1,100%	2,220%	3,200%	4,080%	4,680%	5,060%	5,220%	3,200%	1,180%
OECD	0%	36%	86%	150%	159%	180%	193%	221%	250%	283%	173%	60%
REForm	0%	-22%	-22%	8%	37%	51%	53%	64%	71%	73%	4%	-62%
World	0%	21%	71%	150%	241%	324%	396%	474%	538%	587%	350%	113%
Liquids												
ALM	0%	29%	70%	117%	152%	229%	341%	476%	605%	735%	882%	1,035%
Asia	0%	35%	92%	157%	235%	335%	457%	564%	657%	742%	828%	921%
OECD	0%	1%	-2%	-15%	-29%	-58%	-61%	-58%	-55%	-51%	-40%	-29%
REForm	0%	-33%	-50%	-38%	-33%	-22%	-11%	5%	16%	27%	27%	33%
World	0%	4%	10%	19%	19%	33%	62%	96%	130%	162%	200%	239%
Solids												
ALM	0%	50%	100%	200%	350%	400%	450%	350%	300%	250%	250%	300%
Asia	0%	55%	125%	210%	265%	290%	280%	170%	100%	60%	55%	55%
OECD	0%	30%	20%	-10%	-10%	-30%	-50%	-60%	-70%	-70%	-60%	-50%
REForm	0%	-23%	-30%	-30%	-38%	-38%	-38%	-53%	-69%	-69%	-69%	-69%
World	0%	26%	57%	91%	117%	128%	120%	62%	20%	0%	2%	4%
Electricity												
ALM	0%	100%	266%	500%	1,166%	2,033%	3,033%	4,466%	5,966%	7,500%	9,200%	10,900%
Asia	0%	175%	525%	1,075%	2,150%	3,425%	4,900%	6,250%	7,525%	8,700%	9,450%	10,200%
OECD	0%	27%	50%	63%	68%	81%	90%	131%	186%	245%	363%	481%
REForm	0%	33%	116%	250%	450%	633%	833%	1,033%	1,216%	1,383%	1,466%	1,533%
World	0%	51%	134%	251%	468%	725%	1,020%	1,360%	1,694%	2,028%	2,345%	2,665%
Total Final Energy												
ALM	0%	40%	103%	188%	344%	562%	848%	1,174%	1,500%	1,818%	1,981%	2,144%
Asia	0%	67%	170%	307%	495%	705%	940%	1,090%	1,237%	1,385%	1,427%	1,472%
OECD	0%	16%	32%	50%	50%	57%	76%	93%	114%	139%	140%	142%
REForm	0%	-21%	-19%	1%	25%	50%	75%	100%	123%	144%	139%	135%
World	0%	18%	49%	94%	145%	212%	294%	367%	441%	516%	540%	564%

A2 scenario (MiniCAM)												
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Gas												
ALM	0%	41%	108%	191%	325%	408%	433%	500%	583%	691%	658%	633%
Asia	0%	180%	420%	740%	880%	960%	1,060%	1,140%	1,280%	1,480%	1,400%	1,280%
OECD	0%	32%	70%	111%	109%	88%	63%	49%	45%	49%	27%	4%
REForm	0%	-22%	-33%	-33%	-33%	-37%	-46%	-46%	-42%	-35%	-44%	-48%
World	0%	19%	51%	92%	109%	111%	101%	104%	118%	140%	119%	100%
Liquids												
ALM	0%	29%	58%	94%	117%	182%	282%	388%	511%	652%	788%	923%
Asia	0%	42%	85%	128%	150%	200%	285%	371%	471%	585%	700%	814%
OECD	0%	0%	-2%	-6%	-13%	-26%	-20%	-20%	-15%	-5%	5%	15%
REForm	0%	-33%	-55%	-61%	-61%	-61%	-55%	-50%	-38%	-22%	-11%	-5%
World	0%	3%	8%	14%	12%	23%	51%	78%	112%	152%	192%	233%
Solids												
ALM	0%	50%	150%	250%	450%	650%	850%	900%	1,000%	1,050%	1,100%	1,150%
Asia	0%	65%	130%	200%	240%	290%	340%	340%	360%	395%	410%	430%
OECD	0%	20%	30%	30%	30%	40%	60%	50%	40%	50%	50%	60%
REForm	0%	-23%	-30%	-46%	-46%	-38%	-30%	-30%	-30%	-30%	-30%	-30%
World	0%	28%	62%	95%	122%	153%	191%	191%	202%	222%	233%	244%
Electricity												
ALM	0%	100%	233%	433%	833%	1,400%	2,066%	3,033%	4,166%	5,433%	6,900%	8,366%
Asia	0%	175%	450%	825%	1,125%	1,575%	2,100%	2,900%	3,875%	5,000%	6,375%	7,750%
OECD	0%	27%	59%	95%	113%	168%	213%	236%	277%	336%	409%	481%
REForm	0%	33%	83%	133%	166%	233%	300%	433%	583%	750%	933%	1,116%
World	0%	51%	122%	211%	311%	442%	602%	814%	1,071%	1,377%	1,737%	2,097%
Total Final Energy												
ALM	0%	40%	92%	151%	244%	366%	518%	700%	914%	1,159%	1,403%	1,648%
Asia	0%	75%	157%	247%	307%	392%	500%	610%	752%	930%	1,112%	1,297%
OECD	0%	13%	23%	30%	28%	27%	33%	33%	42%	58%	76%	93%
REForm	0%	-21%	-30%	-30%	-26%	-23%	-14%	1%	21%	44%	67%	89%
World	0%	18%	39%	64%	82%	110%	148%	189%	243%	310%	379%	448%

B1 scenario (MiniCAM)												
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Gas												
ALM	0%	16%	83%	175%	300%	391%	433%	450%	475%	483%	508%	533%
Asia	0%	160%	420%	820%	1,080%	1,240%	1,300%	1,260%	1,160%	1,080%	1,060%	1,040%
OECD	0%	16%	40%	72%	63%	45%	32%	24%	22%	26%	31%	37%
REForm	0%	-22%	-24%	-2%	-2%	-11%	-26%	-37%	-46%	-53%	-55%	-60%
World	0%	9%	36%	85%	103%	109%	101%	95%	90%	86%	88%	92%
Liquids												
ALM	0%	11%	35%	64%	94%	141%	205%	252%	294%	329%	347%	370%
Asia	0%	28%	64%	107%	142%	185%	235%	257%	278%	292%	292%	292%
OECD	0%	-12%	-23%	-33%	-40%	-52%	-51%	-51%	-50%	-47%	-45%	-43%
REForm	0%	-33%	-55%	-55%	-55%	-55%	-61%	-61%	-61%	-66%	-66%	-66%
World	0%	-7%	-9%	-6%	-6%	1%	17%	25%	33%	42%	45%	49%
Solids												
ALM	0%	50%	100%	150%	250%	300%	350%	250%	200%	150%	150%	150%
Asia	0%	35%	70%	110%	130%	130%	105%	45%	0%	-20%	-30%	-35%
OECD	0%	10%	0%	-30%	-30%	-30%	-40%	-50%	-60%	-70%	-70%	-70%
REForm	0%	-23%	-38%	-46%	-53%	-61%	-69%	-76%	-84%	-84%	-92%	-92%
World	0%	11%	22%	33%	46%	46%	35%	-4%	-28%	-44%	-46%	-51%
Electricity												
ALM	0%	66%	166%	300%	600%	1,000%	1,500%	2,000%	2,466%	2,866%	3,000%	3,100%
Asia	0%	150%	375%	700%	1,075%	1,475%	1,925%	2,275%	2,525%	2,725%	2,675%	2,625%
OECD	0%	9%	13%	22%	27%	40%	59%	72%	90%	109%	113%	113%
REForm	0%	33%	83%	150%	183%	216%	250%	266%	283%	266%	250%	233%
World	0%	31%	80%	142%	222%	320%	428%	525%	605%	671%	677%	680%
Total Final Energy												
ALM	0%	22%	59%	111%	192%	281%	385%	466%	537%	603%	637%	666%
Asia	0%	47%	110%	187%	252%	312%	362%	372%	385%	400%	390%	382%
OECD	0%	-1%	-3%	-5%	-10%	-17%	-16%	-16%	-13%	-9%	-6%	-3%
REForm	0%	-21%	-28%	-17%	-16%	-17%	-19%	-25%	-28%	-32%	-35%	-39%
World	0%	4%	16%	34%	49%	66%	85%	94%	104%	115%	118%	121%

B2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
Gas												
ALM	0%	33%	100%	200%	375%	541%	675%	883%	1,100%	1,325%	1,425%	1,516%
Asia	0%	180%	460%	860%	1,200%	1,520%	1,840%	2,200%	2,560%	2,880%	2,880%	2,900%
OECD	0%	26%	65%	111%	111%	103%	93%	90%	91%	103%	101%	100%
REForm	0%	-22%	-28%	-20%	-20%	-24%	-33%	-35%	-31%	-26%	-26%	-28%
World	0%	15%	50%	104%	135%	159%	177%	209%	247%	290%	299%	307%
Liquids												
ALM	0%	23%	58%	100%	135%	205%	329%	452%	582%	711%	811%	917%
Asia	0%	35%	85%	150%	192%	257%	357%	457%	550%	635%	692%	750%
OECD	0%	-4%	-8%	-12%	-20%	-34%	-31%	-31%	-30%	-27%	-26%	-23%
REForm	0%	-33%	-55%	-55%	-61%	-61%	-61%	-61%	-61%	-55%	-55%	-50%
World	0%	0%	4%	15%	14%	28%	58%	88%	118%	147%	170%	193%
Solids												
ALM	0%	50%	150%	200%	350%	500%	650%	600%	600%	600%	600%	600%
Asia	0%	50%	110%	175%	220%	245%	260%	195%	160%	150%	150%	150%
OECD	0%	20%	20%	10%	10%	10%	10%	-20%	-30%	-40%	-40%	-40%
REForm	0%	-23%	-38%	-46%	-53%	-61%	-61%	-69%	-76%	-76%	-76%	-76%
World	0%	22%	48%	75%	100%	115%	128%	88%	66%	62%	62%	60%
Electricity												
ALM	0%	100%	200%	400%	800%	1,333%	2,000%	2,866%	3,766%	4,666%	5,533%	6,400%
Asia	0%	175%	450%	825%	1,275%	1,825%	2,450%	3,175%	3,900%	4,625%	5,275%	5,925%
OECD	0%	18%	40%	63%	72%	100%	127%	136%	145%	154%	168%	186%
REForm	0%	33%	66%	133%	150%	183%	216%	233%	266%	316%	350%	383%
World	0%	45%	108%	191%	291%	417%	568%	734%	905%	1,080%	1,242%	1,405%
Total Final Energy												
ALM	0%	33%	85%	155%	259%	396%	574%	770%	981%	1,200%	1,377%	1,559%
Asia	0%	65%	147%	250%	340%	440%	550%	632%	730%	842%	927%	1,012%
OECD	0%	8%	16%	23%	20%	14%	18%	17%	20%	25%	29%	33%
REForm	0%	-21%	-30%	-25%	-25%	-26%	-26%	-26%	-23%	-16%	-10%	-7%
World	0%	13%	33%	62%	83%	113%	151%	185%	225%	270%	305%	341%

Percentage increases/decreases from 1990 data in the SRES regions in SO_x emissions indicating industry development, but when decreasing, possibly clean air technology

A1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	21%	39%	46%	45%	42%	38%	0%	-21%	-29%	-22%	-15%
Asia	0%	42%	114%	182%	167%	116%	28%	-19%	-46%	-53%	-46%	-40%
OECD	0%	-25%	-42%	-90%	-95%	-98%	-98%	-96%	-93%	-90%	-85%	-80%
REForm	0%	-35%	-40%	-40%	-37%	-44%	-62%	-80%	-90%	-91%	-89%	-87%
World	0%	-2%	11%	13%	9%	-6%	-33%	-54%	-66%	-68%	-63%	-58%
A2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	21%	39%	46%	72%	106%	148%	167%	164%	140%	108%	76%
Asia	0%	42%	107%	159%	188%	215%	240%	236%	216%	183%	145%	108%
OECD	0%	-25%	-28%	-63%	-66%	-70%	-74%	-76%	-76%	-74%	-71%	-67%
REForm	0%	-35%	-38%	-41%	-30%	-20%	-9%	-5%	-3%	-4%	-12%	-20%
World	0%	-2%	14%	16%	28%	42%	55%	58%	53%	41%	26%	11%
B1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	21%	23%	27%	26%	21%	14%	-14%	-36%	-50%	-54%	-58%
Asia	0%	42%	76%	108%	92%	57%	1%	-37%	-62%	-73%	-75%	-76%
OECD	0%	-25%	-46%	-70%	-74%	-78%	-81%	-83%	-85%	-85%	-84%	-83%
REForm	0%	-35%	-43%	-47%	-44%	-49%	-61%	-78%	-89%	-94%	-92%	-92%
World	0%	-2%	-2%	-2%	-7%	-19%	-38%	-57%	-69%	-75%	-76%	-76%
B2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	21%	35%	45%	60%	83%	115%	100%	78%	50%	25%	0%
Asia	0%	42%	102%	157%	174%	172%	152%	95%	48%	9%	-9%	-29%
OECD	0%	-25%	-41%	-69%	-72%	-75%	-77%	-80%	-81%	-80%	-78%	-76%
REForm	0%	-35%	-40%	-43%	-38%	-35%	-34%	-48%	-60%	-70%	-75%	-81%
World	0%	-2%	8%	13%	20%	22%	21%	1%	-16%	-32%	-42%	-51%

Percentage increases/decreases from 1990 data in the SRES regions in Nuclear Energy, possibly standing for 'investment'

A1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	200%	400%	700%	1,100%	1,00%	2,100%	2,700%	3,200%	3,800%	7,200%	10,500%
Asia	0%	300%	800%	1,600%	2,600%	3,600%	4,600%	5,000%	5,400%	5,900%	9,600%	13,400%
OECD	0%	-20%	-35%	-40%	-45%	-55%	-60%	-55%	-50%	-40%	30%	95%
REForm	0%	33%	100%	233%	266%	300%	333%	333%	366%	400%	666%	933%
World	0%	4%	37%	87%	150%	212%	270%	316%	366%	420%	808%	1,195%
A2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	200%	400%	600%	1,200%	1,900%	2,700%	3,300%	4,100%	5,000%	6,200%	7400%
Asia	0%	300%	700%	1,200%	1,800%	2,600%	3,700%	4,200%	4,900%	6,000%	7,400%	8,800%
OECD	0%	-25%	-35%	-30%	-30%	-20%	-10%	-10%	-5%	10%	35%	60%
REForm	0%	33%	66%	100%	133%	166%	233%	266%	300%	366%	466%	533%
World	0%	4%	25%	62%	120%	195%	287%	337%	412%	516%	654%	791%
B1 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	200%	300%	400%	800%	1,100%	1,400%	1,500%	1,400%	1,300%	1,400%	1,400%
Asia	0%	200%	600%	1,000%	1,700%	2,200%	2,500%	2,300%	2,000%	1,600%	1,600%	1,600%
OECD	0%	-35%	-55%	-60%	-60%	-60%	-65%	-65%	-70%	-70%	-70%	-65%
REForm	0%	33%	66%	133%	133%	133%	100%	66%	33%	0%	0%	0%
World	0%	-8%	0%	20%	70%	104%	125%	112%	91%	58%	66%	70%
B2 scenario (MiniCAM)												
	1990	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**	**2090**	**2100**
ALM	0%	200%	400%	500%	900%	1,600%	2,300%	2,900%	3,600%	4,300%	5,500%	6,800%
Asia	0%	300%	700%	1,100%	1,900%	2,800%	3,900%	4,400%	5,000%	5,600%	7,000%	8,300%
OECD	0%	-25%	-40%	-45%	-45%	-45%	-40%	-40%	-40%	-35%	-20%	0%
REForm	0%	33%	66%	100%	100%	100%	133%	100%	100%	133%	166%	200%
World	0%	0%	16%	41%	91%	158%	241%	287%	337%	400%	525%	654%

ANNEX 5. DEMOGRAPHIC PROJECTIONS

as percentage change from 1990 baseline data calculated from World Bank data (historic data for all countries are available from the World Bank, the World Resources Institute, and UNDP)

	1995-00	2000-05	2005-10	2010-15	2015-20	2020-25	2025-30	2030-35	2035-40
Birth rate	22%	21%	19%	19%	18%	17%	16%	16%	15%
Death rate	9%	9%	9%	9%	9%	9%	9%	9%	10%
Rate of natural increase	1%	1%	1%	1%	1%	1%	1%	1%	1%
Net migration rate	0%	0%	0%	0%	0%	0%	0%	0%	0%
Growth rate	1%	1%	1%	1%	1%	1%	1%	1%	1%
Total fertility rate	3%	3%	2%	2%	2%	2%	2%	2%	2%
Net reproduction rate	1%	1%	1%	1%	1%	1%	1%	1%	1%
Life expectancy at birth	67%	67%	68%	70%	70%	71%	72%	73%	73%
Life expectancy at age 15	57%	56%	57%	58%	58%	59%	59%	60%	61%
Infant mortality rate	53%	49%	43%	36%	34%	31%	28%	25%	23%

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