

# Global Farming Systems Study: Challenges and Priorities to 2030

## **SYNTHESIS AND GLOBAL OVERVIEW**

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# Preface

For more than a decade, the proportion of internationally supported public investment directed at agriculture and the rural sector in developing countries has been declining. In the year 2000, World Bank commitments to the rural sector reached their lowest ever levels, measured as a proportion of their total lending portfolio. Moreover, this has occurred at a time when the process of globalisation is bringing about profound changes in patterns of trade and investment, placing agricultural producers and rural communities, more generally, under tremendous pressure to adapt to changing circumstances. Nor is there any evidence of significant progress in reducing the incidence of hunger. In order to reinvigorate its efforts aimed at poverty reduction and sustainable growth among rural populations, the World Bank initiated in 2000 a review of its rural development strategy<sup>1</sup>.

As part of this review, the World Bank sought the assistance of the Food and Agriculture Organization of the United Nations (FAO) in evaluating how farming systems might change and adapt over the next thirty years. Amongst other objectives, the World Bank asked FAO to provide guidance on priorities for investment in food security, poverty reduction, and economic growth, and in particular to identify promising approaches and technologies that will contribute to these goals. The identification of future changes affecting farming systems relied heavily on work undertaken in FAO over many years in monitoring trends affecting agricultural production and assessing their likely implications for future output, productivity and nutrition levels.<sup>2</sup>

The global study commenced with the delineation and characterisation of about 70 major farming systems encompassing all developing regions of the world. As existing data systems are based, almost without exception, on national and sub-national administrative areas, while farming systems cross national and even regional boundaries, it was neces-

sary to re-estimate and re-analyse a wide variety of data relating to system characteristics, including physical, social, economic, demographic and environmental parameters. This analysis provided the necessary quantitative underpinning for the central, qualitative, task of developing expert judgements on the future evolution of farming systems and their developmental priorities. In all, the study encompassed the contributions of over 40 specialists in a range of disciplines, both within and outside of FAO, and took into account comments from many others. The whole exercise was completed in just over six months.

Although any specific farming system embraces considerable heterogeneity, the diagnosis of the dynamics, constraints and opportunities of typical farm households contributes to the identification of interventions to improve system performance and sustainability. Therefore, the farming systems presented in this study are considered to provide an effective broad framework for the prioritisation of development actions and investments for accelerating agricultural development, particularly in ways which can reduce rural poverty and hunger.

The results of the study are summarized in a set of seven documents, comprising six regional reports and the global overview contained in this volume. This document, which synthesises the results of the six regional analyses as well as discussing global trends, cross-cutting issues and possible implementation modalities, presents an overview of the complete study. This document is supplemented by two case study reports of development issues of importance to farming systems globally.

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<sup>1</sup> "Rural Development: From Vision to Action". World Bank, Washington D.C., 1997.

<sup>2</sup> Most recently in "Agriculture: Towards 2015/30. Technical Interim Report" Global Perspective Studies Unit, FAO, Rome, April, 2000.

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## Table of Contents

<b>PREFACE</b>	iii
<b>I INTRODUCTION</b>	1
Study Purpose	1
Poverty and Agricultural Development	1
The Concept of Farming Systems	4
Delineation of Major Farming Systems	6
Evolution of Farming Systems	8
Factors Influencing Farming Systems Development	8
Study Structure and Format	9
<b>2 GLOBAL FACTORS INFLUENCING THE EVOLUTION OF FARMING SYSTEMS</b>	10
Natural Resources and Climate	10
Science and Technology	12
Globalisation and Market Development	14
Policies, Institutions and Public Goods	15
Information and Human Resources	16
<b>3 SUB-SAHARAN AFRICA REGION</b>	18
Introduction	18
Characteristics of the Major Regional Farming Systems	18
Regional Strategic Priorities	22
Map: Major Farming Systems	25
<b>4 MIDDLE EAST AND NORTH AFRICA REGION</b>	27
Introduction	27
Characteristics of the Major Regional Farming Systems	28
Regional Strategic Priorities	30
Map: Major Farming Systems	33
<b>5 EASTERN EUROPE AND CENTRAL ASIA</b>	35
Introduction	35
Characteristics of the Major Regional Farming Systems	35
Regional Strategic Priorities	39
Map: Major Farming Systems	43
<b>6 SOUTH ASIA REGION</b>	47
Introduction	47
Characteristics of the Major Regional Farming Systems	47
Regional Strategic Priorities	52
Map: Major Farming Systems	57
<b>7 EAST ASIA AND PACIFIC REGION</b>	59
Introduction	59
Characteristics of the Major Regional Farming Systems	61
Regional Strategic Priorities	65
Map: Major Farming Systems	69

<b>8 LATIN AMERICA AND THE CARIBBEAN</b>	<b>71</b>
Introduction	71
Characteristics of the Major Regional Farming Systems	72
Regional Strategic Priorities	75
Map: Major Farming Systems	79
<b>9 GLOBAL CHALLENGES AND PRIORITIES</b>	<b>81</b>
The Challenge of Contrasting Farm Characteristics	81
Global Challenges and Priorities for Coming Decades	83
Achieving Sustainable and Productive Use of Natural Resources	83
Deploying Science and Technology	84
Exploiting Globalisation and Market Development	87
Refocusing Policies, Institutions and Public Goods	89
Enhancing Agricultural Information and Human Capital	92
<b>10 SOME OPERATIONAL IMPLICATIONS</b>	<b>94</b>
Demand-driven Approaches to Integrated Rural Development	94
Support Services and Related Institutions	96
Financing Instruments	96
Assessing Impact using Farming Systems Frameworks	98

# 1 Introduction

## STUDY PURPOSE

In 1997, the World Bank issued a statement of its global strategy for rural development entitled “Rural Development: From Vision to Action”. Subsequently, important improvements in the performance of the rural portfolio have been achieved. These include increases in quality-at-entry of rural projects, reductions in the proportion of projects at risk and an improved impact from supervision. However, the strategy does not appear to have achieved its key objective of reversing the declining trend in rural investment volumes within the Bank. In financial year (FY) 2000, a historical low of only 38 rural development projects were approved world-wide by the Bank, with a total value of US\$1.5 billion – in comparison with US\$4 billion in FY97. This is equivalent to only 10 percent of new loan commitments by value<sup>3</sup>. Of further concern is the assessment by the Operations Evaluation Division of the Bank during FY99 that only 37 percent of agricultural projects and 42 percent of all rural projects were sustainable. Finally, important changes in world-wide economic, institutional and political conditions have occurred since the preparation of Vision to Action and these now need to be taken into account in looking at future operations.

With poverty reduction still the central goal of the World Bank and considering that a majority of the world’s poor are dependent on agriculture, the Rural Development Strategy remains an important document, but needs to be updated. The revised Strategy will be more action-oriented and will have a stronger regional focus than previously. Each regional

division of the Bank has been given primary responsibility for developing its own regional strategy, and a number of supporting studies have been commissioned – largely from thematic groups within the Bank – to provide technical inputs to the strategy formulation. In this context, FAO was invited to collaborate in preparing a supporting study with the following objective:

*“On the basis of a determination of the principal trends and issues affecting major farming systems in each World Bank region over the next 30 years, propose operational strategies, approaches and technologies that will contribute to significant and sustainable rural development and poverty reduction among farming system participants.”*

## POVERTY AND AGRICULTURAL DEVELOPMENT

Recent World Bank activities have been categorised according to final beneficiary location in urban space or rural space. Of an estimated total population in developing countries of approximately 5.1 billion in 1999, 3.0 billion reside in rural areas. Of these some 80 percent, or 2.5 billion people, are members of agricultural households<sup>4</sup> – including farming, pastoral, fishing and forestry households (see Table 1-1). Women constitute 44 percent of the 1.3 billion persons in the agricultural labour force of developing countries. Despite the trend towards urbanisation, the

<sup>3</sup> Cees de Haan and Sanjiva Cooke, 2000. FY00 Report on the Rural Portfolio. Unpublished Bank document. August 2000.

<sup>4</sup> FAOSTAT, 2000. FAO, Rome.

Table 1-1: Distribution of Rural and Agricultural Populations in Developing Countries

Region	Total Population (million)	Rural Population (million)	Agric. Population (million)	Agric Popn. as % of Total Popn.	Economically Active in Agriculture (million)	Econ. Active in Agric. as % of Total Econ. Active	Female Econ. Active as % of Econ Active in Agriculture
Sub-Saharan Africa	626	417	384	61%	176	63%	47%
Middle East/ North Africa	323	138	99	31%	35	31%	44%
E. Europe/ Central Asia	478	154	86	18%	47	36%	44%
South Asia	1 325	955	742	56%	345	59%	39%
East Asia/ Pacific	1 836	1 184	1 119	61%	654	63%	47%
Latin America/ Caribbean	505	126	110	22%	44	21%	17%
<b>Developing World</b>	<b>5 093</b>	<b>2 974</b>	<b>2 540</b>	<b>50%</b>	<b>1 300</b>	<b>53%</b>	<b>44%</b>

Note: 1999 national statistics as reported in FAOSTAT. The definition of rural varies by country, but is often a residual after urban population numbers are extracted. Agricultural population is usually defined as individuals employed in agriculture, fishery, forestry and hunting and their non-working dependents. The definition of developing regions follows World Development Report 2000/2001, with the exception that Turkey is included in Eastern Europe and Central Asia.

absolute number of people living in rural areas world-wide is growing at nearly 1 percent per annum.<sup>5</sup>

It is estimated that, world-wide, 1.2 billion people<sup>6</sup> live in poverty (i.e. consume less than US\$1 per day per capita) and that 790 million are under-nourished<sup>7</sup>. The distribution of poor people between regions is shown in Table 1-2, for both 1987 and 1998. A majority of the poor are found in South Asia, East Asia and the Pacific and Sub-Saharan Africa. During

this period, the number of poor decreased in East Asia and the Pacific (strongly influenced by China) and the Middle East and North Africa region. In contrast, the number of poor people has increased in the South Asia, Latin America and the Caribbean, Eastern Europe and Central Asia regions, with an especially large and disturbing rise in Sub-Saharan Africa. The total population of poor in developing countries changed little during this period.

Table 1-2: Distribution of the Poor between Developing Regions (millions)

Developing Region	1987	1998
Sub-Saharan Africa	217	291
Middle East and North Africa	9	6
Eastern Europe and Central Asia	1	24
South Asia	474	522
East Asia and Pacific	418	278
Latin America and Caribbean	64	78
<b>All Developing Countries</b>	<b>1 183</b>	<b>1 199</b>

Source: World Bank (1999)

<sup>5</sup> World Bank, 2000. World Development Indicators 2000. Table 3.1.

<sup>6</sup> World Bank, 2000. World Development Report 2000.

<sup>7</sup> FAOSTAT, 2000. FAO, Rome.

Table 1-3: Rural/Urban Poverty Indicators for Selected Developing Countries

Region/Country	Population below national poverty line (%)		Region/Country	Population below national poverty line (%)	
	Rural	Urban		Rural	Urban
<b>Sub-Saharan Africa</b>			<b>South Asia</b>		
Ghana	34.3	26.7	Bangladesh	46.0	23.3
Kenya	46.4	29.3	India	43.5	33.7
Nigeria	49.5	31.7	Nepal	44.0	23.0
Madagascar	77.0	47.0	Pakistan	36.9	28.0
<b>Middle East/North Africa</b>			<b>East Asia/Pacific</b>		
Algeria	16.6	7.3	China	7.9	<2
Egypt	23.3	22.5	Indonesia	12.3	9.7
Morocco	18.0	7.6	Mongolia	33.1	38.5
Yemen	19.2	18.6	Vietnam	57.2	25.9
<b>Eastern Europe/Central Asia</b>			<b>Latin America/Caribbean</b>		
Estonia	14.7	6.8	Brazil	32.6	13.1
Kazakhstan	39.0	30.0	Colombia	29.0	7.8
Kyrgyz Republic	48.1	28.7	Guatemala	71.9	33.7
Romania	27.9	20.4	Peru	67.0	46.1

Source: World Development Indicators, 2000. Table 2.7, World Bank.

National data from a large number of countries suggest that the incidence of poverty in urban areas is less than in rural areas<sup>8</sup>, although the relative importance of rural poverty varies substantially from one country to another (see Table 1-3). Across all developing countries, more than 70 percent of total poverty is found in rural areas.

Historically, poverty alleviation and economic growth have often been viewed by governments and planners as distinct and separate objectives. In many developing countries, poverty alleviation has been the responsibility of social affairs ministries, and has involved measures such as subsidies, safety nets and social investment programmes. However, while producing important short-term benefits, such measures do not usually result in the escape of many poor households from poverty, as they fail to address the requirements for sustainable income generation. Economic growth, on the other hand, has frequently been narrowly associated with accelerated manufacturing activity in urban areas, often resulting in an overall deterioration in income distribution.

In spite of the orthodox approaches outlined above, the evidence is quite clear that agricultural development provides an effective means for both reducing poverty and accelerating economic growth. As Mellor has stated,<sup>9</sup> it normally achieves this not only by increasing incomes for producers and farm workers, but more importantly by creating demand for non-tradable goods, namely services and local products. It is this indirect effect on demand – and the associated employment creation – in the non-farm sector of rural areas and market towns, that appears to be the main contributing factor to the reduction of rural poverty. Furthermore, as other studies show,<sup>10</sup> agricultural growth reduces urban poverty more rapidly than does urban growth itself, largely because of the consequent reduction in urban food costs and lower rates of in-migration from rural areas. As Mellor states: “the evidence is overwhelming that it is essential to accelerate agricultural growth if poverty is to decline rapidly”.

Agricultural growth is undoubtedly an effective engine for both economic development and poverty

<sup>8</sup> However, a number of ex-communist countries (e.g. Mongolia, Georgia) display higher urban than rural poverty rates.

<sup>9</sup> “Agricultural Growth, Rural Employment and Poverty Reduction – Non-Tradables, Public Expenditure and Balanced Growth”. John W. Mellor, Presentation to World Bank Rural Week, 2000.

<sup>10</sup> “Why Have Some Indian States Done Better than Others at Reducing Rural Poverty” Guarav Dhatt and Ravallion, M., *Economica* 65: 17-38.

reduction. The form that this growth takes, however, is expected to have a bearing on its input on poverty reduction. Thus growth in the output in productivity of small farms can be expected to have a broader effect on poverty reduction than growth on large mechanised holdings. It should be noted, however, that agricultural growth alone may not be sufficient to achieve inclusive food security in most rural communities, needing to be complemented by measures which lead to broader access to food. Evidence from empirical research also suggests that the provision of public goods, especially research, extension and education play a central role in this process. The performance of the public sector is thus extremely important in determining the rate and distribution of agricultural growth.

The challenge for developing countries is to identify specific agricultural and rural needs, and to focus investment in areas where the greatest impact on food security and poverty will be achieved. This is made possible through developing an understanding of the local factors and linkages found in the wide range of rural locations subject to differing socio-economic and ecological conditions. Within this process, it is also extremely helpful to be able to group locations with similar development constraints and investment opportunities. The analysis of farming systems facilitates both the identification and the planning stages of the process.

## THE CONCEPT OF FARMING SYSTEMS

Farmers typically view their farms, whether large corporations or small subsistence units, as systems. The following diagram of a Bangladesh farm system drawn by farmers (see Figure 1-1) illustrates the structural complexity and interrelationships between various components of a farm system. The diagram shows the multiple natural resources available to farm women and men, which often include different types of land, various sources of water and access to common property resources including ponds, grazing areas and forest. To these natural resources may be added climate and biodiversity. The resource endowment of any particular farm depends, *inter alia*, on population density, inter-family distribution of resources and the effectiveness of institutions in determining access to resources.

The functioning of a farm system is strongly influenced by the external rural environment, including markets, policy and information linkages. Not only are farms closely linked to the non-farm economy through commodity and labour markets, but also the rural and urban economies are strongly interdependent. For example, it is quite common for small farm households to derive 40 percent or more of their income from off-farm activities. Farm women and men are also linked to rural communities and social networks, and this social capital influences the management of farms.

For the purposes of this study, farming systems are defined as populations of farms that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. The biophysical, economic and human elements of a farm are interdependent, and thus farms can be analysed as systems from various points of view. Although smallholder farms are more numerous than large commercial or co-operative farms, the latter provide livelihoods for a significant proportion of the rural population in some regions. Regardless of their size, individual farm systems are organised to produce food and meet other goals through the management of available resources – whether owned, rented or jointly managed – within the existing social, economic and institutional environment. They often consist of inter-dependent production and gathering components concerned with crops, livestock, trees and fish farming. Thus, in this study, farm activities and household livelihoods embrace fishing, pastoralism, farm forestry, hunting and gathering, as well as cropping and intensive animal husbandry. Non-farm income, which makes a significant contribution to the livelihoods of many poor rural families, is also considered. Farm systems are not only found in rural areas: there is a growing realisation of the magnitude of the urban agriculture in many cities and towns in developing countries. Refugees and the landless, however, are excluded in this Study, although the impact of farming systems development on these categories of poor will be flagged.<sup>11</sup>

The analysis of farming systems constitutes the core of the Farming Systems Approach, which diagnoses constraints and identifies opportunities and strategic priorities for rural development. The power

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<sup>11</sup> It is understood that the landless will be covered under another study of non-farm income which also contributes to the rural development strategy formulation process. In this study the importance of off-farm income is recognized and the linkages to farming systems development are identified, as well as the potential impact of farm growth on the landless.



Table 1-4: Evolution of the Farming Systems Approach<sup>14</sup>

Characteristic	1970s	1980s	1990s	2000
<b>System Level:</b>				
Farm				
Household				
Groups/Community				
District/Zones/Catchments or Sector				
<b>Livelihood Focus:</b>				
Crops				
Crop-Livestock				
Multiple Household Livelihoods				
<b>Functional Focus:</b>				
Research				
Research + Extension				
Research+Extension+Support Service				
Multi-sectoral, incl. Non-agricultural				
<b>Stakeholder Focus:</b>				
Public				
Public + Civil society				
Public + Civil society + Private				
<b>Other Foci:</b>				
Gender				
Household food security				
Productivity+Resource mgmt				

Darker squares indicate greater focus on the element in that period

## DELINEATION OF MAJOR FARMING SYSTEMS

The delineation of the major farming systems presented in this study provides a useful framework to determine appropriate agricultural development strategies and interventions in developing countries. The definition of such broad farming systems inevitably results in a considerable degree of heterogeneity within any single system. However, the alternative of identifying discrete micro-level farming systems in each developing country – which could result in hundreds or even thousands of systems world-wide – would complicate the debate concerning appropriate regional and global strategic responses. The main farming systems have, therefore, been

mapped in order to estimate the magnitudes of their populations and resource bases. Within each of the broad systems, emphasis has been placed on the identification of the typical farm type or household livelihood pattern, and the associated trends and development issues, thus contributing to the identification of broad strategic approaches to poverty reduction, food security improvement and agricultural growth.

The general criteria used for the definition of the farming systems in this study have been based on the following:

- the available natural resource base, including water, land, grazing areas and forest; climate – of which altitude is one important determinant; landscape, including slope; and farm size and tenure, in relation to access to different resources;

<sup>14</sup> Adapted from J. Dixon and P. Anandajayasekaram, 2000. "Status of FSA Institutionalisation in East and Southern Africa and its Implications", International Farming Systems Research Extension Symposium, November 2000, Santiago, Chile.

- the dominant farm activities and household livelihood pattern (e.g. crops, livestock, trees, aquaculture, hunting and gathering, off-farm activities); technologies and the resulting intensity of production and integration of crops and livestock; and farm management and organisation (e.g. family, corporate, co-operative, etc).

Based on these criteria, the following seven broad types of farming system are prevalent, to a greater or lesser degree, in the developing regions: (i) irrigated farming systems, embracing a broad range of food and cash crops, and of farm sizes; (ii) rainfed farming systems in humid high potential areas, with systems dominated by one or another crop activity (notably root crops, cereals, industrial tree crops – both small scale and plantation – and commercial horticulture) and mixed crop-livestock systems; (iii) rainfed farming systems in steep and highland areas, often mixed crop-livestock systems; (iv) rainfed small-scale farming systems in dry or cold low potential areas, with mixed crop-livestock and pastoral systems which grade into sparse, often dispersed, systems with very low current productivity or potential because of extreme aridity or cold; (v) large-scale commercial farming systems, across a variety of ecologies and with diverse production patterns; (vi) coastal artisanal fishing and mixed farming systems; (vii) urban-based farming systems, typically focused on horticultural and animal production.

Applying the above criteria and farming system groups in a pragmatic fashion, with emphasis on poverty reduction and agricultural growth, resulted in the identification of 72 farming systems, with an average agricultural population of about 40 million inhabitants. Sometimes, sufficient differences exist within a farming system to justify reference to distinct sub-types, for example, small scale farms and plantations or commercial farms, or low altitude and high altitude areas. The names chosen for the farming systems reflect the seven farming systems types outlined above and incorporate key distinguishing attributes, notably:

- water resource availability, e.g. *irrigated*, *rainfed*, *dry*;
- natural resource extraction basis, e.g. *forest-based*, *coastal*;
- climate, e.g. *tropical*, *temperate*, *Mediterranean*;
- landscape relief/altitude, e.g. *highlands*, *upland*, *lowland*;
- farm scale and structure, e.g. *small scale*, *large scale*;

- the dominant livelihood, e.g. *root crop*, *tree crop*, *rice-wheat*, *artisanal fishing*, *pastoral*;
- production intensity, e.g. *intensive*, *extensive*, *sparse*;
- crop-livestock integration, e.g. *mixed*;
- location, e.g. *urban based*.

The spatial mapping of farming systems presented in this study represents a compromise between the usefulness of showing farming system areas in a graphical manner, and the dangers of implying sharp boundaries between neighbouring systems. With a large degree of variation inevitable among individual farm households within any one system, there are in reality, no sharp boundaries but rather fuzzy transitions. Often, one farming system gradually merges into another. In other cases, broad systems may be separated by limited areas with quite distinct characteristics (e.g. lower slopes of mountain areas), the identification of which would not be useful in a study with this purpose and on this global scale.

Irrigation constitutes a special case in relation to the heterogeneity of farming systems. Where irrigation-based production is the dominant characteristic within an area, as in the case of large-scale irrigation schemes, the entire zone has been classified as an irrigation-based farming system. However, substantial amounts of irrigation appear as small yet important areas of otherwise rainfed farming systems, and their implications are reflected in the analysis of constraints and opportunities. Because irrigated agriculture is so different from rainfed – not only in characteristics, but also in terms of priorities and strategic approaches – substantial localised concentrations of irrigation have been identified through cross hatching on the farming system maps.

For the purposes of this study, from three to five farming systems were identified in each region on the basis of those judged to constitute key regional targets for poverty reduction in the coming three decades. The main criteria employed were; (i) potential for poverty reduction and (ii) potential for agricultural growth. Rapid and sustained growth in a major farming system – even one not currently associated with high levels of poverty – could be expected to have a significant impact on regional poverty through migration and market linkages. Factors determining a system's apparent growth potential include: (i) favourable or acceptable underlying agro-climatic and soil conditions; (ii) a relatively high ratio of land and other resources (water, forest) to human population; (iii) a current low intensity of exploitation, and

(iv) the identification of constraints to intensification which are now considered to be feasible to remove or reduce.

## EVOLUTION OF FARMING SYSTEMS

To achieve the study objective of identifying issues and strategies related to farming systems development during the coming 30 years requires an understanding of the dynamics of farming systems.<sup>15</sup> Both internal and external factors will influence the evolution of individual farms and, in aggregate, the farming system. Whilst internal factors centre on household goals, the resource base (closely related to population pressure) and the technologies in use, external factors are more diverse. These may include market development and shifts in demand, agricultural services and policies, and the availability of market and policy information. Moreover, relationships are reciprocal; the farm system co-evolves with its external environment.

Often, the evolution of farm systems follows a recognisable pathway. For example, a system originally dependent solely on the use of hand hoes may face constraints as market-driven diversification occurs. This could lead to the increasing use of cattle for draught power, replacing some manual operations and, if land is available, an expansion of the cultivated area. Later, the intensification of crop production may be driven by population expansion and shortage of land. Market-driven evolution sometimes leads to specialisation in production and often to greater use of external inputs. Further stages may include partial mechanisation of crop production, substantial market integration and increased use of inputs. Ultimately, a high degree of production intensity is likely, perhaps with an export orientation, usually characterised by intensive use of inputs, land aggregation and a high degree of mechanisation. In certain circumstances intensive mixed systems may develop. In either case, good technical and market information is important.

In any one location within a farming system, different farms may be at different stages of evolution because of differentiated resource bases, family goals and capacity to bear risk, or degree of market access. Individual farm systems may also be shifted out of the overall trajectory of system evolution because of internal or external shocks, such as family sickness,

natural disasters, or policy shocks such as structural adjustment. Moreover, completely new alternatives may arise in the future, perhaps related to technology or markets, which could not easily be foreseen at this point.

Over decades, farming systems may differentiate into sub-types that continue to evolve along recognisably different pathways. For example, in systems under population and market pressure some farms may successfully intensify for market production, whereas others may regress to low input-low output systems. Such differentiation has been observed in some regions under the pressure of structural adjustment programmes.

In this study, an attempt is made to anticipate the co-evolution of farming systems and their environments from the present until the year 2030, taking account of:

- key trends in the farming systems, including resource and asset patterns (natural, physical, financial, human and social), technology and productivity, livelihoods (crops, livestock and off-farm enterprises) and outcomes (household food security and income);
- key trends in the socio-economic and institutional environments, including community organisation, markets, services and information.

What is clear, however, is that no single strategy can be relied upon to respond to the needs of different farms, or the needs at different times during the coming 30 years. Multiple support and intervention strategies will be required to allow for these diverse development paths, and they must be flexible enough to evolve to meet new conditions and influences that arise over time.

## FACTORS INFLUENCING FARMING SYSTEMS DEVELOPMENT

In order to present the analysis of farming systems and their future development within a framework that is broadly comparable between systems and across different regions, a number of broad sets of influences have been defined, within which the discussion of issues, trends and strategies is generally presented for each region, as well as at a global level. These influences, described briefly below, group factors that

<sup>15</sup> Volumes have been written on the evolution of agriculture. Boserup (1965) in "The Conditions of Agricultural Growth" analysed the effects of population growth; Pingali and Binswanger, and later McIntyre, took market development into consideration as well.

are of importance to the present and future status and development of farming systems. The categories themselves represent, in the broad opinion of a wide range of experts within the United Nations Food and Agriculture Organisation, the major areas in which farming system characteristics, performance and evolution are likely to be significantly affected over the next thirty years.

#### **Natural Resources and Climate**

Issues and expected changes related to the availability, quality, utilisation and management of natural resources, as well as possible changes in climatic parameters, such as rainfall, temperature and the frequency of severe weather events.

#### **Science and Technology**

Current levels and distribution of technologies, as well as changes and advances in their utilisation and scientific developments in areas such as analytical tools, biotechnology and post-harvest treatments.

#### **Globalisation and Market Development**

The impact and changes related to expanding market infrastructure and activity in rural areas, as well as the broader implications of reductions in barriers to trade between countries and future patterns of demand for agricultural outputs.

#### **Policies, Institutions and Public Goods**

The role and impact of the state and related institutions on the functioning of farming systems, expressed principally through policies, programmes, institutions, services and public investment in the rural space.

#### **Information and Human Resources**

The relevance of non-material capital to farming systems, in terms of knowledge, information and ability to access and utilise such knowledge.

### **STUDY STRUCTURE AND FORMAT**

The study is documented in seven parts. This Synthesis and Global Overview provides an outline of future challenges, opportunities and proposed development strategies from a world-wide perspective. The rele-

vance of farming systems analysis to rural development is discussed, and particular attention is paid to describing the key trends that are expected to influence farming system evolution over the next thirty years, as well as their likely impact on poverty and growth. This overview also presents a synthesis of the six individual regional analyses, available separately, and then reviews commonalities and crosscutting issues emerging from these analyses, as well as the lessons to be drawn in terms of broad priority areas which would benefit from consideration in a cross-regional context. It concludes with a brief discussion of implementation modalities and other issues of relevance to the implementation process.

The six complete regional analyses<sup>16</sup> provide more detailed coverage and maps of each World Bank region, and illustrate key issues, strategies or interventions. An initial overview of the agricultural status of the region in question is followed by a brief description and prioritisation of its major farming systems. Historical and anticipated future trends related to agriculture within the given region are also provided. Selected farming systems from the region are then examined in considerable detail. As a single region may contain as many as 15 identified farming systems, 3-5 priority systems have been selected in each region for this particular purpose, on the basis of the potential for poverty reduction or economic growth existing in the system. Discussion of each priority system is divided into three sections: (i) system description; (ii) system issues and trends, and (iii) recommended strategies and interventions. The regional analyses conclude with a discussion of regionally important issues and present proposals for overall strategic priorities.

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<sup>16</sup> Comprising Sub-Saharan Africa (AFR); Middle East & North Africa (MNA); Eastern Europe and Central Asia (ECA); South Asia (SAS); East Asia & the Pacific (EAP); and Latin America & the Caribbean (LAC). This study does not provide any analysis of farming systems in OECD countries except in so far as they are expected to influence systems in the developing world.

## 2 Global Factors Influencing the Evolution of Farming Systems

Farming systems have changed substantially in recent decades. Their evolution is directly influenced by internal factors – notably the availability of resources and population growth – as well as by external factors such as markets, new technologies, support services, policies and information. The trends affecting these forces at the global level are discussed in broad terms in the following section<sup>17</sup>. More detailed trends at the regional and farming system levels are presented in the separate regional volumes and briefly summarised in the relevant following Chapters of this document.

### NATURAL RESOURCES AND CLIMATE

The interaction of natural resource availability, climate and population determines the physical basis for farming systems. During the early stages of development, increasing population generally leads to an expansion in cultivated area and, in many cases, conflict between different land and water resources users. Once the majority of good quality land is already exploited, further population increases lead to the intensification of farming systems. As forests come under increasing pressure, biodiversity is threatened and there may be growing tension between development and conservation goals. These trends may be exacerbated by colonial and post-colonial forces that have resulted in the concentration of indigenous or minority peoples on poorer quality land, thus aggravating the degradation problem.

In the last four decades of the 20th century, the population of developing countries has doubled,

reaching 5.1 billion in the year 2000<sup>18</sup>, of which 59 percent are classed as rural, and 85 percent of those as agricultural<sup>19</sup>. Over the next thirty years, rates of population growth in developing countries are projected to slow from their current level of 1.8 percent per annum to an estimated 0.4 percent per annum. When combined with increased rates of urbanization (from 40 percent in 2000 to 57 percent in 2030), the rural population of developing countries is expected to start to decline after 2020.

The rapid population growth of past decades has increased demand for food and other agricultural produce. Since the early 1960s, the amount of land under cultivation in developing countries increased by a quarter to just over 1 billion ha; and an additional 0.1 billion ha are under permanent crops. Relative resource availability is very much a function of population – the availability of arable land per capita in developing countries has declined by almost half since the 1960s. The current pressure of agricultural population on arable and permanent crop land averages 2.3 persons per hectare – in relation to total population the pressure averages 4.6 persons per hectare. The pressure of population on land varies widely across regions, as shown in Box 2-1, from 0.3 persons per hectare in East Europe and Central Asia and 0.7 persons per hectare in Latin America, to 4.9 persons per hectare in East Asia and the Pacific.

Since the 1960s, pasture and grazing land has expanded, by 15 percent globally, to about 2.2 billion ha in 1994. Some of this expansion came at the expense of forest and woodland, which declined to about 2.3 billion ha over the same period. Annual

<sup>17</sup> Derived from FAO staff discussions related to the Strategic Framework, Medium Term Plan and cross-departmental brainstorming sessions for this Study, supplemented by FAO, 2000. Agriculture Towards 2015/2030. Technical Interim Report. FAO, Rome.

<sup>18</sup> See Table I-1.

<sup>19</sup> Agricultural population is defined by FAO as those economically active in agriculture, fisheries or forestry and their dependants.

growth rates in arable areas vary considerably between the regions, as shown in Box 2-2. By far the highest growth rates in arable land were experienced in Latin America and the Caribbean – being 1.26 percent p.a., compared with 0.18 percent p.a. in South Asia. It is worth noting that during this period cropping intensity rose in total only 5 percent, suggesting that, in global terms, farming systems are still in the area expansion phase.

The FAO AT 2030 report estimates that an additional 1.8 billion ha of land of “acceptable” quality remains available for exploitation, but this seemingly favourable scenario is constrained by a number of factors. Much of the land categorised as suitable for agriculture is, in fact, only suitable for a very narrow range of crops (e.g. olive trees in North Africa). Secondly, more than 90 percent of available land is in Latin America and Sub-Saharan Africa, which means that further expansion is a very limited option for most of North Africa, Asia and the Middle East. Even where potential for area expansion appears to exist, over 70 percent of these areas are estimated to suffer from one or more soil or terrain constraints. Nevertheless, as shown in Box 2-2, FAO foresees some continued expansion in cultivated land area to 2030 – but at only half the rate (0.34 percent p.a.) of the last 40 years – adding about 120 million ha to the world total. By the year 2030, despite the addition of a further 2 billion people to the global population, average arable land per agricultural person is actually expected to rise slightly, as more land is brought into cultivation and urbanisation increases.

The projected rapid increase in irrigation during the same period reflects the uneven distribution of agricultural land suitable for rainfed production.

Despite the typically high costs involved in developing irrigation systems, irrigated land use has risen at three times the rate of overall land expansion, doubling total irrigated area world-wide since 1961 to 197 million ha. This suggests that despite global averages, the expansion phase of agricultural systems is indeed over in many areas. However, intensification through irrigation has its limits too. At present, irrigation consumes about 70 percent of the total volume of fresh water used by humans, but this proportion is likely to decline during the coming 30 years. Although irrigation is expected to continue to expand in the coming three decades, non-agricultural demand for water is also expected to grow strongly<sup>20</sup> Despite the fact that only 7 percent of total renewable water resources in developing country are currently exploited, competition from other users together with the fact that much of the available water is not located in areas of agricultural need, will slow irrigation growth in the coming decades to around 0.6 percent per annum – only a third of its historical rate.

The expansion of agriculture plus changes in production technologies has led to a reduction of agrobiodiversity. During the past four decades, there has been a considerable reduction in the number of species and an even greater contraction in the number of cultivars of rice, wheat and maize in current use. A similar loss of biodiversity has occurred with domestic animals. With the expansion of plant and animal breeding capacity, the number of crop varieties and animal breeds in common usage is likely to decline even further.

There is a widespread belief that increasing population pressure within individual farming systems will inevitably lead to further land resource degrada-

**BOX 2-1: AGRICULTURAL POPULATION PRESSURE ON ARABLE AND PERMANENT CROP LAND BY REGION**

	(persons/ha)
Sub-Saharan Africa	2.2
Middle East & North Africa	3.1
East Europe & Central Asia	0.3
South Asia	3.5
East Asia & Pacific	4.9
Latin America & Caribbean	0.7

Source: FAOSTAT, 2000

**BOX 2-2: EXPANSION IN ARABLE LAND FROM 1961 TO 1997, AND PROJECTED TO 2030**

	1961-97	1995/7-2030
	(% p.a.)	
Sub-Saharan Africa	0.73	0.65
Middle East & North Africa	0.42	0.22
South Asia	0.18	0.13
East Asia & Pacific	0.91	0.07
Latin America & Caribbean	1.26	0.55

Source: FAO 2000

<sup>20</sup> Rosegrant, M. 1997 “Water Resources in the Twenty-First Century: Challenges and Implications for Action”, IFPRI.

tion, including soil erosion, mining of soil nutrients, depletion of groundwater and disappearance of biodiversity. However, evidence that increasing population density – of humans or animals or both – *causes* land degradation is contradictory. In fact, there is a growing body of studies that indicate that, at least in some cases, the reverse could be true. Increased population density has sometimes been accompanied by more productive and diversified farming systems and more sustainable livelihoods (see Box 2-3). This is not to imply that high population densities do not often lead to severe resource management problems, particularly on unstable hill slopes. However, the relationship between population density, farming systems and resource degradation is complex and dynamic, and degradation is not inevitable. Inequitable distribution of land is often a root cause of degradation, through the alienation of better quality land by capital-intensive, large-scale farmers and the pushing of smaller, weaker, or migrant farmers onto marginal land.

The nature of resource management trends differs between high and low potential areas. In intensely-farmed high potential areas, soil organic matter commonly decreases, soil structure deteriorates and micronutrient deficiencies and nutrient imbalances arise. In irrigated areas, ground water tables may fall. In low potential areas, nutrient losses from erosion and nutrient mining are increasing and desertification is a major concern.

The potential impact of global warming has been widely debated in the scientific community, culminating in the UN Framework Convention on Climatic Change (UNFCCC) in 1992. Agriculture currently contributes about 30 percent of the global anthropogenic emission of greenhouse gases. Growth in the production of these gases by crops is expected to slow, but methane production by livestock could increase around 60 percent by 2030. Accumulated evidence<sup>21</sup> now strongly suggests that impacts from global climate change will be significant: average global surface temperatures are expected to rise by an estimated 1.4 to 5.8°C in the next 100 years, while the frequency of climatic extremes (temperatures, precipitation and winds) is expected to increase dramatically. Models based on the Intergovernmental Panel on Climate Control (IPCC) scenario of a one percent increase in greenhouse gases per year predict, with a very high degree of statistical significance, that within 80 years extremes that are currently experienced only once a

### BOX 2-3: POPULATION DRIVEN RESOURCE ENHANCEMENT

In Machakos, Kenya increasing population density led initially to fragmentation of land, deforestation, soil degradation, household food insecurity and poverty. However, recent studies have identified a U-turn in resource management. As remittances have flowed back into the community, farmers have invested in their land, farm forestry has expanded rapidly, and erosion and soil fertility declines have been reversed, leading to resource enhancement, and rising household incomes.<sup>22</sup>

century will become normal. Rising temperatures will inevitably lead to a rise in sea levels (estimated at between 0.1 and 0.9m over this century).

There is little doubt that agriculture, and food security among rural populations, will be affected by these changes. Among the impacts predicted with some degree of confidence by the IPCC working group is a reduction in potential crop yields in most tropical and sub-tropical regions, and also in mid-latitudes if temperature increases are towards the higher end of the predicted range. Water availability, particularly in the sub-tropics, is expected to diminish, although some areas, such as South East Asia, may experience increased water availability, as a result of increased intensity in monsoon activity. There is expected to be a widespread increase in the risk of flooding, as a result both of rises in sea level, and as a consequence of increased severity of precipitation from storms, hurricanes and monsoons. Finally, labour availability may be affected as a result of an expected increase in the transmission of diseases, both vector borne (e.g. malaria), and water borne (e.g. cholera). Overall, the report states that the food security position in Africa can only be expected to worsen as a result of predicted climate changes.

## SCIENCE AND TECHNOLOGY

Investments in agricultural science and technology have expanded rapidly during the last four decades of the 20th century and have led to significant innovation within the sector. In addition, major technical and institutional changes have also occurred that are expected to lead to long-term structural changes in

<sup>21</sup> IPCC Working Group 2 Third Assessment Report, February 19, 2001.

<sup>22</sup> Machakos, Kenya (see Tiffen et al), Sindalpalchowk, Nepal (Dixon pers comm).

the process of technology development and dissemination. In the earlier years, the CGIAR international research system was established and national agricultural research organisations (NARs) were greatly strengthened. More recently, the research agenda has moved from a focus on individual crop performance to a growing acceptance of the importance of increased system productivity. This is viewed as resulting from better-managed interactions among diversified farm enterprises, from sustainable resource management, and better targeting of technologies towards women farmers and poor households. Research methods are being revolutionised by biotechnology. Perhaps even more importantly in the long term, institutional modalities are now shifting. From a public sector focus, largely led by the international system, more emphasis is now given to public-private partnerships driven more by the demands of clients.

The historical focus of research effort on food crop production technologies, with a particular emphasis on improved varieties, has been undeniably successful. Average crop yields have increased by nearly three quarters (71 percent) since 1961, while average cereal grain yields have doubled to 2.8 t/ha. Increased yields have contributed to increased food security at all levels and have led to declining real prices for food grains. It is significant that FAO projections to 2030 indicate a continuing increase in land

productivity. As shown in Box 2-4, global average wheat yields under both rainfed and irrigated conditions, are expected to increase by about 40 percent from the mid-1990s to 2030; rice yields by about 33 percent during the same period; and maize yields by 39 percent during this period (see also Figure 2-1).

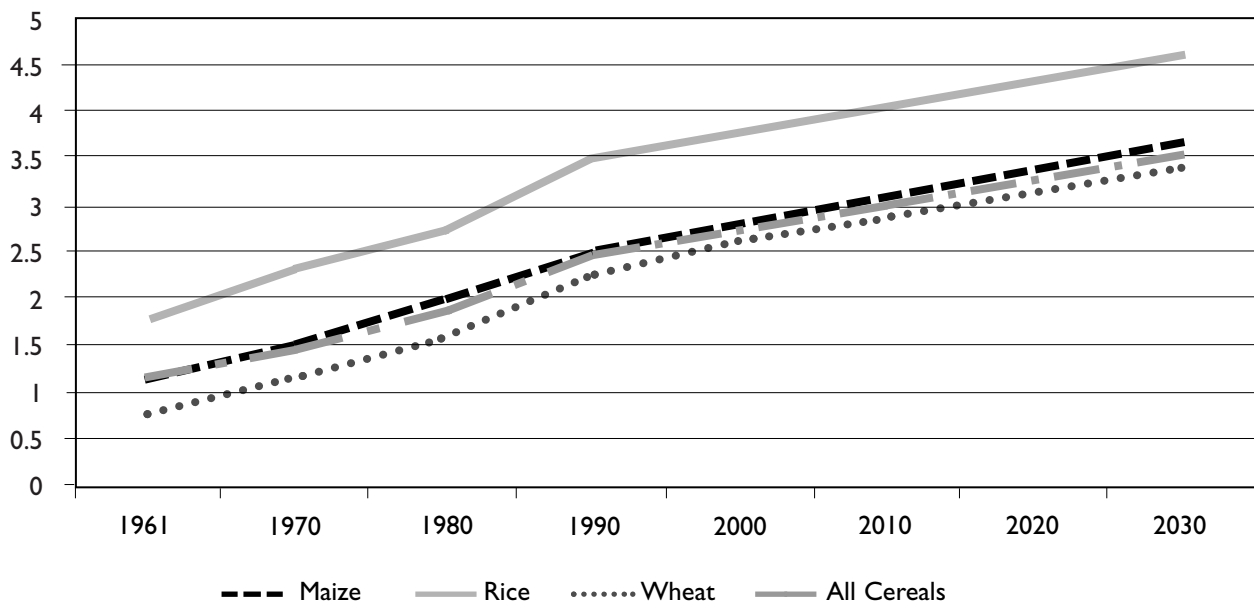
<b>BOX 2-4: PROJECTED YIELD INCREASES TO 2030</b>		
	1995-7	2030
	(t/ha)	
Wheat	2.46	3.44
Rice	3.50	4.63
Maize	2.52	3.49

Source: FAO 2000

Average yield increases for all cereals are expected to be even greater under irrigation (3.82 t/ha to 5.16 t/ha) than under rainfed conditions (1.71 t/ha to 2.23 t/ha). Irrigation efficiency is expected to increase. Average fertiliser nutrient use in developing countries is expected to grow from around 90 kg/ha in the mid 1990s<sup>23</sup> to 107 kg/ha in 2030; and increases in fertiliser nutrient efficiency are also expected.

Investments in technology development for non-cereal crops have usually received a lower priority.

Figure 2-1: Cereal Grain Yield Trends 1961-2030



<sup>23</sup> A repetition of the rapid growth of the 1960-1990 period, from a low base of 7 kg/ha in the early 1960s, is not expected.

The private sector and farmers organisations have invested in research for commercially important cash crops – examples include coffee, tea, sugar cane and bananas – but many tropical staples and minor cash crops have received relatively little attention.

#### **BOX 2-5: IS STAGNATION OF RICE YIELDS A PROBLEM?<sup>24</sup>**

There has recently been increasing concern about stagnating rice yields. After rapid growth in the 1970s and about 80s, yield increases in the 1990s have been lower than the rate of population growth. However, a synthesis of evidence suggests that these reductions do not necessarily presage stagnation in average yields. Potential productivity gains exist both in terms of raising maximum yields and through reduction in the “yield gap” between the best and the average farmers within a region. In fact, although the annual yield increases of about 0.8% forecast by FAO for the next 30 years are considerably slower than for earlier decades, average global irrigated rice yields are still expected to increase from 4.35 t/ha in the mid 1990s to 5.77 t/ha in 2030 (rainfed rice yields are also expected to increase). Yields also need to be viewed in the context of the productivity of the whole farm system over the course of the full year; in general, these whole-farm productivity levels are rising steadily.

Weed and pest pressure is increasing for many crops and further research is needed in this area. Similarly, investment in livestock research has generally not been commensurate with the contribution of the sub-sector to household income or GADP. Only one Consultative Group research centre concentrates on livestock (ILRI), although other centres have animal production programmes. In contrast, agricultural research in industrialised countries has been relatively well funded (albeit at much lower levels than for human sciences). Consequently, a greater range of new technologies is available for production systems and crops of interest to developed countries than for smallholder production systems in developing countries.

Growing investments in biotechnology are likely to increase agricultural research productivity, and have the potential to revolutionise production practices and generate customised varieties. However, most biotechnology research is concentrated in the

private sector and thus is likely to focus on profit-generating inputs, export crops and agro-processing. Countries such as China and Argentina have sown large areas of genetically modified cereals, oil crops and other commercially important species within the last five years. Whilst there has been a gradual decrease in the national and international public funding available for agricultural research and extension systems, private sector biotechnology research has attracted ample funding.

Substantial regional differences exist in the way in which research and extension are financed, with many Latin American countries increasingly privatising their extension services. With the shift in public resource allocation from agriculture to processing, marketing and service industries, farming systems have often become more self-reliant, more diverse or more integrated into the rural and rural/urban economy.

#### **GLOBALISATION AND MARKET DEVELOPMENT**

The process of globalisation, through the reduction of impediments to international trade and investment, is already generating profound changes in the structure of production at all levels, including smallholder-farming systems in many developing countries. Not only is market development in developing country systems accelerating, but patterns of production and natural resource usage are also changing profoundly in response to market forces. The FAO AT2030 study assumes that this process will continue at a moderate pace, but a reversal or even acceleration is always possible.

As barriers to trade between countries diminish, and subsidies to industrialised country producers are gradually removed, those products which are competitive in world markets will benefit, while those that have hitherto relied on protection will be under threat. Broad social, economic and cultural trends will also contribute to a profound reshaping of market demand, as increased urbanisation, rising incomes, improved communications and the diffusion of cultural preferences, have their impact. Finally, the availability of new production, post-harvest and transport technologies will also change demand patterns by making possible the delivery of new products, or

<sup>24</sup> For further details see Tran, D. and N. Nguyen, 2001, Trends in Rice Yields, Crop Production and Protection Division, Case Study, Global Farming Systems Study, FAO, Rome.

established products in new forms, to markets where they have been previously unattainable.

Globally, the AT2030 report forecasts that, although no major food category will decline in absolute terms over the next 30 years, categories such as vegetable oils, meat, dairy and horticultural products will grow much more rapidly than roots and tubers or cereals for human consumption. Prices for these staple products, with their low income elasticities of demand, will continue a long-term secular decline, despite the recent price peaks in 1996.<sup>25</sup>

It should be borne in mind, however, that these projections are based upon effective demand (i.e. purchasing power) and not need. That is to say, the elimination of chronic malnutrition, stunted children or nutritionally linked diseases, will not necessarily result from the realisation of these projections. A major concern remains that, without public intervention through carefully targeted measures for improving food access, a very large number of people will continue to remain chronically undernourished as a result of market failure.

Although demand from urban centres in developing countries will provide a major impetus for the increased consumption levels foreseen in AT2030, changes in production patterns, resource constraints and demand in industrial countries will also profoundly impact market forces in the developing world over the next 30 years:

- previously heavily protected or subsidised products such as wheat and rice (Europe and Japan), sugar (Europe and U.S.), dairy products (Europe), cotton, orange juice and tobacco (U.S.), will move to more efficient producers, primarily in the developing world; but only to the extent that resistance to removal of subsidies in developed countries can be overcome;
- competing demands for natural resources (land and water) and labour, and increasing restrictions on the use of agrochemicals, will make intensive horticulture more difficult to maintain in areas such as Southern California, Florida, Mediterranean Europe and large parts of Japan;
- there will be an increasing tendency for environmentally and socially undesirable production (e.g. pig and poultry production, tanneries) to move from industrial to developing countries;

- output of 'organic' products, currently no more than 1-2 percent of industrialised country markets, will expand rapidly in importance in response to food safety concerns, as will the demand for natural additives (colorants, flavours) and intensive labour requirements for these products will tend to favour developing country producers;
- speciality products and tropical 'exotics' will experience rapidly growing demand from expanding immigrant and ethnic communities, restaurants, returning tourists and other wealthy groups seeking products currently not generally available in the high income countries; and
- demand for ready-to-eat foods (peeled, stoned, and sliced fruit; ready made salads; pre-cut vegetables) will drive the development of new packaging and hygiene technologies and favour developing countries where labour is relatively cheap.

Ever larger and generally wealthier urban populations in developing countries will also drive the expansion and intensification of marketing and agricultural supply systems, support growth in international trade – cities are easier to supply than dispersed populations – and increase the demand for goods with a higher income elasticity of demand (meat, dairy, oils, fruit and vegetables). Urban agriculture will continue to grow in importance and area. Urban demand will also gradually expand for processed foods, creating increased opportunities for value added in local products.

Although high transport costs will provide some protection, rural markets will come under increasing external pressure as retailers, even in isolated areas, have greater access to imported products, tinned goods etc. Producers dependent upon the sale of surpluses will find increased competition and lower prices in local markets.

## POLICIES, INSTITUTIONS AND PUBLIC GOODS

It is well known that the development of dynamic farming systems requires a conducive enabling policy environment. The greatest change in this environment during the past 30 years has been structural adjustment, which has resulted in liberalised trade

<sup>25</sup> Rosegrant, M., M. Paisner and J. Witcover, 2000, "Global Food Projections to 2020: Emerging Trends and Alternative Futures", IFPRI.

and exchange rate regimes and radically reduced or eliminated subsidies. Structural adjustment has reduced, but not eliminated, the urban bias in policies. More recently, international agreements and the establishment of the World Trade Organization, the implications of which are discussed in the previous section, have further boosted trade liberalisation.

The widespread introduction of structural adjustment marked another step in a key policy trend that can be discerned over the last few decades; the decline of national food security as a dominant element in the shaping of policies for rural areas. In the 1960s, the perceived need to ensure national food security was paramount for many governments, and justified direct intervention in agricultural marketing, storage, import licensing, input subsidies and other areas. Yet the concept of food security as a key policy issue for developing countries has not disappeared. The FAO-sponsored World Food Summit of 1996 once more highlighted food security, although from the perspective of reduction of hunger rather than from a national security viewpoint.

As structural adjustment programmes have progressed, policy makers have increasingly shifted their attention to the potential to increase the efficiency of service delivery through the restructuring of institutions. This has led to several results with enormous long-term impact:

- the shift in traditionally public sector roles to civil society and the private sector;
- the decentralisation of remaining government services; and
- an increasing restriction of government investment to public goods provision.

The first two trends fit well within the increasing tendency, at a broader social level, to encourage more local-level participation in decision making and resource allocation, while the third is, in part, an outcome of the shedding of many previous responsibilities to the private sector. These tendencies will probably continue to grow in importance during the next one to two decades. However, while such trends offer significant benefits in terms of mobilisation of non-governmental resources and a better alignment of public activities to local needs, they have also created constraints. In many countries, civil society and the private sector have experienced difficulties in effectively replacing public services in finance, extension, education, health and infrastructure development and maintenance, particularly in rural areas

where poverty is widespread. Smaller farmers and female headed households have suffered especially.

The strengthening of local institutions, including decentralisation and democratisation at local levels, is noticeable in many countries. In recent years, the role of women in local governance has been greatly strengthened in some countries, although long-term outcomes are not yet clear. These trends have exposed rifts between central and local authorities in setting development priorities and budgetary allocations, as well as when developing oversight mechanisms.

A further policy area that will inevitably retain, and even increase, its importance over the next thirty years, is that of access to and control of natural resources – particularly land and water. As populations increase and marginal lands suffer increasing levels of degradation, the demands of poorer, minority and indigenous populations for more equitable access to key resources will continue to intensify. Although accelerating rates of urbanisation will relieve some of the pressure, governments who are unable to develop and implement effective policies on land and water ownership, taxation, reform and management, will face the risk of serious social conflict.

## INFORMATION AND HUMAN RESOURCES

The recent evolution of farming systems based upon increasing specialisation (e.g. large scale broiler units) or integrated intensification (e.g. rice-fish-ducks) has required extra knowledge on the part of farm operators.

The need for information and human capital has also increased as production systems become more integrated with regional, national and international market systems. Farmers have to understand the nature of the demand that they are responding to – in terms of its implications for varieties, timing, packaging, permitted chemicals, etc. – and increasingly to modify their portfolio of products and activities as market demand changes. The concept, now quite common among farmers in developed countries, that the product mix in five years time might look entirely different from today, is a long way from being accepted or even understood among farmers in many developing countries. In part, of course, smallholders may lack the capital or risk-taking capacity to undertake such radical changes, but a lack of education, information and training is frequently a key limiting factor.

Many observers anticipate an information revolution during the coming 30 years that will provide large

volumes of technological, market and institutional information to smallholder farmers. Within the next decade or so, such a revolution is considered unlikely to reach most producers in low income countries, although operations that are more commercial may well benefit<sup>26</sup>. It is difficult to see how computers and the Internet are going to have much direct impact in the short term on often functionally illiterate rural populations who do not even have access to electricity and adequate food resources. Inevitably, issues of equitable access and dissemination are likely to arise, as marginalised populations are bypassed.

Given the high returns repeatedly demonstrated to primary education, however, it is considered likely that rural education will expand considerably in those countries where civil conflict is absent and economic stability can be maintained. This development may leave the next generation better equipped to participate in knowledge-based agriculture and utilise the expanding information base.

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<sup>26</sup> Even so, a recent study of small and medium enterprises in Tanzania, in which nearly 90 percent of owners were trained to high school level and above, found that over two thirds did not make significant use of the internet and similar electronic sources. "Survey of Information Technologies within Small, Micro and Medium Enterprises in Tanzania" E. Mungunasi. Draft report prepared for the World Bank. Undated, 2000.

## 3 Sub-Saharan Africa Region<sup>27</sup>

### INTRODUCTION

Sub-Saharan Africa (AFR) has a total population of 626 million people and an agricultural population of 385 million (61 percent). Total land area is 2.5 billion ha, of which about 173 million ha is under annual cultivation or permanent crops. Agro-ecologically, 43 percent of the land area is arid and semi-arid, 13 percent is dry sub-humid, and the remaining 38 percent is either moist-sub-humid or humid. In West Africa, 70 percent of the population lives in the moist sub-humid and humid zones, whereas in East and Southern Africa, half of the population lives in these zones. Some 20 percent of the region's population live in arid and semi-arid areas.

With an estimated total of 290 million people – almost half of the region's population – living on less than US\$1 per day, Sub-Saharan Africa accounts for nearly one fourth (24 percent) of the world's poor people. Nineteen of the 25 poorest countries in the world are found in the region. Cumulatively, 16 percent of the region's population lives in countries that have a GNP per capita below US\$200 per annum and 75 percent live in countries with a GNP per capita below US\$400. In East and Southern Africa, it is estimated that rural poverty accounts for as much as 90 percent of total poverty, and of the rural poor, most are farmers. Although the drought-prone areas tend to be poorer than other areas, because of their relatively low population they account for a relatively low proportion of the total number of poor people. The majority of the rural poor are concentrated in the moist sub-humid and humid areas. It is estimated that, throughout the region, there are 236 million agricultural poor, which represents 60 percent of the

agricultural population and 80 percent of the total number of poor in the region.

Agriculture accounts for 20 percent of the region's GNP, employs 67 percent of the total labour force and is the main source of livelihood of the region's poor. Agriculture is the dominant export sector for East Africa (accounting for 47 percent of total exports), and a significant one in all the other sub-regions of Sub-Saharan Africa (accounting for 14 percent of exports in Southern Africa and 10 percent in West Africa).

### CHARACTERISTICS OF THE MAJOR REGIONAL FARMING SYSTEMS

Fourteen broad farming systems were defined on the basis of criteria such as natural resource base, dominant livelihoods, main staple and cash income sources (see Map).

Five of these farming systems were selected as priorities: three on the basis of poverty reduction potential (Tree Crop Farming System, Maize Mixed Farming System, and the Agro-pastoral Millet/ Sorghum Farming System) and two on growth potential (Cereal-Root Crop Mixed Farming System and the Irrigated Farming System). Together they support almost half of the agricultural population of the region.

#### Irrigated Farming System

This system covers 35 million ha and includes large-scale irrigation schemes such as the Gezira scheme in Sudan, as well as large riverine and flood recession-based systems that are found in pockets along major

<sup>27</sup> The material in this section is extracted and summarised from the Global Farming Systems Study: "Regional Analysis: Sub-Saharan Africa".

Table 3-1: Major Farming Systems in Sub-Saharan Africa

Farming Systems	Land area (percent of region)	Agric Popn (percent of region)	Principal Livelihood	Incidence of Poverty	Potential for poverty reduction	Potential for agric. growth
Irrigated	1	3	Rice, vegetables, livestock	Low	Low	High
Tree Crop	3	7	Tubers and cash tree crops	Low to Moderate	High	Moderate/High
Forest-Based	11	7	Tubers, forest gathering activities	Severe	Low	Low/Moderate
Rice-Tree Crop	1	2	Banana, coffee, spices, rice, roots, legumes	Moderate	Low	Low
Highland Perennial	1	8	Ensete, wheat, livestock, off-farm activities	Very Severe	High	Low
Highland Temperate	2	8	Wheat, barley, legumes, livestock, off-farm activities	Moderate	Moderate	Low/Moderate
Root Crop	12	12	Yams, legumes, vegetables	Low Moderate	Moderate	Moderate
Cereal-Root Crop Mixed	13	15	Maize, sorghum, cassava, yams, livestock, off-farm activities	Low	Low	High
Maize Mixed	10	16	Maize, cassava, cattle remittances	Moderate	High	Moderate/High
Large Commercial & Smallholder	5	5	Cereals, legumes, livestock, remittances	Low (moderate labourers)	Low	Moderate
Agro-Pastoral Millet/Sorghum	8	9	Millet, sorghum, livestock, remittances	Severe	High	Low/Moderate
Pastoral	14	7	Livestock, remittances	Severe	Low	Low
Sparse (arid)	18	2	Livestock, remittances	Severe	Low	Low
Coastal Artisanal Fishing	2	3	Artisanal fishing, coconuts, cashew	Moderate	Low	Low/Moderate
Urban-Based	Not mapped	little	Horticulture, dairying, fattening livestock	Low	Low	High

Priority systems for poverty reduction and/or growth are shaded

rivers, West African *fadama* systems and Sahelian oasis agriculture. In nearly all cases, irrigated farming is combined with rainfed cropping and/or animal husbandry. The total 2.6 million ha of cultivated area, including 1.9 million ha of land equipped for irrigation, encompasses an agricultural population of 7 million people and small numbers of cattle (3.4 million head). Poverty incidence is lower than elsewhere and absolute numbers of poor are also low.

The term "irrigated systems" is often a misnomer because, with the exception of the Gezira scheme, the irrigated fields almost always constitute a part of a larger farming and livelihood system that includes rainfed farming and livestock. Within the irrigated farming category it is useful to distinguish between large-scale, centrally managed irrigation schemes and small-scale, farmer-managed schemes. Within the latter category it is also useful to distinguish between government-assisted schemes and traditional irrigation systems. One can also distinguish between irrigation proper and run-off harvesting, and between full and partial water control.

Irrigated holdings vary from a high of 22 ha per household on the Gezira scheme to less than 1 ha on the informal irrigation systems. Crop failure is generally not a problem but livelihoods are vulnerable to water shortages, scheme breakdowns and deteriorating input/output price ratios. Many state-run schemes are currently in crisis because of prolonged neglect and accumulated financial losses, but if institutional problems can be solved, future growth potential is good. Small-scale, farmer managed irrigation (SSFMI) has been more successful and is expected to expand in the coming decades. To be economically viable, farmers have to be able to grow and market high value crops such as vegetables, (which is only feasible in proximity to markets). Effective development requires an integrated and participatory approach.

### Tree Crop Farming System

This system occupies 73 million ha in a belt that stretches through the humid forest zone of West Africa from Côte d'Ivoire, Sierra Leone and Liberia, to Ghana, Nigeria, Cameroon and Gabon. Similar systems are found in eastern Madagascar. It accounts for 6 percent of the cultivated area in the region (10 million ha) and 7 percent of the agricultural population (25 million). The backbone of the system is smallholder industrial tree crop production (cocoa,

coffee, oilpalm and rubber). Food crops are interplanted between tree crops and are grown mainly for subsistence. Commercial tree crop estates (particularly for oilpalm and rubber) and smallholdings often coexist in the same locality, with the smallholder tree crop farmers receiving services through nucleus estate-outgrower schemes. Irrigation accounts for only about 0.1 million ha, and the cattle population is only one percent of the regional herd. Since crop failure is not a problem, price/market fluctuations for industrial crops constitute the main source of vulnerability. Socio-economic differentiation is considerable. Growth potential is moderately high. Poverty incidence is lower than in other systems, but numbers of poor are relatively high due to high population density.

The main trends during the past decade concern increased population pressure on natural resources, dismantling of parastatal input supply and marketing services and the withdrawal of public sector from industrial crop research and extension. Strong international competition has led to depressed producer prices and declining market share for most industrial tree crops. This has resulted in neglect of some tree crops as well as decreased demand for hired labour on commercial estates. Use of mineral fertiliser and agrochemicals is declining due to high prices, low profitability and lack of credit for their purchase. During the coming three decades, population pressure is likely to increase even further. The medium-term prospects of this farming system depend to a great degree on the effectiveness of support and marketing services and, where relevant, the elimination of export taxes. The most promising avenues for development of the system involve active producer groups linked to private sector, product quality upgrading and diversification into non-traditional export crops.

### Maize Mixed Farming System

This farming system accounts for 246 million ha and an agricultural population of 60 million. The 32 million ha of cultivated area has very little irrigation (0.4 million ha or 6 percent of the regional total) but large numbers of cattle – 36 million head. It is the most important production system in the East and Southern Africa region, stretching across plateau and highland areas at altitudes of 800-1,500 metres from Kenya to Tanzania to Zambia, Malawi, Zimbabwe, South Africa, Swaziland and Lesotho. In West Africa, the system is found in highland parts of western

Cameroon and Nigeria. Average farm sizes are relatively modest, around 2 ha. Climate varies from dry-sub humid to moist-sub-humid. The most typical areas have monomodal rainfall, but some areas experience bimodal rainfall. In the latter case, farmers have two cropping seasons but they usually harvest only once a year from a given field.

The main staple is maize and the main cash sources are migrant remittances, cattle, small ruminants, tobacco, coffee, cotton and sale of food crops such as maize, pulses and sunflower. Cattle are kept for ploughing, breeding, milk, farm manure, bridewealth, savings and emergency sale. In spite of scattered settlement, community institutions and market linkages in the maize belt are relatively better developed than in other production systems. The main sources of vulnerability are drought and market volatility. Socio-economic differentiation is considerable, due mainly to migration and resulting remittances. The system is in crisis: farm input use has sharply fallen as high prices make fertiliser use uneconomic and product prices have become more volatile following liberalisation. As a result, yields have fallen and soil fertility is declining as smallholders revert to extensive production practices. Chronic poverty is linked to small farm size and absence of draught oxen and migrant remittances, but transitory poverty has sharply increased as a result of retrenchment of off-farm workers, coupled with policy reforms affecting maize. In spite of the current crisis, growth prospects are relatively good.

Average farm sizes may continue to fall as population pressure increases. There are signs of serious fertility decline, with a drop in organic matter combined with an increase in acidity levels in some soils. The farm gate input/output price ratio for maize has steadily deteriorated and this trend may well continue during the coming three decades. With the removal of subsidies on inputs and guaranteed prices, smallholder maize growers are reverting to low-input/low-output strategies and poverty appears to be increasing. Access to farm inputs, credit, markets and good quality open-pollinated seed remains a problem. Thus, key issues include: limited resource base, high cost of chemical fertiliser relative to the price of maize, declining soil fertility, shortage of livestock to produce organic manure and for farm power. To address these problems, the main strategic options include conservation farming, especially where labour/land ratios are low, and the use of enriched fallows. For areas of high population density areas, diversification towards high value crops is a promising option.

### **Cereal-Root Crop Mixed Farming System**

The system accounts for 312 million ha and has an agricultural population of 59 million people who cultivate 31 million ha of land, almost entirely rainfed (only 0.4 million ha of irrigation). It stretches from Guinea through northern Côte d'Ivoire to Ghana, Togo, Benin, and the mid-belt states of Nigeria to northern Cameroon and there is a similar zone in central and southern Africa. Although the system shares a number of characteristics in common with the Maize Mixed Farming System (such as 120-180 growing days with monomodal rainfall), it has characteristics that set it apart: namely, relatively low population density, abundant arable land, larger average farm size, poor communications, lower altitude, higher temperatures, presence of tsetse challenge (limiting livestock numbers in the moister parts of the system) and consequent absence of animal traction. Although cereals such as maize, sorghum and millet are important in the system, in the absence of animal traction, root crops such as yams and cassava are more significant than cereals. A wider range of crops is grown and marketed and intercropping is far more important. The main source of vulnerability is drought. Poverty incidence is low and numbers of poor people are modest, but growth prospects are high.

The savanna zone represents one of the main under-utilised resources in the region. In the 1980s and early 1990s, smallholder maize and cotton expanded rapidly at the expense of sorghum and root crops, especially in the more northern, drier part of the Savanna. Recently, increased urban demand has led to an expansion of the area under root crops. The ample opportunities for growth through expansion of the cropped area as well as through higher yields per hectare can be exploited through three types of concerted action: conservation farming, integrated pest management and crop/livestock integration.

### **Agro-Pastoral Millet/Sorghum Farming System**

This system occupies nearly 200 million ha and accounts for an agricultural population of 33 million people cultivating some 22 million ha. Pressure on arable land is very high, but the irrigated area is still limited, at no more than 0.6 million ha. Crops and livestock are of equal importance. Rainfed sorghum and pearl millet are the main source of food but are rarely marketed. Sesame and pulses are sometimes sold. Land preparation is by oxen or camel, or by

hand hoe along riverbanks. Livestock – including 25 million cattle – are kept for subsistence (milk and milk products), offspring, transportation (camels, donkeys), land preparation (oxen, camels), sale or exchange, savings, bridewealth and insurance against crop failure. The population is sedentary in that they live in villages all the year, although part of their herds may continue to migrate seasonally with herd boys.

The main source of vulnerability is drought, leading to crop failure, weak animal condition and distress sale of assets. Poverty incidence is high and absolute numbers of poor are relatively high. Growth potential is modest and presents important challenges but a sufficient range of technologies is available to warrant a focus on these systems.

Soil fertility problems are emerging in the plains due to shortened fallow periods and continuous cultivation. Land shortage is also a problem in the densely populated areas where soils are more fertile. There is an acute shortage of drinking water and firewood in certain areas. There is a variety of crop and livestock production constraints related to the low rainfall and prevalence of droughts; these can be alleviated by better land husbandry, water harvesting plus multiplication of drought-resistant, early maturing millet and sorghum varieties. In addition, livestock development requires disease monitoring and approved certification schemes for the export of live animals and animal products, and greater integration with more favoured areas.

## REGIONAL STRATEGIC PRIORITIES

Given the high prevalence of poverty in the region, the strategic goal should be broad-based, pro-poor growth. A strong case can be made for channelling resources to smallholder agriculture in the region, because rural poverty still accounts for 90 percent of total poverty and roughly 80 percent of the poor still depend on agriculture or farm labour for their livelihood. A number of regional priorities and strategic thrusts for addressing them emerge from the analysis.

The five priority farming systems analysed within the regions reveal a sharp divergence between the three selected on the basis of poverty reduction potential (Tree Crop System, Maize Mixed System, and the Agro-Pastoral System) and the two included on the basis of growth potential (Cereal-Root Crop System and Irrigated System). Yet all these farming systems share a number of common challenges that

define a clear strategic focus for Sub-Saharan Africa over the next thirty years. These challenges can be summarised as:

- sustainable management of natural resources and the reversal of degradation;
- improved channels for input supply, new technology and information; and
- the capacity to respond to globalisation and market development.

However, these overall strategic thrusts require specific strategies and interventions in each of the five principal categories outlined in the introduction to this study. These can be summarised for each of the following areas: natural resources and climate; science and technology; globalisation and market development; policy, institutions and public goods; information and human resources. Each of these categories is briefly examined below:

### Natural Resources and Climate

The key natural resource issues are; declining soil fertility, land degradation, organic matter shortage, striga weed infestation, high vulnerability to drought and the negative environmental impact of mechanised tillage. These problems have been exacerbated by high rates of population growth in many systems.

Strategic priorities include:

- **Soil Fertility Management.** The soil fertility issue cuts across all systems to a greater or lesser extent but the acute crisis is currently felt by the Maize Mixed Farming System, the Cereal-Root Crop Farming System and the Highland Temperate Farming System. As a result of economic liberalisation and removal of subsidies, fertiliser application on maize and wheat has sharply diminished as fertiliser prices have more than doubled and farmgate prices have slumped. Whole regions that used to specialise in smallholder maize are reverting to extensive cultivation of local varieties without fertiliser; technical levels are regressing and poverty is increasing. The general response to soil fertility constraint is better land husbandry, and one of the specific interventions is conservation agriculture.
- **Water Resources Management.** The lack of moisture is a critical constraint on yield improvement, especially in dry, low potential, areas. Investment in

small scale irrigation schemes and water harvesting are a strategic priority.

### Science and Technology

The key issues are: low relevance of agricultural research to poor smallholders; lack of site specificity; neglect of minor farming systems and minor commodities; shortage of alternatives to costly or uneconomic fertiliser and pesticide use; lack of attention to integrated resource management and system oriented technologies; and lack of risk-reducing technologies.

Strategic priorities include:

- **Diversification.** This is an important strategic thrust for several farming systems, in response to declining terms of trade for grain or for risk in drier areas. Technologies for high value crops, horticulture and livestock (see below) are called for.
- **Affordable and Environmentally Friendly Pest and Weed Control:** Pest and weed problems plague all farming systems to some extent. However, the need to find an alternative to costly use of pesticides is particularly felt by cotton growers and irrigated vegetable growers. The solution is proactive, farmer-based pest and weed control through Integrated Pest Management (IPM).
- **Coping with Moisture Stress.** The main thrusts for addressing the seasonal or drought-induced moisture stress for crops are: (i) introduction of drought-tolerant, early-maturing crops and varieties; (ii) maximisation of soil moisture retention/ utilisation through land husbandry; and (iii) water harvesting. On the livestock side, reduced vulnerability can be achieved by; developing sound land use and water policies for the rangelands; implementing drought early warning, mitigation and rehabilitation practices; control of epizootic diseases; development of conservation agriculture appropriate for arid and semi-arid areas, and development of viable non-pastoral alternatives for those that can no longer be sustained by the resource base.
- **Livestock husbandry.** Technologies related to disease control and feed and pasture management are required, in both pastoral and mixed farming situations.

### Globalisation and Market Development

The key issues are: deteriorating terms of trade for traditional exports; inability of local maize growers to compete with imports; and low farmer share of the price of export crops.

Strategic priorities include:

- **Diversification:** Diversification provides a partial answer to farmers' problems of: (i) deteriorating input/output price ratios for maize and wheat; (ii) deteriorating terms of trade for traditional export crops, and (iii) vulnerability to crop failure in arid/semi-arid zones. For households with too little land to support themselves from farming alone, diversification of income sources into a combination of crop, livestock and non-farm activities should be the main focus. Diversification is particularly important for sustainable poverty reduction because it increases poor households' resilience in the face of both weather-related and market shocks.
- **Non-traditional Exports and Product Upgrading:** This strategy responds to farmers' felt need to cope with declining profitability of traditional export crops. Partial solutions include diversification into non-traditional export crops, and the upgrading of existing export products to obtain the highest possible price. For pastoralists, agro-pastoralists and mountain livestock keepers, the main thrust would be to devise and implement disease monitoring and approved certification schemes for the export of live animals and animal products.

### Policy, Institutions and Public Goods

Key issues include: the inability of the public sector to ensure even minimal levels of access to public goods in rural areas; poor governance; urban bias and anti-smallholder bias; breakdown of agricultural services as a consequence of government withdrawal; reluctance of the private sector to take up the challenge of farm input supply, smallholder credit and crop marketing; withdrawal of government from seed supply, and the lack of private sector interest in supplying open-pollinated varieties and planting material; dismantling of parastatal input supply and marketing functions for industrial crops and reluctance of the private sector to advance inputs to farmers at planting time while deducting their cost from the revenue from marketed

produce; collapse of public financial institutions in the agricultural sector; poor infrastructure leading to high transaction costs of doing business in rural areas, and reform of customary land tenure; poor sustainability of public sector irrigation schemes; and disappointing results of past investment in agricultural research and extension.

Strategic priorities include:

- **Securing Land Rights:** There are two main issues: (i) how to enable rural communities in low population density areas to protect their customary land rights without precluding growth, and (ii) how to ensure more equitable access to land in dualistic countries in Southern Africa. The strategic thrust for the former might be community-based land tenure reform, as illustrated in the Mozambique case study. Other possibilities include promulgation of pastoral codes in arid/semi-arid Sahelian countries and of codes of conduct for artisanal fisheries in West Africa, *gestion de terroir* approaches, or conflict resolution in connection with community-based natural resource management.
- **Public Goods.** It is important to maintain a balance between short term interests of many farmers and the longterm interests of government and the population as a whole. One critical category of public goods for the region is investment in technology development, especially when targeted to resource

management, maintenance of biodiversity, eradication of widespread pests such as tsetse, non-commercial small holders and vulnerable groups including women.

### Information and Human Resources

In spite of low levels of education in rural areas of the region, smallholders have considerable indigenous technical knowledge. Past extension approaches based on technician-led, message-based prescriptive recommendations are ill suited to emerging problems. High levels of HIV prevalence among farmers and agriculture service providers are also a source of serious concern. New multi-component integrated technologies such as conservation farming, integrated pest management and land husbandry require new extension approaches that emphasise experiential learning and building farmers' capacity to make informed choices. Gender issues are equally important and the vital role of women farmers in each farming system needs to be more fully recognised. This recognition should be accompanied by effective measure for raising the managerial and technical capacity of women farmers and a search for other ways of empowering them to play a more dynamic role in the changes necessary for future improvements to be implemented.

## 4 Middle East and North Africa Region<sup>28</sup>

### INTRODUCTION

The Middle East and North Africa Region (MNA) includes 16 low and middle income countries and a total area of 1.1 billion ha, of which some 62 percent is largely uninhabited due to extremely arid conditions. The total population of 296 million people is about 40 percent rural and includes about 84 million agriculturalists and their dependants. Of the 29 million agricultural labour force, 13 million are female. Settlement patterns vary depending on historical forces and political changes, but populations are generally increasing in major cities and concentrated in larger villages. There are a significant number of pastoralists who are highly mobile and move seasonally between low and high altitude in mountainous regions and from the wetter zones to the drier steppe in lowland areas. There is a wide diversity of environments, from the wetter coastal regions to high mountain plateau and to drier steppes and desert in the interior. Adequate and reliable rainfall is generally confined to a narrow strip close to coastlines, but there are significant areas of irrigated land along the major rivers of the region where it is feasible to pump groundwater. The humid areas account for two percent of the land area and over 6 percent of the population, whereas the arid and semi-arid areas account for 85 percent of the land area and contain 23 percent of the population. These average figures mask the fact that there are centres of population as well as intensively irrigated areas carrying high population densities, in the arid and semi-arid areas zones.

The Middle Eastern sub-region was probably the birthplace of agriculture, and is the centre of origin of

major cereal and legume crops and of the domestication of sheep and goats. Typically, crops can be grown with rainfall though the winter period or with irrigation during the summer or winter. The main rainfed crops are wheat, barley, legumes, olives, vines, fruit trees and vegetables. Many subtropical crops are also grown with irrigation in the summer months. Livestock, mainly sheep and goats, are now an important feature of many farming systems and provide an important link between and within the different farming systems, from extensive pastoralism to feed lots in peri-urban agriculture.

Generalised economic performance statistics about the region are dominated by the few very wealthy oil exporting states but these mask the huge inequalities of income and livelihood that exist across the area. The growing cities have proved to be a magnet for many young people, but unemployment rates are high and poverty is widespread. Approximately 22 percent of the total population fall below the international poverty line of \$US1 per day (World Bank 1999) and an estimated 13 percent are undernourished (FAO 2000).

There is significant poverty and malnutrition in rural areas and land ownership is highly skewed with a small number of farmers owning large areas of the better quality land. Poverty is aggravated by uncertain rainfall, limited choices for crop and livestock production, poor yields and continuing natural resource degradation. Markets are weak and support policies are geared toward assistance to urban areas and the provision of cheap food. Rural farmers and pastoralists are particularly vulnerable to the widespread policy of providing price subsidies on imported grains

<sup>28</sup> The material in this section is extracted and summarised from the Global Farming Systems Study: "Regional Analysis: Middle East and North Africa"

and other crops in order to support urban populations. The low productivity of rainfed agriculture limits the potential for agricultural expansion without additional and more efficient irrigation, but access to water is a key political and economic issue which is growing in importance. In 1997 agriculture contributed 13 percent to regional GDP, accounted for 19 percent of exports and 50 percent of employment in the region. However, constraints to agricultural expansion have meant that many economies have had to rely on alternative engines for economic growth based on oil, mining, manufacturing, trading and other commercial activities.

### CHARACTERISTICS OF THE MAJOR REGIONAL FARMING SYSTEMS

The study has defined and characterised eight major regional farming systems, based on criteria which include natural resources and climate, altitude, main crops, importance of livestock and access to supple-

mentary or full irrigation (see Map). The systems, and their estimated potentials, are summarised in Table 4-1.

#### Irrigated Farming Systems

The large-scale Irrigated System covers about 19 million ha of land, with about 6.6 million ha equipped for irrigation, of which some 5 million ha are estimated to be under cultivation. The agricultural population is estimated at 16 million people. These large scale irrigated systems are primarily found along the Nile, Euphrates and Tigris rivers (Egypt, Syria, Iraq) and in Morocco and Libya. Small-scale systems, on the other hand, are far more dispersed and are present on minor water courses and where ground water is accessible. Livestock are relatively unimportant within this system.

The large irrigated systems have often developed downstream from major dams and most have a long history of development. They are dominated by inten-

Table 4-1: Major Farming Systems of the Middle East and North Africa<sup>29</sup>

Farming Systems	Land area (percent of region)	Agric Popn (percent of region)	Principal Livelihood	Incidence of Poverty	Potential for poverty reduction	Potential for agric. growth
Irrigated	2	19	Fruits, vegetables, cash crops	Moderate for small farmers	High	High
Highland Mixed	7	32	Cereals, legumes, sheep	Extensive	Moderate	High
Rainfed Mixed	2	19	Tree crops, cereals, legumes	Moderate for small farmers	High	High
Dryland Mixed	4	15	Cereals, sheep, remittances	Extensive for small farmers	Moderate	Moderate
Pastoral	23	10	Sheep, goats, barley	Extensive for small herders	Moderate	Low
Sparse (arid)	62	5	Camels, sheep	Low	Low	Low
Coastal Artisanal Fishing	negligible	little	Fishing	Moderate	Low	Low
Urban-Based	negligible	little	Horticulture, poultry	Low	Low	Low

Priority systems for poverty reduction and/or growth are shaded

<sup>29</sup>Data on farming systems are considered to be preliminary estimates, which will be subsequently revised.

sive, year-round cropping of a wide variety of annual crops. Many systems suffer from recurrent problems of poor water management, salinity, sodicity, and gypsum soil problems (e.g., Euphrates). Several of these systems represent significant areas within the overall cropped area of the country (e.g., Nile delta). These systems are usually highly diversified, growing a mixture of cash crops (e.g., cotton, sugar beet and vegetables and other high value crops and fodder.). Cropping intensity varies between 120 percent and 160 percent.

Many of the large-scale systems have combinations of State and private land ownership, and conflicting management objectives and weak institutions appear to be common problems. Centralised management of water access and distribution is common and land may be managed in large blocks with mechanised systems. In other cases, water access and distribution is managed centrally but the land has been allocated to large numbers of tenants or owners who individually manage small plots, from 0.5 to 5 ha, and share other inputs and marketing facilities. Water user associations (WUAs) are becoming more prevalent in these situations, dealing with ongoing operation and maintenance of the irrigation systems and ensuring the implementation of better water sharing procedures.

Privately financed and operated tubewell irrigation has arisen in recent years. Water is extracted from deep tubewells and is distributed through sprinkler or trickle systems to farmers, who mainly grow high value vegetable, flower and fruit crops for export. These systems present a challenge to older irrigated systems, but are also a threat to traditional small-scale systems that rely on simple water lifting devices. Where the new systems pump large quantities of water, the rate of extraction may exceed the rate of recharge, pushing down groundwater tables to a level which traditional systems can no longer reach (e.g. the Sana'a Basin in Yemen, the Souss Plain in Morocco, the Bekaa Valley in Lebanon).

Small scale irrigated systems are widespread across the region and although they may not be important in term of numbers of people involved or in the amount of food and other crops produced, they are a significant element in the survival of people in dry areas. Such systems develop along small perennial streams and at oases, or depend on flood and spate activity or shallow boreholes. The major crops are mixed cereals and vegetable cropping. These locations (where water is available) always provide a focal point for socio-economic activity but intense local competi-

tion for limited water resources between livestock owners and farmers is becoming increasingly evident.

There is considerable potential for these systems to develop more intensively using a combination of more equitable and rational regulation and pricing of water, more research into water quality management, participatory water management systems, restorative soil management, co-operatives, credit and market access for smaller producers.

### Highland Mixed Farming System

This system, covering 74 million ha, is most widespread in Iran, but is also important in Morocco and Yemen. An agricultural population estimated at 27 million cultivate about 22 million ha, of which almost one quarter is irrigated, by owners or tenants. Annual rainfall varies from 200-800mm. A large number of smallstock and some cattle are supported by the system.

The high altitude arable and common grazing lands typical of this system experience slow plant growth during the cold winters. Wheat and barley dominate the crop mix and are adapted to survive extended cold periods. They are generally grown in monoculture with occasional fallows. Surrounding these cropped areas are common grazing lands, which may be utilised by owners from the same region or by pastoralists. A typical farm may have a small area of cropped land (1-3 ha) which is primarily used for cereal production, and access to common grazing land for sheep and goats.

On higher altitude sloping lands in several countries there are terraces which were created several thousand years ago (e.g. Yemen). These have been planted with fruit trees, coffee, qat, oil trees and vegetable crops, sometimes with supplementary irrigation in the summer months for crops such as melons or high value fruits.

The opportunities for further development of these areas in the next 30 years include the restoration and revival of terrace cultivation and water management systems, the further development of community management of water catchments and the better integration of crop and livestock systems.

### Rainfed Mixed Farming System

This system covers an area of about 23 million ha in coastal areas of Morocco, Algeria, Tunisia, Lebanon, and Syria, as well as in more favourable zones of

Northeast Syria and Northwest Iraq. Some 14 million ha of land is cultivated by an agricultural population of about 16 million. A wide diversity of rainfed crops and trees are grown but irrigation within the system is limited (0.6 million ha). The sheep and goats within the system make extensive use of crop residues and other fodder. In the wetter areas (600 to 1000mm) with a growing period of more than 270 days, tree crops (olives, fruits and nuts) are an important component and may dominate the system. They may be intercropped with cereals and vegetables while the trees are immature. Wheat, barley, lentils, chickpeas, potatoes, sugar beet, and faba beans are the main annual crops. Vegetables, oil crops and flowers may also be grown, often with protection and irrigation in order to capture specialised, niche markets in Northern Europe and elsewhere. Many of these farms are intensively capitalised with a high level of inputs, and farmers are very sensitive to market opportunities. There are a number of specialised dairy and poultry enterprises. These systems may also include summer crops grown following winter fallow or with some supplementary irrigation. In the drier areas of the farming system (600 to 300mm) where the growing period is restricted to 180-270 days, cereals are more important and there is often a greater degree of interdependence among farming families who frequently share resources and equipment, and links to dryland farmers and pastoralists who graze the stubble.

Typical farm sizes are about 5 ha, with scattered parcels of land of different quality. Cereal and legume lands are generally managed collectively in blocks to aid mechanisation of operations and post-harvest grazing management. Off-farm income, especially from seasonal urban employment, may be important.

The system presents major opportunities for intensification through combinations of restorative soil and water management technologies, equitable land reform, the removal of price distortions, the development of farmer organisations and support for integrated support services. Irrigation is becoming increasingly important but there are also dangers from over-extraction and lack of appropriate regulation and pricing. Urban development represents both a major threat as well as an opportunity for the development of intensive, peri-urban food production systems.

### Dryland Mixed Farming System

With only 150-300mm of rain per annum, this system represents a drier version of the Rainfed

Mixed Farming System and covers some 42 million ha along some coastal zones in Morocco, Algeria, Tunisia, and Syria, as well as in the interiors of Syria, Jordan, Northern Iraq, and parts of Northern Iran. The agricultural population of 13 million cultivate some 17 million ha and manage significant numbers of small-stock, and some cattle, on an estimated 2 million holdings (owners or tenants). There is about 3 million ha of irrigated land within the system.

The amount and distribution of rainfall is highly uncertain, and the system is dominated by cereals (mainly barley and wheat), grown in rotation and with single or double season fallows. Occasionally, and in more moist areas, legumes (lentils and chickpeas) may be grown. Interactions with pastoral systems are strong as sheep may graze whole-crop barley in a dry year and the stubble of the harvested crop in average or wetter years. Small areas of irrigated vegetables may be grown in association with these systems, or sometimes cereals are given supplementary irrigation. Emigration from the system has been increasing and wind erosion is a problem.

A typical farm has about 7 ha of arable land, scattered in several parcels around the village. A number of farming families have small sheep flocks which are grazed around the village and for part of the year in the steppe. Poorer families have some members who work for larger farmers or find temporary or more permanent work in urban areas.

The potentials of this system lie in the opportunities for water harvesting, conservation tillage and diversification crops that are adapted to the harsh conditions. There is also scope for better integration of crops and livestock in these systems.

## REGIONAL STRATEGIC PRIORITIES

A review of the characteristics, trends and potentials of the main farming systems in the Middle East and North Africa region indicates the close interdependence of people, water and land-based resources, as well as linkages across systems (e.g. in livestock and labour movements). With the exception of irrigation, public investment in rural areas of the region has been modest, and many policies have been detrimental to the sector. Poorer farmers in dry rainfed areas and pastoralists – who occupy a unique role in the rural economy and in the maintenance of the environment in dry areas – have been particularly ignored. In view of the interdependency of resource management systems, the neglect of one farming system could have

major impact on people dependent upon other systems. Research and extension institutions and systems have been notably weak and unproductive for many years and there has been a serious lack of systemic thinking about the nature of natural resources and how they might be managed more sustainably in order to reduce poverty.

The most significant trend over the past 30 years has been rapid urbanisation. This trend is expected to continue, leading to further demand for water and food, particularly cereals and livestock products, and the growth of urban and peri-urban systems of food production. In the rural areas, the proportion of income earned from non-agricultural activities is likely to continue to grow, and this has to be considered when strategic options for potential investment are being reviewed. The key strategies for the region presented below are considered to be essential elements for an overall support programme for the revitalisation of farming systems and rural livelihoods in the region. They are all, to a large extent, interdependent, as they cut across the farming systems as we have characterised them and have a greater or lesser relevance across the region.

### Natural Resources and Climate

The key issues related to natural resources arise from deterioration in quality of both water and soil resources. In addition, non-renewable water resources are under increasing threat from excessive extraction in a number of “hot” spots. Erosion of soil resources from both wind and water continues, often as consequence of inappropriate mechanical management methods and heavy grazing pressure in specific areas. Climatic changes are likely to result in greater extremes of drought conditions, which may well affect the low rainfall areas more severely. The priorities that need attention are:

- The revival of older systems of rational, rotational grazing land management, which involve all stakeholders.
- Watershed, rather than individual farm, soil and water management systems.
- The development of sustainable groundwater management systems.
- Long term, sustainable soil and water management techniques for annual and perennial cropping.
- Conservation of the biodiversity base, particularly in light of the high number of precursor species for major crops found within the region.

### Science and Technology

Despite the region’s exceptional history of innovation in agricultural science and technology, the modern era has not served the region or its peoples, well. There is a need for a classical revival of science and technology, which truly serves the needs of the majority of rural and urban people. The key areas would appear to be:

- The restructuring and integration of research and extension systems.
- More research on the development of more sustainable and integrated farming and livelihood systems. (IPM and ISWM).
- The incorporation of farmers, both men and women, into the research and dissemination system.
- More work on irrigation water use efficiency (both technical and social).
- Development of organic foods (crops and livestock) and medicinal plant production and processing systems.
- Minimum tillage systems of soil and water management.
- Technologies geared specifically for women producers and processors.

### Globalisation and Market Development

The rapid development of global, highly competitive, markets has resulted in great pressures on existing production and marketing systems, and many smaller producers are under serious threat. Nevertheless, the rapid pace of urbanisation within the region offers potential for new demand in these areas, including for higher value products, if producers can adapt their practices to new conditions. Support is also needed for many small and medium rural businesses in adapting to these changing conditions. Key interventions would include:

- Elimination of state-imposed impediments to rural small enterprise development in areas such as storage, processing and services, and the provision of training and other support measures.
- The promotion of producer organisations which can supply urban and export marketing systems and develop the capacity to increase the value of traditional outputs.
- Provision of information, market contacts, and financing of trial shipments to create direct producer-consumer links for niche goods (organic foods, herbs, and medicines).

- Credit schemes linked to the adoption of more efficient irrigation technologies and the use of minimum or no-till cultivation practices.

### Policies, Institutions and Public Goods

The region has a recent history of centralised control of resources, which has often excluded smaller farmers and livestock holders from access to key resources and made change a difficult and uncertain process. Areas of potential improvement include:

- Re-assessment of existing water regulations, particularly related to the pricing of water and the use of non-renewable groundwater resources.
- More balanced policies on grain pricing, imports and regulation to give better market access to smaller, rural producers.
- Continuing market-based land reform in order to develop more equitable access to land resources and more sustainable land use practices.
- Support for the formation of water and land use groups in which participants have an equal say in management plans and decisions.
- Decentralise power structures, with wider involvement of women, relating to rural development and livelihoods.

### Information and Human Resources

Perhaps the key to the revival of agriculture in the region is through the investment in the development of greater access to local and international knowledge and information systems. Steps would include:

- A restructuring and reorganisation of higher agricultural education systems which will focus more on rural and rural-urban livelihood systems rather than production agriculture.
- Redesign curricula to work more on systemic, interdisciplinary approaches to learning (i.e., not limited to disciplines and commodities).
- Improve access to local and international market information for small producers.
- Improve access to relevant information for women farmers and rural workers.
- Focus the education of young rurally based people on the opportunities for development of agro-industries, tourism, ecotourism and the rich history of the region.
- Revive research and extension systems to bring them more in line with participatory approaches to research and development, which are now widespread.

## 5 Eastern Europe and Central Asia<sup>30</sup>

### INTRODUCTION

The Eastern Europe and Central Asia Region (ECA) encompasses 28 countries with widely divergent levels of economic development. With between 10 and 30 percent of the population dependent on agriculture, the countries of the region are at an intermediate stage of sectoral development. History as well as proximity to the European Union (EU), determine two sub-regions with significant differences in available resources and level of social and economic development, Central and South Eastern Europe, and the Commonwealth of Independent States.

The Region covers a total area of 2.4 billion ha, or nearly 18 percent of the globe. Total rural population is about 154 million, of which 56 percent are economically active in agriculture. Average population density is low, but there is significant variation depending on the agro-ecological zone and latitude. Huge areas covering more than half of the entire region are in the arid and/or dry sub-humid areas above 78° of latitude, where permafrost and lack of moisture render them completely unsuitable for agricultural production. This is the area with extensive forest resources, the largest part of it in the taiga zone. The region's most productive agricultural area is the moist sub-humid agro-ecological zone covering 10 percent of total area. A further 27 percent of total area lies in the arid and semi-arid zone, and has only limited production potential unless irrigated. Mountain and hilly areas of more than 30 percent slope comprise the remaining 11 percent of total area of the region.

The level of development differs widely across the region. On the average, in 1998 agriculture contributed

12 percent of GDP in value added terms, but individual country figures range from 4 percent to 54 percent. The average contribution of agriculture to exports was 11 percent. There are also big differences in the importance of agricultural labour in countries' labour force ranging from 11 to 54 percent<sup>31</sup>. During the last 10 years the number of people exposed to poverty has substantially increased: by 1997, five percent of population were living on less than \$US1/day, while another 20 percent live on less than \$US2/day<sup>32</sup>.

Besides the global trends and factors that influenced developments in agriculture during the last decade, the countries of the region have been passing through the complex processes of transforming their political and economic systems. Transformation of underlying economic structures, particularly those relating to the rural sector, has proven to be a far more complex task than originally envisaged. To a large extent the inherited large-scale structures have survived the transition, being reborn as co-operatives or corporate holdings. By contrast, in most of the region, the family farm has emerged primarily as a response to rural poverty and unemployment, providing household-oriented production with low external input usage and output productivity. Only in a few instances have truly commercially oriented family units been able to establish themselves.

### CHARACTERISTICS OF THE MAJOR REGIONAL FARMING SYSTEMS

The heterogeneity of agro-ecological, political, economic and social conditions in the region has resulted in the

<sup>30</sup> The material in this section is extracted and summarised from the Global Farming Systems Study: "Regional Analysis: Eastern Europe and Central Asia"

<sup>31</sup> World Bank Development Indicators 2000.

<sup>32</sup> World Bank Development Indicators 2000.

development of variety of farming systems. Altogether eleven major farming systems have been identified for the purposes of this study. The systems are characterized by the resource base, pattern of livelihoods or economic activities and production structure of the dominant farm type. There are significant differences among those systems regarding the level of economic and institutional development, their potential for increased output and reduction of rural poverty. Three of eleven identified farming systems appear to be of great significance from the point of view of agricultural growth and poverty reduction, and were selected for more detailed analysis.

### Mixed Farming Systems

These systems are located in mountainous areas of Central Europe and occupy the area of 85 million ha. The total population in the areas of these farming systems is 99 million, out of which 36 million live in rural areas and about 16 million are economically

active in agriculture. The incidence of poverty is moderate and affect mostly minorities, marginal groups, unemployed and unskilled labourers and people living in marginal areas.

The conditions for agricultural production are very heterogeneous. In the warmer parts of the region, severe droughts sporadically affect crop production and yields. The growing season lasts between 120 to 300 days. The types and quality of soils vary largely, from poor sandy soils to rich chernozem. Most of the agricultural area is located in the plains and crop production is largely dedicated to wheat, maize, oil crops and barley, combined with smaller proportion of fruit and vegetables. Livestock production is dominated by primarily dairy cattle and pigs.

Privatisation and changes of economic systems, policies and institutional arrangements during the last decade led to transformation of the large-scale state and collective agriculture to more efficient and smaller farming units. Private farms now own most of the land but there are considerable differences in the organisational forms. In terms of ownership and

Table 5-1: Major Farming Systems in Eastern Europe and Central Asia Region

Farming systems	Land area (% of region)	Agricultural population (% of region)	Poverty	Potential for poverty reduction	Potential for agricultural growth
Irrigated	1	5	Moderate to severe	Moderate	Low
Mixed	4	19	Low to moderate	High	Moderate
Forest based Livestock	3	6	Moderate	Moderate	Moderate
Horticulture Mixed	3	12	Moderate to severe	Moderate	Moderate
Large scale Cereal-Vegetable	4	17	Moderate to severe	Moderate	High
Small scale Cereal-Livestock	1	4	Moderate	Moderate	Low
Extensive Cereal-Livestock	18	16	Moderate to severe	Moderate	Low
Pastoral	3	11	Moderate to severe	Moderate	Low
Sparse (cold)	52	2	Severe	Low	Low
Sparse (arid)	6	9	Severe	Low	Low
Urban based	n.a	n.a	Severe poverty	Low	Low

Priority systems for poverty reduction and/or growth are shaded.

management the system is characterised by two dominant subsystems: (i) Small to medium scale private family farms and (ii) Medium to large corporate/co-operative farms.

Small to medium-scale private family farms operate between 5-100 hectares. Most of them are small in size with fragmented land, frequently using obsolete second hand machinery. In order to minimise the costs farmers frequently apply limited cultivation and less fertiliser, resulting in lower yields. The access to the input and output markets is restricted by activities of local monopolies. Increased commercialisation is also inhibited the lack of market support institutions and information, as well as the lack of farmers' management capacity and knowledge. Land markets are not fully functional and in many cases farmers are faced with unclear property rights and inadequate land registration systems, which combined with the lack of rural finance restricts the access to credit. The most important crops are winter wheat, sunflower, oilseed rape, fodder crops oil crops and fruits and vegetables. Livestock production often complements crop production so the produced crop is partly used as feeding material. Smaller farms are usually diversified, whilst the bigger ones tend to specialise in livestock production. With the prospects of acceding to the EU in the near future, the newly established family farms, will become more specialised and become similar to those of the EU.

Large-scale corporate/co-operative farms operate between 300 to 6 000 ha of own and partly hired land. Corporate farms generally have qualified staff, labour force and management, and are reasonably well equipped. Nevertheless, despite relatively good productivity, subsidisation and easy access to credit as compared with small individual farmers, the level of profitability is low due to the inefficient management and over employment. The number of employees in co-operative farms remains high, increasing the production costs. Available machinery and assets, apart from a few, are obsolete and old. It is expected that with the accession to the EU many of those farms will further restructure and decrease in size.

#### Large Scale Cereal-Vegetable Farming System

This system is typical of Ukraine Southwest part of Russian Federation and the Republic of Moldova and covers an estimated 100 million ha principally in the

wet sub-humid agro-ecological zone, and has an estimated total population of 68 million. Rural populations are in the range of 34 percent overall, declining only slowly. Most of them are engaged in large-scale agricultural production in collective agricultural enterprises and are partly paid in kind. Farms generate little or no cash income and co-operative members or farm labourers depend largely on their household plots to sustain their livelihoods. Relatively high levels of poverty mostly affect old people, young families and former co-operative members.

Annual precipitation varies from 360 mm to 1 600 mm. Droughts are frequent in the southern areas, justifying irrigation. In the north of this region, drainage is more important than irrigation. The dominant soil types are the rich (black soils and brown chestnut soils).

Most of the farms are still large, ranging from 500 to 4 000 ha. The dominant ownership is co-operative or corporate, although private ownership is gradually gaining in importance. The main crops are wheat, barley, sunflower, maize, sugar beets and vegetables. The yields have been constantly decreasing during the last 10 years, and have reached very low levels (cereals 2 to 3 tonnes/ha, sugar beets 10 tonnes/ha). Even during the Soviet era, yields were poor and did not exceed 3 tonnes/ha for cereals.

The deteriorating financial situation of large scale farms has resulted in worn out machinery and lower quantities of inputs being applied, in turn worsening yields and profitability. Land reform is still incomplete, as most workers have received only paper shares, and are not entitled to physical parcels or assets when they leave. Restructured farms hardly change their style of management, nor do they improve their profitability, and the restructuring process is creating very few real private farms.

While land reform and farm restructuring must go ahead with renewed commitment, the best opportunity to improve farm profitability, irrespective of size and status, is to introduce Western Europe technology for cereal growing. Such technology, based on a modest increase in nitrogen fertilisation, combined with the use of small quantities of modern fungicides, can double cereal yields, restore profitability and allow to start re-capitalising. It has been verified in a number of farms in Ukraine, but adoption is constrained by difficult access to imported agro-chemicals, specialised equipment parts, such as precision nozzles, and indifference of scientists and managers, pointing to the need of awareness building and training.

Human resource development is key for the future development of this system, including training in financial and business management and in human resource management. Training farm managers and workers in integrated crop management is also essential as existing knowledge is excessively discipline oriented. Advisory services need to be established, particularly for the nascent family farms.

### Extensive Cereal-Livestock Farming Systems

This system is typical for semiarid regions of the Russian Federation and northern Kazakhstan. The average length of the growing season is 125 days, and annual precipitation ranges from 200 to 400 mm, concentrated during spring and fall. Winters bring little snow, many sunny days and strong winds while summers are dry with hot winds. The system extends over 425 million ha, with a rural population of roughly 25 million. This is the steppe area with natural grassland which was home to sheepherders migrating over long distances to avoid extreme winters, and seeking seasonal pastures. During the Soviet era, pastoralists were collectivised, and livestock production intensified based on cultivated and irrigated fodder. Sheep numbers were greatly increased, resulting in the serious degradation of pastures. During the sixties and seventies, the "Virgin Lands" programme transformed the steppes from grassland pastures into huge and highly mechanised farms for wheat production, sometimes in areas far too marginal for sustained cultivation.

Land reform has formally privatised former state and collective farms. The new farms remain mostly very large, often well above 10 000 ha, and account for over 80 percent of the land, the rest being used by "peasant farms", private farms and household plots, the latter providing about half of the total value of agricultural output. Principal outputs are wheat and barley, hay and some industrial crops combined with traditional breeds of sheep, cattle and horses. Livestock production is based on summer pasture grazing and winter stall-feeding, and is now essentially private.

Farm restructuring produced relatively few private farms, as members were not informed of their rights or afraid not to be able to access inputs or machinery services. Most of the restructured farms have not improved in efficiency and profitability, and land remains essentially under state ownership, reducing access to credit and incentives to invest. The

financial situation of large-scale farms has continuously deteriorated, and wages are not regularly paid. The decline in production is due to many factors, including declining input use, deteriorating irrigation infrastructure and machinery, and declining soil fertility; some 20 percent of the land has been dropped from production. In Kazakhstan the new bankruptcy policy has led to an acceleration of restructuring, with positive outcome in the richer parts of the system, but socially serious consequences in the more marginal areas, where farms are often bought by outsiders only to be stripped of their moveable assets, leaving workers without equipment to till their small plot and forced to quit. Farm restructuring projects have not been very successful so far, which raises questions as to the validity of a purely financial approach to restructuring.

Services remain grossly underdeveloped. Former state-owned enterprises continue to enjoy a monopolistic position in the industry and government intervention in markets is still common. Barter still dominates the trade, representing over 80 percent of total sales. Agricultural research remains widely arranged on the Soviet pattern, is under-funded and unresponsive to farmers' problems. Competitive grant schemes would facilitate a reallocation of resources to priority domains and practical adaptive research. Advisory services are required, particularly for small family farms and need public financing, particularly in the first years.

Technology options exist to improve productivity and protect the environment. The main opportunity lies with conservation agriculture, including reduced tillage, as developed in particular in similar areas of North-America, and which were explored by Soviet scientists, but were not favoured under the previous command economy which emphasised output at any cost. Conservation agriculture would enable moisture retention during the winter, utilise summer precipitation efficiently, and address serious wind erosion problems resulting from cultivation, and deserves to be adapted to local conditions through practical research involving farmer participation. Alternative rotations and crop diversification that could provide farmers with greater flexibility and protect the resource base, should also be investigated. Livestock will assume renewed importance, relying on traditional meat breeds, which are well adapted to the steppe environment, and on extensive grazing.

## REGIONAL STRATEGIC PRIORITIES

The key regional issues encompass natural resource management, land reform and farm organisation, science and technology development, markets, labour and rural poverty. After almost ten years of reforms, the divide between the Central and Southeast Europe on the one hand and the Commonwealth of Independent States countries on the other hand has sharpened. Due to more comprehensive transition policies, the transformation of agriculture is well advanced in Central Europe, production and productivity are picking up, and job opportunities exist outside agriculture. By contrast, the transformation of agriculture in the Commonwealth of Independent States countries is still in its early stages. The large-scale farm structures have survived in many of those countries, and distortions in production, pricing and marketing of “strategic” products continue. Emphasis is therefore given to the Commonwealth of Independent States countries, which faces more acute issues, for which solutions are not obvious.

### Natural Resources

Natural resources in the region have been exploited in an unsustainable manner for decades. During the Soviet period, agriculture was characterised by heavy mechanisation, intensive use of agro-chemicals fertilisers and pesticides, poor water management, and excessive numbers of animals. As a result, soil degradation has been extensive. It was hoped that privatisation would improve the situation, but so far, the only environmentally positive impact has been the reduction in the quantities of chemicals being used.

**Irrigation.** Excessive expansion of irrigated systems, poor water management and the difficulty to rehabilitate infrastructure have led to large-scale environmental, economic and social fiasco. Solutions to contain further degradation and develop sustainable systems involve the establishment of participatory management systems, as successfully piloted in several countries, but large-scale rehabilitation will require huge investments and time. Not all systems can or should be rehabilitated. Where rainfall exceeds 300-350 mm, rainfed farming could be successful. There, conservation agriculture would improve the use of rainfall water, increase yields, and reduce drought risks, besides reducing soil erosion and rebuilding soil organic matter.

**Pasture management.** Poor pasture management has put severe pressure on the natural resource base in the pastoral farming systems, resulting in the deterioration of natural vegetation and extensive soil erosion. New systems of pasture management are needed that preserve the resource and regulate access without excluding the poor. They must be developed with the local communities and focus on protection and rehabilitation of areas of intense grazing close to the villages (e.g. through cut and carry systems) and fuller exploitation of remote pastures.

### Science and Technology

The research system is largely run-down throughout the Commonwealth of Independent States sub-region, as resources have dwindled and many scientists have left. Research contribution to agricultural revival is currently hampered by lack of funding and by difficulties in understanding farmers’ needs and how to respond. Former recommendations are not helpful for improving present practices. However, farmers need help as they are forced to re-invent farming systems and technologies adapted to the new environment. Competitive grant funding can help revitalise research systems, introduce new ways of working and focus research on farmers’ priorities. However, increased regular funding and investment are also needed once there is agreement on national priorities and reorganisation.

The research priorities are in facilitating the production of quality seeds, in improving crop and herd management and in facilitating the development of farming systems taking into account local agro-ecological conditions and market opportunities. The best opportunities would seem to lie in developing conservation agriculture in semiarid zones (extensive cereal-livestock farming); intensifying grain production through borrowed technology (cereal-vegetable large-scale system); improving water management in the irrigation systems; and developing feed and pasture management systems well adapted to local situations.

**Effective advisory systems** are now needed, particularly for small family farms. Due to the paucity of well-adapted techniques, advisors should develop skills in simple participative experimentation to test, e.g., different varieties. Their work should also cover training and advice in farm management, business plans, accounting, credit, etc. Some of these services could be

against payment, but most services will need public funding, at least in the initial stages. In spite of the urgent need, development should be slow and flexible, emphasizing quality and responsiveness over quick coverage. Programs to support advisory services development need to place a strong emphasis on training, e.g. in participatory methods and in farm management.

**Participatory Technology Development.** Fine adaptation to local circumstances is required to use efficiently limited inputs. This is a case where participatory technology development (PTD) may be the most effective way to adapt and disseminate new technology. In such an approach, farmers themselves are trained in experimentation, and decide with the help of scientists what they want to test and how. Domains that would most benefit from a PTD approach include conservation agriculture (including zero or reduced tillage), improvement of livestock feeding systems, and generally any development that implies changes in management.

### Globalization and Market Development

Markets have been disrupted throughout the region. Within the Russian Federation, barriers were established to restrain movements of basic food products. Outside, former providers have lost the Russian market for fruits, vegetables and other high value crops, which became too expensive for most consumers, or too low in quality for the wealthier. Several governments still interfere in unpredictable ways in prices and trade, making agricultural production a risky venture. Many obstacles to trade are formal or “informal” taxes which increase the cost of transport, limit the reach of goods, discourage exploration and testing of new market opportunities, and in general reduce the speed at which farmers will specialise in activities where they have comparative production advantage. In the CSEE countries, the macro-economic environment has become more favourable, and prices are open to world market influences. Support for domestic production has increased in the past few years, but remains generally below EU levels. The challenge will be to retain support methods that promote efficiency and competitiveness.

### Policies, Institutions and Public Goods

**Land Tenure and Farm Organisation.** Excessive attention has been placed in many countries on farm size and economies of scale. Where large scale farms have been kept, they have not proven more effective than the small private farms, except regarding access to inputs and markets, but this has not translated into higher productivity or greater market orientation. The large farms would not survive without their associated household plots, the importance of which is growing. International projects that aimed to facilitate restructuring and introduce modern management have not developed any convincing model yet for improving the large farms.

By contrast, small family farms certainly had a difficult start but seem far more responsive to market opportunities and their situation is slowly improving. Moreover, they are retaining an important labour force, which would otherwise be unemployed. Where policies have favoured large-scale farms, it is time to review those policies and their outcomes. Programmes that would look at the whole farm, rather than just at farm management and ownership, and envisage the transformation of the whole community, are perhaps the only way to avoid sweeping social and economic failure. Such programmes would start from the existing symbiotic relationship between the large scale farm and the workers’ household plots and explore the possibilities to strengthen the latter into private farms, while changing the former into a service provider with or without a core farm structure.

Where land has been massively privatized and distributed, the focus now needs to be on the establishment of formal land tenure institutions as well as on the provision of a whole range of farm support services, a domain where small scale farms are weakest, although many forms of cooperation have already developed. Mechanisms for ensuring fair, transparent and secure access to land and natural resources and the protection of property rights are required. New professional skills need to be acquired, particularly in the market related fields, land valuation and real estate management.

**Labour, Employment and Poverty.** The former sovkhoses and kolkhoses provided high levels of rural employment. With the demise of most non-farm activities, agriculture remains the major (or unique) employer, and needs to absorb labour from other sectors, although farm workers were already underemployed.

Once privatised, the large scale farms have delayed and reduced salary payments, rather than shed labour. This attitude indicates an ambiguous relationship which ensures that, as long as the large scale farm survives, workers continue to receive a nominal wage plus facilities to cultivate their own plot. Wholesale farm liquidation as happening in some places can have dramatic consequences on livelihoods if workers lose the possibility to continue farming their plots.

Land reform policies that focus on just creating well functioning large farms, disregarding the future of workers, may be harmful, as anyway the restructured farms are not visibly more efficient. Where large farms still prevail, agricultural policies need to be tested for their potential impact on labour and poverty. But this is not sufficient, and specific rural poverty alleviation policies are needed to better inform the poor on their rights and involve the civil society in protecting those rights. Rural poverty allevi-

ation initiatives need to recognise the importance of rural communities and rural livelihoods, including non-farm aspects.

### Information and Human Capital

A high priority should be assigned to rural education, both agricultural and non-agricultural (vocational) education, in schools. Whilst vocational training should equip farm household members to transfer to the non-farm economy, farmers themselves will need stronger skills in order to exploit modern technological and market opportunities.

Given the rapid policy, institutional and technological transitions in the environment of farming in the region, widespread information dissemination is important as farm incomes are to rise.



## 6 South Asia Region<sup>33</sup>

### INTRODUCTION

The South Asia (SAS) region<sup>34</sup> supports 1 344 million people or 26 percent of the population of developing countries, of whom 970 million live in rural areas. Of these, some 751 million people in about 150 million households depend for their livelihood on farming, fishing and pastoral occupations. The region, which covers 514 million ha, has the highest rural population density, *viz.* 1.88 persons per ha, among all the regions in the world.

The high population density and long history of human settlement in the region have resulted in the utilisation of all significant natural resources available for agriculture. About 20 percent of the region consist of steeply sloping hills and mountains supporting 5 percent of the regional population. The main agricultural areas comprise 19 percent of humid or moist sub-humid lowland with 43 percent of the regional population, 29 percent of dry sub-humid containing 33 percent of the regional population, and 32 percent of semi-arid and arid lowland containing 19 percent of the population.

Of 1.2 billion people world-wide living on less than \$US1 per day, more than 40 percent are found in South Asia. The vast majority of them live in rural areas and most are under-nourished. Indicators of other dimensions of poverty, such as female illiteracy of 59 percent, child mortality of 89 per 1000 children under 5 years and a child malnutrition rate of 51 percent, also point to extensive poverty in the region. The rural poor are particularly vulnerable to droughts, floods and other natural disasters. An estimated 66 percent of the vulnerable population in

India are small farmers and 2 percent are artisanal fishing families. Women are particularly disadvantaged – female-headed farm households have average incomes that are far less than those of male-headed farm households. Of the eight countries in the South Asia region, only Maldives and Sri Lanka have achieved middle-income status. Average per capita income in the region is low: annual GNP of US\$440 per capita, or US\$2 030 per capita in parity purchasing power terms. Official development assistance in 1998 amounted to only US\$4 per capita (cf. US\$21 per capita in Sub-Saharan Africa) which represents 0.9 percent of GNP. Historically, the agriculture sector generated the surpluses that supported the growth and development of other sectors of the economy. This process of growth of other sectors of the economy is more advanced in India and Pakistan, where Gross Agricultural Domestic Product (GADP) comprises only 25 percent and 24.6 percent respectively of national GDPs. Region-wide, the value added from agriculture in 1999 was 28 percent of regional GDP. The sector employs 59 percent of the labour force and generates 16 percent of the value of total exports.

### CHARACTERISTICS OF THE MAJOR REGIONAL FARMING SYSTEMS

For the purposes of this study, eleven broad farming systems have been defined (see Map), although significant heterogeneity usually exists within each area. The characteristics of farming systems are summarised in Table 6.1. For the purposes of this study,

<sup>33</sup> The material in this section is extracted and summarised from the Global Farming Systems Study: "Regional Analysis: South Asia".

<sup>34</sup> The South Asia region comprises eight countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

four major farming systems were chosen as having the greatest overall potential for agricultural growth and poverty reduction in the coming 30 years, viz.: (i) Rice Farming System; (ii) Rice-Wheat Farming System; (iii) Rainfed Mixed Farming System, and (iv) Hill Mixed Farming System. Most of the poor of the region work in these farming systems, which also produce more than three-quarters of the regional GADP.

### Rice Farming System

This old and well-established farming system covers some 5 percent of the region in the southern areas of Bangladesh and West Bengal, and the coastal plains of Tamil Nadu, Kerala and Sri Lanka and accounts for 22 million ha of cultivated land and an agricultural population of 130 million people. The farmers are owner-operators as well as sharecroppers. Farm size distribution is skewed, with a large number of small, share-cropper or owner-operated farms of 0.3 – 1.0 ha and a few medium to large owner-operated farms of 4 – 10 ha. Rice is invariably grown in the wet season and rice or another less water-demanding crop (e. g., coarse grains, oil seeds, legumes, and vegetables) in the dry season. Supplemental irrigation is common in the monsoon season and full irrigation in the dry season. Just under half of the cultivated land is irrigated. The strategic importance of rice and generally easy access to farming areas have favoured the development of well functioning extension services. Fodder resources are limited except for paddy straw, but this farming system has about 13 percent of the bovines, including a significant proportion of dairy animals, in the region.

Most farmers in this system use fertiliser and improved seed. Uptake of improved varieties has been hampered by the lack of good quality certified seed, relatively poor taste, low tolerance to early or late transplanting (important when both onset of the monsoon and irrigation system are unreliable) or unimpressive yields compared with existing varieties. Typical farm households are vulnerable to low yield, as well as crop failure in flood and cyclone prone areas, and supplement their farm incomes with off-farm earnings. During the coming 30 years, per capita land availability is expected to decline, but there is likely to be some market-driven land consolidation and a reduction in sharecropping. Hybrid rice will be widely adopted, except in deepwater and other unfavourable rice ecologies. The declining terms of

trade for rice and increasing costs of production will induce diversification of production, e.g. dairy and aquaculture. Intensive pressure on land will limit the availability of fodder, leading to a decline in the population of buffaloes. Two-wheel tractors will replace draught buffalo. Increased labour costs will favour greater mechanisation.

There will be improvements in public infrastructure, transport, and educational and health facilities along with decentralisation of decision making. Women will gain greater responsibility in local governance and their incomes will increase. Farmers' organisations and the private sector are likely to play a more proactive role in technology testing and dissemination, as well as input supply and marketing, as public sector budgets for support services decline. Micro-finance services along the lines of the Grameen Bank in Bangladesh will become widespread. Increased seasonal and permanent out-migration can be expected.

Thus, the main driving issue for system evolution in the coming three decades will be declining paddy prices and increasing labour costs, which make it increasingly unattractive to use high levels of inputs. This would in turn tend to slow down the growth of rice productivity. The low prices reflect declining world prices, but in some instances may also be due to government attempts to keep rice prices low in order to satisfy urban populations – using price controls and monopoly purchases with countervailing subsidies on fertilisers, irrigation and other inputs. The unfavourable terms of trade for rice can only be countered in the long run by more efficient production practices, thus increasing the comparative and competitive advantage of local rice production. An effective programme of research and extension to improve labour and factor productivity would be needed. Equally, it would be necessary to avoid urban bias in trade and economic policies. The productivity of this farming system could be increased through intensification; by upgrading existing irrigation systems, conjunctive use of groundwater using tubewells, intensified research and extension, farmer training (particularly in better on-farm, integrated nutrient management and integrated pest management, mechanisation of cultural operations, and improved post-harvest handling and milling. The main opportunities for improving the productivity of the system would, however, be through diversification into income generating enterprises such as dairy, aquaculture, horticulture and local processing.

Table 6.1: Major Farming Systems in South Asia<sup>35</sup>

Farming Systems	Land area (percent of region)	Agric Popn <sup>a</sup> (percent of region)	Principal Livelihood	Incidence of Poverty	Potential for poverty reduction	Potential for agric. growth
Rice	7	17	Rice (both seasons), vegetables, legumes, off-farm activities	Extensive severe poverty	Moderate	Moderate
Coastal Artisanal Fishing	1	2	Fishing, rice, legumes, livestock, coconut	Moderate to severe poverty	Moderate	Low
Rice-Wheat	19	33	Rice, wheat, vegetables, livestock, off-farm activities	Extensive moderate and severe poverty	High	Moderate – High
Highland Mixed	13	7	Cereals, livestock, horticulture, seasonal migration	Moderate to severe poverty	Moderate	Moderate
Rainfed Mixed	29	30	Cereals, livestock, vegetables, legumes, fodder crops, off-farm activities	Extensive poverty, severity varies seasonally	Moderate	Moderate
Dry Rainfed	4	4	Coarse and irrigated cereals, legumes, off-farm activities	Moderate poverty	Moderate	Moderate – High
Pastoral	11	3	Livestock, scattered irrigation, migration	Severe poverty, especially drought induced	Low	Low
Sparse (arid)	11	1	Scattered livestock where water permits	Severe poverty, especially drought induced	Low	Low
Sparse (mountain)	7	0.4	Summer herding of livestock	Severe poverty, especially in remote areas	Low	Low
Tree Crop	little, dispersed	little	Tea, rubber coconuts, cereals, wage labour	Moderate poverty, mainly of agricultural workers	Moderate	High
Urban based	negligible	little	Horticulture, dairying, poultry, other activities	Moderate	Low	Low

Priority systems for poverty reduction and/or growth are shaded

<sup>a</sup> Defined as those employed in farming, fishing, livestock raising or forestry and dependants.

<sup>35</sup> Data are drawn from a variety of sources including national statistics, remote sensing and expert judgement, and should be considered as preliminary estimates, for future refinement.

## Rice-Wheat Farming System

This farming system covers 19 percent of the land in the region, and dominates the Indo-Gangetic plain, including the Terai of Nepal, the Gangetic plain in Uttar Pradesh, Bihar and West Bengal and the north-west of Bangladesh, with an agricultural population of 254 million. The cultivated area is estimated at just over 60 million ha, of which 80 percent is irrigated. The cropping pattern comprises a 'summer' paddy crop and a 'winter' (cool, dry season) wheat crop, sometimes followed by a short 'spring' vegetable crop. In some areas cotton is part of the system. The farming system contains about 30 percent of the region's total bovine population, 25 percent of its dairy cattle, 15 percent of its sheep and 23 percent of its goats. With improved varieties of both rice and wheat and the use of irrigation and fertiliser, the system has shown remarkable increases in production. However, in recent years the declining or stagnant yields and factor productivity of the rice-wheat cropping system have given cause for concern and have been the subject of an on-going intensive research programme. Poverty and household food insecurity are widespread, principally among landless agricultural workers and sharecroppers. Heterogeneity within the farming system arises chiefly in terms of access to land and water. The western parts of the zone in Pakistan have larger holdings with fewer animals and are more mechanised. Security of land tenure is often an issue and share cropping is more widespread than in the other farming systems.

Average farm size will continue to grow due to permanent and seasonal out-migration, although the skewed distribution pattern of small farm size is expected to be accentuated in the near term. Land close to urban centres will continue to increase rapidly in value and there may also be an increase in absentee ownership. Soil productivity decline or stagnation in the rice-wheat system is likely to continue for some time, as no definite breakthrough has yet emerged from the research being conducted on this problem – although certain management measures have been suggested to mitigate it. Water table levels are declining alarmingly in some areas due to indiscriminate sinking of tubewells and uncontrolled pumping. Serious problems of water availability are likely to arise within this decade in these areas, unless there is strict monitoring of the aquifers and regulation of their exploitation. Elsewhere, water tables are rising due to poor water management with resultant build-up of soil salinity and sodicity. Reversing these trends

will depend not only on the success of future research and extension but also on policy decisions favouring balanced fertiliser use and efficient utilisation of water.

Good opportunities exist for much better integration of ruminant livestock into smallholder farming systems. Treatment of straw with urea or other chemicals is likely to be adopted more widely in future. The system can also incorporate many other forms of diversification, including the introduction of fruit trees or other cash crops in situations where land is owner occupied. The typical enterprise pattern is expected to shift towards more dairy, horticulture and feed grains. Some improvement in infrastructure, decentralisation and a greater role for women in local governance can be expected. Funding of public sector research and extension will diminish, and the private sector and farmers organizations may play a larger role in technology testing and advisory services. The opportunity cost of labour will be a critical determinant of the viability of interventions. Diversification will also require further investment in markets and transport infrastructure, provision of inputs and other support services including market information by farmer co-operatives and the private sector – perhaps with the government playing a facilitating role.

## Rainfed Mixed Farming System

The farming system covers nearly 30 percent of the land in the region with an estimated cultivated area of 87 million ha, and an agricultural population of 226 million. It includes parts of Sind, Punjab and North West Frontier Province in Pakistan, large areas of Central, Southern and Western India, the northern part of the Terai bordering the Shivaliks and the dry zone of Sri Lanka. The system is generally rainfed, but supplemental irrigation from a local tank (and where feasible from tubewells and agro-wells) may be available for part of the land in most years. Irrigated land accounts for 14 million ha, or some 16 percent of the cultivated area. Crop production is generally risky due to partial or total dependence on rainfall and the introduction of new technology is difficult. The crops grown include wheat, barley, vegetables and fodder crops in the cooler northern areas, and maize, sorghum, finger millet, vegetables, cotton, chickpea, pigeon pea, green gram, black gram, groundnuts and sunflower in the warmer climates of southern India and northern Sri Lanka. Double cropping is possible only in limited areas with irrigation or on heavy black soils with high water-holding capacity. In southern

India and the Dry Zone of Sri Lanka, where land holdings are smaller, farmers prefer to grow paddy on any irrigated land available and in the poorly drained valley bottoms during the wet season. Fruit trees are grown in home gardens or small orchards but expansion of production is constrained by remoteness from markets. The system supports 32 percent of the cattle and 20 percent of the sheep and goats in the region. Livestock generally provides a major part of the farm family's cash income.

Although similar in area to the rice-wheat system, the rainfed mixed farming system has only about half the population density of the former. A high proportion of the rural population in this system lives in poverty while practising subsistence agriculture. Typically, farming areas under this system are not well served by infrastructure and are remote from markets. Agricultural extension and other support services are poorly developed, while most farmers use traditional technology with a strong bias towards risk avoidance. Land tenure is often an issue in these areas and owners may not have sufficiently clear titles for use as collateral for obtaining institutional credit.

There will be increasing scarcity of fresh water resources as agricultural and urban demands expand. Land degradation on sloping lands, including soil fertility decline, can be expected to continue. Food crop production will increase and the use of hybrid sorghums and millets will become more widespread. Soybean, mung and other higher yielding legumes will replace traditional pulses. The oilseed and horticulture (fruits) components of the cropping pattern is likely to expand. The system will become more commercial, with a modest increase in the use of external inputs and a moderate level of mechanisation. Livestock productivity is expected to increase with more stall-feeding. Although household food security will improve, there will be food deficits in drought years.

Some improvement of transport infrastructure and social services is expected with decentralisation of government agencies and the role of women in local decision making may be strengthened. Public sector research and extension will contract and there will be a greater role for farmer organisations and private sector in the provision of agricultural services. A limited expansion of the non-farm rural economy is expected.

Improving the availability of water for drinking could enhance the overall water security of farm families and irrigation through repair of existing

tanks, diversion works from streams, low-lift pumps or wells and agro-wells. These improvements would require social mobilisation and participatory planning if they are to be sustainable. Physical and vegetative measures and reduction in overgrazing by livestock are required in the upper catchments to maintain vegetative (trees and pasture) cover to reduce water runoff and encourage infiltration and percolation to recharge the ground water.

### Highland Mixed Farming System

This farming system – comprising cereals, legumes, tubers, fodder, fodder trees and livestock – is found in the upland areas of Pakistan, India, Nepal, Bangladesh and Sri Lanka. It covers about 13 percent of the land in the region. Cultivated area is estimated at nearly 19 million ha and the agricultural population is 53 million. In the remoter and higher areas, where artificial fertilisers are very costly or unavailable and distance to markets is prohibitive, the flow of nutrients to the farm is generally from grazing, or from the cutting of fodder trees in woodland areas at higher altitude. In more accessible areas, such as the central highlands of Sri Lanka, the opportunity for successful vegetable production can result in a highly intensive system of commercial production. Similarly, in the hills of Himachal Pradesh there has been a large expansion in horticulture, particularly fruit orchards. In general, ruminant livestock are an important part of the system for draught, milk, manure and cash income. There is very little irrigation.

In many hill areas the reduction of forest cover and expansion of continuous unimproved cultivation on steep upper slopes, often with thin or poor soils, has led to further impoverishment of already poor communities that are barely eking out a subsistence existence. They have virtually no cash income and women have to walk further each day to secure their water and fuelwood needs. Soil and water conservation under these conditions is generally poor, and erosion and soil fertility decline can be serious. There are usually few local opportunities for young people who often leave to find work elsewhere. Insecurity of land tenure compounds the problems of these rural people, most families having settled either on common land or within forest boundaries. Often there is a general absence of social cohesion – with each family a law unto itself and none of the normal hierarchy of village councils or headmen. This dearth of

social capital makes it difficult to resolve land ownership disputes, to obtain agreement on the use and management of common lands, and to introduce improved technology and soil and water conservation methods. Other factors aggravating the lack of social capital include the low level of education and the paucity of communications.

Intensification of production is evident in farms with market access, such as those along the milk collection routes outside major hill cities such as Kathmandu. To the north-east of Kathmandu, fresh vegetable production has expanded and the resulting cash injection has increased input use on other crops. In other areas the extensive planting of farm trees for fodder and timber, substituting for the loss of access to forest resources, builds up the natural capital of the farms and reinforces the basis for nutrient recycling through crop-livestock integration. Other experiences have shown how community empowerment improves resource management and incomes. These have generally involved communal management of common resources, and group action to increase production through acquisition of improved germplasm and inputs, well as to improve marketing.

The main strategy for development in these areas is to arrest land degradation and to improve income and living standards through soil and water conservation, integrated crop and livestock husbandry, agroforestry, introduction of cash crops such as coffee or fruit trees (where this is feasible and markets are available), planting of fodder, stall feeding of livestock and provision of drinking water. These possibilities can be further enhanced by development of livestock enterprises – with emphasis on improved nutrition, stall-feeding and collection of dung. Where this can be accompanied by the introduction of a cash enterprise, such as orchard fruit, vegetables, dairying or goat and sheep production, the chances of a significant reduction in poverty are much improved. Finding suitable cash crops for the remoter areas may be difficult – fruit, vegetables and milk are normally ruled out – but there may be opportunities for production of high value-low bulk commodities such as vegetable seeds, spices or medicinal plants. Rural development interventions for poverty alleviation may need to be broadened to include education and health clinics, vocational training schools to foster the remittance economy, and participatory development projects for upland watersheds.

## REGIONAL STRATEGIC PRIORITIES

The region is noteworthy for its high population density and long history of resource degradation. Despite its successful achievement of national food security, which serves as testimony to the strong agricultural institutions in the region, severe rural poverty is widespread. The prospects for rural poverty reduction during the coming 30 years depend on the nature and direction of farming systems development. Farming systems will evolve rapidly in response to changes in the condition of the resource base, developments in technology, evolution of global and local markets, policy shifts, and changes in information flows and human capital. In order to manage this change so as to food security at all levels and reduce rural poverty, strong policy and investment underpinning of agriculture and rural development – tailored to the requirements of the region – would be needed. The strategic priorities for poverty reduction include sustainable management of soil and water resources, market-based intensification and diversification, and agricultural information and knowledge systems. The following paragraphs elaborate upon these priorities in relation to resources, technology, markets, policies and information.

### Natural Resources and Climate

**Population Pressure and Climate Change.** Natural resources will come under increasing pressure from the growing population, especially in the Rice, Rice-Wheat and Highland Mixed Farming Systems. Moreover, significant global warming over the next couple of decades would affect rainfed semi-arid areas badly, especially through increased rainfall variability. Natural resource degradation is, therefore, one of the major regional issues which need to be addressed, with implementation priority to better water management in general and soil and water conservation in the upper catchments in particular. Until such time as affluence leads to the normal demographic transition to lower birth rates, measures to reduce the incentive for large families would alleviate the pressure on natural resources.

**Deforestation.** In most countries of the region, national forest policies regard all income from forest products as national revenue. It has been amply

demonstrated that joint systems of forest management – that allow benefits to pass on to forest dwelling communities – result in maximum benefits to these communities and also to increased efficiency and sustainability in the production of forest products. High priority needs to be given to re-orienting forestry development policy and regulations to allow the wider establishment of such joint forest management systems.

**Soil Degradation.** Soil degradation is an issue in most of the farming systems of the region. Priority needs to be given to on-going and proposed participatory research and extension programmes that address these problems in the Rice-Wheat Farming System and the watershed management and soil conservation programmes in the Highland Mixed Farming System. In several countries, a number of successful, participatory, community-based watershed management pilot projects have developed appropriate methodologies that could be extended to larger, critical watersheds in the region.

**Depletion of Water Resources.** In cultivated areas, sustainable use of water resources would require the establishment of mechanisms for monitoring quantity and quality of groundwater in aquifers and regulation of groundwater extraction for agriculture, industry and urban use. The region's water resources could also be developed further through traditional means; such as construction or rehabilitation of tanks and tubewells and improved water management, as well as through large-scale programmes of soil moisture conservation that include mulching, bunding, relay cropping, windbreaks and more general-purpose tree planting. Significant improvements are likely when realistic water charges are introduced, probably within the next decade in most cases.

## Science and Technology

**Research.** Although a range of technologies exist that are ready for adaptation and adoption by farmers, there is a need for continuing research on farmers' problems, as well as on a number of strategic priority production problems such as: soil degradation in the intensively cultivated systems, germplasm improvement in foodcrops and effective biological nitrogen fixation. There is substantial

capacity in the larger national agricultural research systems (NARS) to exploit the potential of biotechnology, e.g. in the development of new genotypes possessing high yield potential and resistance to biotic stresses. Their germplasm banks will be an important resource for public and private sector plant breeding efforts.

**Fertiliser.** Current use of nitrogen fertiliser in many countries in the region shows considerable scope for improved efficiency. Priority should be given to better integrated nutrient management, wider regulatory measures and economic incentives for balanced fertiliser use and reduced green house gas emissions, together with technological improvements such as more cost-effective, slow-release formulations in order to reduce these losses in the future.

## Globalisation and Market Development

**Globalisation of Markets.** The three significant issues for this region arising from the globalisation of markets are: (i) gaining access to developed country markets in OECD countries; (ii) declining terms of trade for agricultural commodities, and (iii) the continuation of subsidies for agriculture in developed countries. The terms of trade for rice, wheat and other foodgrains have been declining and the opening of economies exposes farmers to these forces – especially in the intensive rice-based, rice-wheat, hill and rainfed mixed farming systems. The long-term strategic response to this has to be to increase production efficiency to reduce unit cost of production, diversify cropping, and shift to specialised produce for niche markets if possible.

**Local Markets and Price Information Systems.** The functioning of local commodity markets and price information systems is of greater direct interest to smallholders than are global marketing issues. Considerable investment in development of rural financial services, including micro-finance and linkages to mainstream banking, are needed if the full potential of the farming systems is to be realised – especially the more remote farming systems such as the Highland Mixed and Pastoral Farming Systems.

## Policies, Institutions and Public Goods

**Pro-Rural Policies.** Most countries in the region have policies that effectively favour the urban and manufacturing community rather than the rural and agricultural sectors, i.e., there are national trade and price distortions with a negative impact on the commercialisation of farming systems. Because the majority of the poor are located in rural areas, poverty reduction efforts should be targeted at increased agricultural productivity and income.

**Strengthening Local Institutions.** Decentralisation and local institutional performance will be key issues in the development of most farming systems. Line departments have already given up some of their functions to the private sector and farmers organisations, and plan to allocate other functions to empowered communities. This trend should be promoted in future so as to achieve better implementing of agricultural programmes. Another far-reaching change which is occurring with decentralisation and which needs to be encouraged, is the growing role of women in panchayat and district decision making, with a particular emphasis on resource management and agricultural support services.

**Farm Size.** Farms are generally small and fragmented. This hinders marketing, and also limits economies of scale in farm operations, such as ploughing, harvesting and threshing. Strengthening of farmers organizations and assisting them to enter into commercial activities – for example by forming farmer companies – would not only help farmers to access services (tractor hire, harvesting, processing) at reasonable rates, but would also give them greater bargaining power in buying inputs and selling their produce. Strong farmers organizations could also participate actively in research and extension activities.

**Rural Infrastructure.** Agricultural development in many areas of the region has been constrained by a lack of infrastructure. In particular, the shortage of secondary roads in remote and sparsely populated areas pushes up input and product transport costs and the lack of health and educational services reduces labour productivity. Investments in roads, drinking water, schools and health facilities and encouragement of private sector participation in the provision of services should, therefore, be an essential

ingredient of a strategy for increasing agricultural production and rural development.

**Water Charges.** Supply of irrigation water is traditionally free in many countries of the region and is often seen as a means of supporting farmers and keeping down food prices. However any significant improvement in water management will not be possible unless realistic charges for water and power used by farmers are introduced. Better arrangements are required to provide an equitable balance between the benefits accruing to downstream users of irrigation water and electricity, and the wellbeing of the communities living in the upper catchments.

## Information and Human Capital

**Rural Education.** Investment in rural education is required to equip farm women and men to manage the emerging knowledge-intensive farming systems, as well as to equip migrant workers with the skills to transfer from agriculture to the non-farm economy. One of the first areas of concentration should be ensuring universal education for rural girls. The strategic research needs outlined above call for reorienting the training of professionals in research and agricultural support services. Such local increases of human capital would underpin the development of small-scale local rural industry.

**Information Services.** The shift to commercial knowledge for intensive farming systems requires a greatly improved flow of information to farmers and investments will be needed in support services providing technical and market information. This emerges as a key issue and is a promising area for public-private partnerships.

## Implications of Different Scenarios

The foregoing analysis and conclusions are based on the global trends outlined in Chapter 2 and the regional trends outlined above. However, there are some future uncertainties that are worth considering that have implications in changing assumptions with regard to future developments, these include climate change, market liberalisation and public investment in agriculture.

**Climate Change.** Accelerated global warming during the coming 30 years would increase climatic variability and production risk, as well as the frequency of severe floods in low-lying coastal areas. Poverty and food insecurity would be aggravated. This increased vulnerability may act as a disincentive to many forms of resource enhancement and to intensification based on external production inputs, unless suitable risk mitigation mechanisms are established.

**Market Liberalisation.** Whilst faster economic reforms may lead to additional poverty during the adjustment process, a rollback of liberalisation would slow down the diversification to high value crops and livestock, and thus diminish the prospects for farm income growth in the medium term.

**Public Investment in Agriculture.** Notwithstanding the key role of private investment in agricultural growth and the comparative strength of agricultural institutions in the region, reduced public investment in agricultural institutions (especially research and information) and local infrastructure would tend to depress growth, especially of the small-scale farm sector, and accentuate rural poverty. Conversely, increased investment in local transport and communications infrastructure and agricultural technology development would be expected to reduce poverty and improve food security.



## 7 East Asia and Pacific Region<sup>36</sup>

### INTRODUCTION

The East Asia and Pacific (EAP) Region, as defined for this study, covers 23 countries and a total land area of 1.6 billion ha with an estimated total population of 1.84 billion (31 percent of the world population), of which 62 percent (1.1 billion) are agricultural. China dominates the statistics of the region because of its sheer size and population. Population growth rates, although moderating, remain high in some countries with the total population expected to reach 2.13 billion by 2015 and 2.31 billion by 2030. The proportion of urbanisation within the region is expected to increase from the current 37 percent to 53 percent by 2030, but many countries will remain largely agrarian. The rural population will continue to gradually age with adverse implications for socio-economic advancement and labour quality and availability. Farms in the region are dominantly smallholder-based with widespread occurrence of subsistence production systems. In most countries, average farm size continues to decline. Although signs of declining rural populations and land aggregation are occurring in some countries, for instance, Thailand and to a small extent in China, it is anticipated that even in 2030 the majority of farms in the region will still be smallholdings.

The region is ecologically and biologically very diverse, but biodiversity is severely threatened in many countries. Forest cover is estimated at 380 million ha (23 percent of land area), 170 million ha (10 percent of land area) of which remains dense forest. Unsustainable logging practices have caused forest areas to decrease (0.8 percent annually between 1990 to 1995) and this trend is expected to continue.

Total cultivated and permanent crop land area in the region is estimated at 232 million ha, of which 58 percent (134 million ha) is found in China. Only a marginal increase is expected by 2030, of another 6 million ha across the region (in China a continuing net decrease in arable land is expected). Large increases in food production during the last 30-40 years have resulted from considerable expansion of cultivated and irrigated farmland, the development and adoption of crop varieties with much higher yield potential, and the increased use of fertilisers and pesticides, resulting in the 'green revolution'. Overall crop production in the region increased at 3 percent per year during the 1980s, but the rate of increase has slowed significantly during the last decade. Because of the limited scope for expansion of arable area, further increases in production will necessarily depend on increased yield and increased cropping intensity.

Output of rice, the main crop in the region, has previously increased at an annual rate of about 2.4 percent, but is expected to decline to only 0.7 percent per annum over the period from 2000 to 2030. Wheat production increased up to 1990, then declined during the last decade, but renewed growth of 1.4 percent per annum is expected during the coming 15 years. Substantial increases in production of maize, barley, oil crops, beverages, fruits and vegetables are also expected, while little increase in production of cotton, millet, sorghum, cassava and pulses is anticipated. Many countries are large importers of cereals (e.g., Indonesia, Malaysia and the Philippines). However, China is both a large exporter and importer, and Thailand and Vietnam are the largest net exporters. Other countries are generally self-sufficient

<sup>36</sup>The material in this section is extracted and summarised from the Global Farming Systems Study: "Regional Analysis: East Asia & the Pacific".

in most years. The region is the most important global producer and exporter of some industrial crops, particularly rubber and palm oil. Natural rubber production is expected to double during the next 30 years. Increased demands from industrialised countries for organically grown foods and timber from renewable forest resources may provide specialised production and niche-marketing opportunities.

Most of the past increases in livestock production in the region have been driven by the rapid expansion of the livestock sector in China. Both total and per capita meat and milk consumption have increased rapidly in the last twenty years. Between 1983 and 1993, per capita annual meat consumption increased from 16 to 33 kg in China and from 11 to 15 kg in Southeast Asia countries while per capita milk consumption increased from 3 to 7 kg in China and from 10 to 11 kg in Southeast Asia countries. The numbers of pigs and poultry in the region have increased rapidly in the last three decades, but growth will slow in the period to 2030. Presently, more than 50 percent of the pigs and 36 percent of chickens and fowls of the world are found in the region. Ruminant livestock are an important source of draft power, meat, savings and income. Total populations of bovines (cattle and buffalo), sheep, goats and dairy animals in the region are estimated at 84, 116, 80 and 3 million, respectively. Cattle, buffalo and goats are spread throughout the region while sheep are mostly found in drier and more temperate areas. Dairy cattle are relatively unimportant because of the traditional unimportance of milk to East Asian people, but are increasing rapidly in peri-urban areas with increased demand for processed milk products by more affluent young people. The increased consumption of meat and milk in diets is expected to continue in all countries in the region, with continued rising per capita income. The scope for increases in livestock numbers and meat production in the region will be mostly confined to increased intensive production of pigs and poultry, as there is relatively less potential for strong growth in ruminant (buffalo, cattle, sheep, goats) meat production under grazed (or stall-fed) conditions.

The gains from the region's rapid economic growth have been strongly biased in favour of the urban population. With the exception of China and South Korea, the economies of the region are strongly agrarian. In general, Gross Agricultural Domestic Product (GADP) has been decreasing as a proportion of national GDP, but is still significant. This trend is expected to continue in all countries, but in some countries a majority of people will still remain depen-

#### **BOX 7-1: INCREASING IMPORTANCE OF LIVESTOCK IN THE REGION**

The traditional diet of East Asia people has been based on cereals and vegetables with very small amounts of meat and fish. Rapidly improving economic circumstances is creating a change in dietary habits with increasing consumption of meat and fish and fruits. This has resulted in increased farm diversification and, when combined with increased farm mechanisation, has increased the food value of animals and decreased their value for other uses. In this scenario, the value and quality of animal food production improves because animals are not kept to adulthood for draft power, enabling more rapid slaughter rates. Mechanisation also allows a shift from husbanding large ruminants to intensive production of pigs and poultry. Technological changes have also occurred leading to improvements in basic animal health and care, provision of additional feed (from crop by-products, cereals and concentrates), specialised forage cultivation and stall feeding (mainly for milk production) and cross-breeding. The most dramatic changes in livestock production have occurred in China. But as the demand for livestock feeds has expanded rapidly in China, feed requirements have not been met from domestic supplies of cereals and concentrates resulting in large imports of feed grains, mainly from developed countries. The intensive, commercial production of pork, poultry and eggs that has emerged in China is more efficient at using these imported feeds. However, small-scale livestock production for food is expected to become more generally an important component of increasingly diversified farming systems in the region, particularly in Lowland Rice, Temperate Mixed and Upland Intensive Mixed Farming Systems. In small-scale livestock production systems, increasing emphasis will be given to on-farm production of feeds for more intensive animal production enterprises resulting in overall greater farm income.

dent on the agricultural sector by 2030. Rural incomes have only increased slowly in most countries. Average regional per capita GNP (1999) was US\$1 000 (US\$3 500 by parity purchasing power) which is low compared to other developing regions. There are 278 million people (15 percent of the total population) who are considered to be living in poverty, with daily incomes of less than US\$1 a day, approximately twice as many in rural areas as in urban areas. A quarter of these people live in China, but significant numbers are found in almost all countries in the region.

## CHARACTERISTICS OF THE MAJOR REGIONAL FARMING SYSTEMS

For the purposes of the regional analysis, eleven major farming systems have been defined (see Map). These systems are necessarily broad-based and defined by

dominant agricultural production patterns, but are considered generally homogeneous enough to indicate future trends and needs as a basis for future strategic support by donors. However, it is emphasised that they include a considerable degree of local heterogeneity and their boundaries are often difficult to define pre-

Table 7-1: Major Farming Systems in East Asia and the Pacific<sup>37</sup>

Farming Systems	Land area (percent of region)	Agric Popn <sup>a</sup> (percent of region)	Principal Livelihood	Incidence of Poverty	Potential for poverty reduction	Potential for agric. growth
Lowland Rice	12	44	Rice, maize, pulses, sugarcane, oil seeds, vegetables, livestock, aquaculture	Extensive severe poverty	Moderate	Moderate
Tree Crop Mixed	5	3	Rubber, oil palm, coconuts, coffee, tea, cocoa, spices, rice, livestock	Moderate poverty mainly of smallholders	High	High
Root-tuber	1	<1	Root crops (yam, taro, sweet potato), vegetables, fruits, livestock (pigs and cattle)	Limited poverty	Good	Moderate
Upland Intensive Mixed	20	28	Rice, pulses, maize, sugarcane, oil seeds, fruits, vegetables, livestock	Extensive moderate and severe poverty	Moderate	Moderate
Highland Extensive Mixed	6	4	Upland rice, pulses, maize, oil seeds, fruits, forest products, livestock	Moderate to severe poverty	Moderate	Moderate
Temperate Mixed	6	14	Wheat, maize, pulses, oil crops, livestock	Extensive moderate and severe poverty	Moderate	Low
Pastoral	20	1	Livestock with irrigated crops in local suitable areas	Severe poverty especially drought induced	Low	Low
Sparse (forest)	11	1	Hunting, gathering	Moderate	Low	Low
Sparse (arid)	20	2	Local grazing where water available	Severe	Moderate	Low
Urban based	n.a.	little	Horticulture, dairy, poultry	Low to moderate	Low	Moderate
Coastal Artisanal Fishing	n.a.	little	Fishing, coconut, mixed cropping	Moderate	Moderate	Low

Priority systems for poverty reduction and/or growth are shaded.

<sup>a</sup> Agricultural populations are defined as those working in farming, forestry or fishing and their dependents.

<sup>37</sup> Data should be considered as preliminary estimates, for future refinement.

cisely. The systems and their key characteristics in relation to poverty are listed in Table 7-1.

In undertaking a more detailed assessment of constraints, needs, and opportunities, four farming systems were chosen that have the greatest relevance to agricultural growth and poverty reduction in the region in the coming 30 years. The four farming systems contain the major proportion of the rural poor in the region and produce more than three-quarters of the GADP.

### Lowland Rice Farming System

The system covers more than 200 million ha, including south and central eastern China, parts of South and North Korea, coastal areas of Vietnam, lowland areas of Myanmar, Thailand, Laos, Cambodia, Philippines and Indonesia, and contains a total population of 849 million with an agricultural population of 488 million. The tropical to sub-tropical environment of the zone varies from humid (270-365 growing days) to moist sub-humid (180-269 growing days) with a single dry season in the cooler part of the year. Rice cultivation has evolved over thousands of years of human settlement in the region. It is now perhaps the most intensive large farming system in the world, with a total cultivated area of 73 million ha and an average farm size of less than one hectare due to continued land fragmentation. Average farm household size is about 4-5 persons but higher in most countries other than China. Extensive severe poverty occurs as a result of: small farm size causing subsistence production; landlessness; and lack of off-farm employment. The main agricultural activity is food crop production. Only about 6 percent of total rice production is internationally traded. Because of long settlement and proximity to cities, local infrastructure and services are generally good. Tremendous variation occurs between areas in the intensity of crop production in rice-based systems. China, Vietnam, Indonesia, South Korea and Malaysia have very intensive production systems, with intermediate production intensity found in Thailand, Philippines and Myanmar and least intensive systems found in Cambodia and Laos.

Rice is the major food crop, with the number of crops varying from 1-3 per year, depending on rainfall distribution, length of growing season and supplementary irrigation availability (almost half the cultivated area is irrigated). Soils are heavy and inherently more fertile than other cropped soils in the region,

but natural fertility is declining and in some places yields are stagnating under intensive continuous cropping. The average yield of paddy is 3.1 t/ha across the region, but is heavily skewed by the higher yields obtained in China (up to 8.1 t/ha in Jiangsu Province). Most countries have lower national average yields than for the region. Modern, higher yielding varieties are used in all countries, but some countries still plant a significant area of lower yielding, traditional varieties because of their perceived higher quality. Fertiliser use in the rice-based crop system is moderate to high, including the use of both inorganic and organic fertilisers. High inputs of organic and inorganic fertiliser combined with the universal use of high yielding varieties are the main determinant of high yields in China. Rice is mostly transplanted, but germinated seed is broadcast in some countries (Thailand and parts of China) where serious labour shortages occur. In many countries, a weakly developed seed production system is a serious constraint to high crop yields.

Other warm-season crops grown in the system include sugarcane, maize, cotton, leguminous pulse crops, sweet potato and cassava, oil crops and fruits and vegetables, with some cool-season crops, such as wheat and rapeseed, grown in more northerly latitudes. Large and small ruminants, pigs and poultry are a minor but important source of food and income generation. The farming system contains 43 percent of bovines (cattle and buffalo), 29 percent of dairy animals and 27 percent of small ruminants in the region. Livestock production systems in many countries are extensive, apart from intensive commercial chicken and pig production and dairying. Large ruminants still provide a major source of draft power, but farm mechanisation is gradually increasing. Land ownership is secured under traditional or - less frequently - freehold tenure. Traditional rights are generally not recognised as legal ownership.

The major future changes in the rice-based farming system are expected to be increased intensification and diversification of crop production with little expansion of overall cropped area. Increasing diversification would include intensifying small livestock production and expansion of small-scale on-farm aquaculture (ponds or rice-fish culture). The trend will be to produce agricultural products with higher value. These changes would allow greater income security and increased family incomes. Should average farm size and farm mechanisation also increase this would further increase household incomes and decrease poverty.

### Tree Crop Mixed Farming System

This system covers 85 million hectares, mainly in Thailand, Malaysia and Indonesia, with smaller areas in Cambodia, Philippines, Vietnam, southern China and Papua New Guinea, and contains a total population of 54 million with an agricultural population of 30 million. The tropical environment of this zone is mostly humid (270-365 growing days), with some extension into moist sub-humid (180-269 growing days) areas. Tree crops are cultivated principally on flat to undulating landscapes on acid soils of low inherent fertility. Both private companies and smallholders own tree crop plantations, the latter typically 2-3 ha. Incomes of smallholders are moderate and little poverty exists. While tree crops are the dominant production system, small farms without tree crops are scattered throughout the system, producing food (rice and maize) and cash crops (soybeans) and livestock. The total cultivated and tree crop area is estimated at 18 million ha but little is irrigated. Poverty is higher amongst these small farmers producing staples, compared with tree crop producers. Landless workers in commercial estates are also poor.

During the 1900s, large areas of tree crops, particularly rubber and later oil palm, were developed as large private sector estates, in Malaysia and Indonesia particularly, but today there are significant areas under smallholder ownership and management. Coconut plantations are more widespread throughout Southeast Asia and Pacific countries and are now mostly smallholder operations. Coffee and tea plantations are confined to specific agro-ecological areas with higher elevation. Cocoa is usually grown as an intercrop at low elevations under humid tropical conditions. Condiments, cloves, pepper, etc., are usually smallholder crops. All these crops require intensive labour inputs for harvesting and processing with profitability very much determined by local labour costs. In some countries, such as Malaysia, high labour costs are now seriously affecting the profitability of rubber plantations and there has been a significant replacement of former rubber areas with oil palm. Large estates have been well supported by research and extension undertaken in industry-funded commodity institutes and private companies. Improvements in production have come from introduction of improved varieties (clones) and improved cultural techniques. Government research extension services have supported smallholder farmers.

Local factories owned by companies are used to process many of the industrial crops. Smallholders

supply raw materials or slightly processed products to these factories. Smallholder co-operatives are usually not well developed and individual farmers are often at the mercy of lower prices given by middlemen for their raw products. Overall prices received are affected by both local and international market conditions. Some inter-cropping of tree crops is undertaken to increase and diversify incomes, both in the early years of establishment of new plantations and in mature plantations. In some systems, for example rubber and coconut plantations, industrial crop production has been combined with annual cash cropping and livestock production. In more recent times alternative products and uses have been developed for some plantation crops to diversify and add income-value, for example wooden products from rubber and coconut.

The major factors influencing the plantation crop sector in the future will be: international demand and prices for industrial crop products; replacement of labour intensive and costly harvesting and processing practices with mechanisation for some crops (such as rubber, oil palm and tea); planting of much higher yielding clones; development and adoption of improved production technologies; new product development; and significant changes in proportion of private companies and smallholder producers. The tree crop sector is expected to continue to expand moderately, given the present over-capacity and large area of immature trees. Annual production increases in the region are expected to be 3.4 percent for oil palm, 2.8 percent for rubber, 3.4 percent for coconut, 1.8 percent for coffee and 3.8 percent for tea up to 2030. It is anticipated that these production increases will come from both area expansion as well as increasing per unit area yields. Plantation crops are generally more profitable than alternative land uses on the generally infertile soils of the system. The extent to which the major private estates will increase their size will depend on overall profitability, but it is anticipated that the smallholder sector will remain important, at least in the medium term. Some tree crops will continue to be grown almost exclusively by smallholders.

### Temperate Mixed Farming System

The defined system covers some 99 million hectares, including the eastern parts of Central and northern China, with smaller areas in Korea DPR and Mongolia, and contains a total population of 284

million with an agricultural population of 162 million. The climate of the zone varies from moist sub-humid (180-269 growing days) subtropical to dry sub-humid (120-179 growing days) temperate. The transitional boundary between this system and lowland rice-based system is not easily defined in central China. In the southern part of the zone, crops can be grown in both summer and winter while in northeast China, Korea DPR and Mongolia, cropping is possible only during the summer. Average farm size ranges from as little as 0.3 ha in central China to over 1 ha further north, with an average household of 4-5 persons. Average incomes are low with modest poverty levels. Some 31 million ha are under cultivation. The dominant crop rotation is wheat and maize. Other major crops include rice, cotton, soybeans, sweet potato and rape, as well as citrus and some temperate fruits. There are 12 million ha of irrigated area within the system. Livestock, particularly cattle, pigs and poultry and agro-forestry are also important components of the system, which accounts for 6 percent of the bovines and 11 percent of the sheep and goats in the region.

Wheat is grown on about 30 million hectares in China, with an average yield of about 4 t/ha in 1999, but only on about 0.5 million hectares in Korea DPR and Mongolia, where yields are much lower (about 1 t/ha) and more affected by adverse climatic conditions. In China, crops are grown with high organic and inorganic fertiliser inputs and intensive pest control practices. Cropping intensity is about 150 percent and the scope for expansion of land area is limited. Wheat yields have risen dramatically since 1970 and even in the last decade have risen by 2.7 percent annually. However, wheat areas have been declining for the last decade in all countries and this decline is expected to continue in the future. Wheat production is expected to increase slightly in the future as a result of increasing yields that will more than offset the declining crop area. By contrast, areas of maize, however, have been increasing and are projected to increase substantially in the future - maize production is expected to double by 2030 as a result of both increased area and yields. This will be a direct consequence of greatly increased demand for animal feeds and probable decline in per capita rice consumption with changing diet preferences.

### Upland Intensive Mixed Farming System

This system covers some 321 million hectares and, as defined, is the most widespread and diverse farming system in the region with major areas located in all countries of East and Southeast Asia. The system contains a total population of 480 million with an agricultural population of 324 million. Whilst the system is characterized by similar landscape, there is considerable variation in ecological. It is found in humid and sub-humid tropical, subtropical, and temperate environments in upland and hill landscapes of moderate altitude and moderate to steeper slope. Soils are generally less fertile, shallower and more susceptible to erosion. Some 76 million ha of land is cultivated within the system, encompassing a wide range of crops, depending on geographic area, landscape slope, terracing and water regime. Some forested areas occur, but are generally depleted because of unsustainable logging practices. Deterioration of natural resources (soil, water) and biodiversity (native plant and animals) and the environment occurs in many areas. Significant degradation of the natural resource base has occurred as a result of high population densities causing more extensive cultivation of fragile landscapes without the adoption of appropriate soil and water management practices.

Most agricultural production occurs under rainfed conditions, but a significant area (18 million ha) is irrigated from local streams and rivers under terraced conditions. In some areas, for example in the Philippines and Indonesia, substantial terraces have been constructed, but in most situations there is only simple terracing or no soil and water conservation structures. Crops cultivated include paddy and some upland rice, wheat, maize, sugarcane, cotton, leguminous pulses, oil seeds, fruits and vegetables. Home gardens are used for vegetable and fruit production for household consumption and sale of products. The system contains 28 percent of the bovines and 15 percent of the small ruminants in the region. Livestock production is an important component of the system, being used for draught power, meat production, asset value and cash income. Livestock production is generally low as animals are raised under extensive conditions. On-farm forestry is limited.

Considerable variation in intensity of production exists in this system, with highest production intensity in southern China. In more extensive areas in other countries, many farms operate subsistence production systems with only small sale of products to meet livelihood needs and for purchase of food. Thus average

incomes are low and significant poverty and food insecurity exist in many areas. Rural credit is rarely available. Households are vulnerable to the consequences of natural disasters, crop failures and ill-health. Rural infrastructure is often poorly developed, particularly in more remote areas, and access to goods and services is poor.

Major changes in agricultural production in this system are expected to come from intensification and diversification of crop production with little expansion of overall cropped area, and improved productivity of livestock and tree crops. The trend will be to produce agricultural products with higher value. Increasing diversification would include an expansion of perennial crops and annual cash crops (as opposed to food crops) and intensification of livestock production. The particular higher-value crops selected for cultivation will depend on access to markets - crops which are bulky and perishable will be grown close to larger markets while those with less bulk and longer shelf-life would be cultivated at more remote locations. These changes would increase household incomes and income security and reduce poverty. Should average farm size increase, partial mechanisation would further increase household incomes and decrease poverty.

## REGIONAL STRATEGIC PRIORITIES

The strong economic growth and commendable reduction in poverty in China and some other countries during the recent past is noteworthy. Nevertheless, poor socio-economic indicators in many countries of the region are a result of widespread subsistence agriculture, small farm size, lack of financial resources, lack of opportunities for farm production intensification and diversification, and lack of opportunity for off-farm employment and income for many rural/farm households. This is caused by many factors, including overpopulation, land fragmentation into uneconomic parcels of land for farming, deterioration of natural resources, lack of land ownership, unavailability of information and lack of knowledge, lack of credit and inadequate supplies of production inputs, and poor marketing prospects (remote distance, poor infrastructure, small local market demand, etc.). The challenge for the future is to create the enabling factors needed to catalyse the rural communities and households to invest their labour, capital and physical resources in agricultural development to obtain strong economic growth. This general situation

requires a clear strategic focus for agricultural development in the region over the next thirty years, based on four major thrusts:

- gradual aggregation of farm land into economic sized units through improved stakeholder security to land, contingent upon the adoption of appropriate land policies, land titling, land leasing arrangements and rural credit;
- promotion and introduction of technologies that provide a holistic and integrated approach to the sustainability and productivity of natural resources and the protection of the environment;
- enactment of policies and conditions that enable and enhance the use and supply of production inputs, technologies and services by farmers to counteract the present low profitability of agriculture, particularly in more globalised and subsidy-free economies; and
- establishment of information and knowledge networks and training that promote general farmer capacity building, entrepreneurship, and innovative agricultural production systems.

The specific strategies and interventions required to create the enabling conditions necessary to achieve a successful outcome to the above major initiatives and hence obtain strong agricultural growth in the East Asia region are briefly examined under each of the five principal categories outlined in the introduction to this study.

### Natural Resources and Climate

The viability and sustainability of upland and mountain farming systems depends to a large extent on the proper conservation and management of natural resources. Future programmes of assistance must emphasise improved watershed management. Such programmes need to be strongly community based, with local people's full participation and involvement in planning, management and use of natural resources. Conservation agriculture should be promoted as an important means of stabilising yields, ensuring maintenance of soil fertility and increased crop production. Water harvesting should be promoted where circumstances permit. Technology introduction and promotion associated with watershed management must be holistic, integrated and provide short- medium- and long-term benefits.

## Science and Technology

While the private sector is expected to increase their provision of goods and services to farmers it is clear that governments will still have to provide certain essential support and services to poor and small farmers. The strategic priorities for the future must be to strengthen the capacity of governments to undertake participatory identification of problems, constraints and opportunities for farm development and provide the necessary enabling framework for effectively linked public-private extension and research services. Government research must keep abreast of private research developments. The value of biotechnology generally, including genetic engineering, must be evaluated, promoted and used where appropriate. Research in the future must be a more holistic, integrated form of research, linked strongly with extension and farmers, that takes greater advantage of synergies, the whole farm situation and emphasises the sustainability of natural resources and protection of the environment. The latent potential of farmers for experimentation, for adaptation of technologies and for farmer-to-farmer extension needs to be exploited. The strategic priorities for agricultural research in the region include increased water use efficiency, improved management of soil structure and fertility, genetic improvement of yield potential of crops, development of locally appropriate diversified crop production systems, intensification of small-scale livestock production, and local value-adding/processing of agricultural products.

## Globalisation and Market Development

Agricultural development must exploit local and international comparative advantages in a more globalised future economy. Governments must identify and promote specific production systems that benefit local farmers through exploitation of local agro-ecological, marketing, and farm resource advantages. Furthermore, improving general economic circumstances up to 2030 will change diets and increase the demand for higher value products (milk, meat, fruits, vegetables, etc.). The promotion of diversification of farm production into higher value products and adding value to farm produce would increase overall level and stability of household income. Training and demonstrations of new technologies are required to improve production, post-harvest management, packaging and marketing of these products.

Opportunities for local level agro-processing should also be promoted to add value to agricultural products.

## Policies, Institutions and Public Goods

Many countries in the region (China, Vietnam, Laos, Cambodia and Myanmar) are still, to a significant degree, under state-managed control, even though rhetoric would indicate they are moving to a market economy. Future emphasis in assistance will have to be more strongly directed to the adjustment of policies that still cause serious distortions in both the general and agricultural economy and thus create strong disincentives for farmers to invest in agricultural development. The most important constraining factors that require strategic assistance are:

- provision of land title and ownership of rural lands to individuals, establish functioning land markets, remove obstacles to land aggregation for fragmented and extremely small holdings and create local part-time and full-time off-farm employment for farmers on marginal units and for those displaced from the land;
- development of state-owned enterprises and development of vigorous decentralised and privatised goods and service industries (involved in seed production, fertilisers, animal health products and vaccines, machinery and agro-processing);
- provision of key infrastructure in many rural areas, especially related to improved water resources management, soil management and transport systems; and
- access by farmers to formal financial services, improved functioning of rural financial markets, stimulation of rural savings and community-managed funds, and graduation of farmers to use of commercial financial mechanisms.

## Information and Human Resources

Farmers are typically poorly educated, with significant levels of illiteracy in some countries. Furthermore, most governments do not have strong educational programmes for farmers and access to information is difficult and limited. Modern information technology development (computerised networks, local provision of computer based information, etc.) and the use of

more traditional training programmes are key elements to agricultural development in the future education. Skills and knowledge building and entrepreneurship of rural families, including women, must be promoted as an essential component of future development assistance, combined with much improved systems for dissemination and access of information to farmers.

### Implications of Different Scenarios

The foregoing analysis and conclusions are based on the global trends outlined in Chapter 2 and the regional trends outlined above. Given the rapid change which has occurred in the region during recent decades, a good deal of which was not anticipated, it is worth considering the implications of changed assumptions with regard to climate change, market liberalisation and public investment in agriculture.

**Climate change.** With so many islands coastal areas of the East Asia and Pacific Region and vulnerable to maritime storms, floods and sea level changes, accelerated global warming would disrupt many communities in the Coastal Artisanal Fishing Farming System.

**Market liberalization.** Agricultural trade has shaped several of the farming systems of the region, and will be an important determinant of future evolution. Whereas Pacific countries import finished animal products, without the importation of feedgrains for domestic meat and milk production the growth of livestock industries will be curbed in China (especially in the Lowland Rice and Temperate Mixed Farming Systems) and Indonesia (especially in the Upland Intensive Mixed Farming System). Open markets for oil palm and rubber will be essential for the intensification of the Tree Crop Farming System.



## 8 Latin America and the Caribbean<sup>38</sup>

### INTRODUCTION

As defined by the World Bank, the LAC region encompasses 42 countries and 20.5 million km<sup>2</sup> with a total population in 2000 of 505 million (expected to reach 725 million by 2030). The region is extremely diverse ecologically and contains a significant proportion of the world's biodiversity, and more than one quarter of the world's forests. Population density is relatively low (25 persons/km<sup>2</sup>) and urbanisation high (73 percent), thus only about 126 million people live in rural areas. By 2030, urbanisation is expected to reach 83 percent regionally, but rural populations will increase in some areas, notably in parts of Central America and the Andes where high rates of population growth are expected.

Land and water use intensity is low by world standards and the 202 million ha of cultivated land – one fifth of the developing world total – represent only 18 percent of the potential for the region, although soil constraints are widespread. There are a further 594 million ha in grazing and pasture land. LAC accounts for 48 percent of the total renewable water resources in the developing world but it is estimated that no more than 1 percent of the available water is currently utilised. More than 40 percent of developing world production of a number of crops; including coffee, citrus, soybean, sunflower, sugar cane and banana comes from LAC.

LAC is the wealthiest of the developing regions (average per capita GNP of US\$3 940 in 1998), and the least dependent on agriculture which contributed only 8 percent of GDP in 1998. Land distri-

bution and incomes are, however, among the most skewed in the world, and there is a strong urban bias; extreme poverty affects 31 percent of rural households (47 million persons) but only 10 percent of urban ones. Historically, labour productivity in agriculture has grown at only half the developing world average. The average food intake in the region is 120 percent of the required daily minimum but 53 million people (10 percent of the population) are estimated to be chronically undernourished.

The most rapid growth in regional demand for foodstuffs over the next 30 years is expected to be focused upon livestock products and vegetable oils, but the primary impetus for increased production is likely to derive largely from international demand, and FAO estimates that cultivated area will expand by 20 percent to 2030 (one third of the 40-year historical rate of 1.76 percent p.a.). If the region maintains its competitiveness, this figure could well be exceeded, given the enormous areas potentially available for development such as the Cerrados, Llanos, and Amazon basin. Intensity of land or water use is not, however, expected to increase significantly.

LAC currently has annual net trade deficits in cereals – 16 million tons; 10 percent of consumption – and dairy products; these are projected to increase. By contrast, it is the only developing region with a net trade surplus in meat products (expected to triple to 2.5 million t/annum by 2030) and is the most important developing region for oilseed exports (15.6 million tons in 1998), which are also expected to rise.

<sup>38</sup>The material in this section is extracted and summarised from the Global Farming Systems Study: "Regional Analysis: Latin America & the Caribbean"

## CHARACTERISTICS OF THE MAJOR REGIONAL FARMING SYSTEMS

Due to its enormous latitudinal range, varied topography, and rich biodiversity, Latin America and the Caribbean have the most diverse and complex range of farming systems of any region. Fifteen farming systems have been distinguished in this study (Map 6). Even this number, however, could easily be expanded; the Andean system alone could yield at least six distinct systems. The systems, and their key characteristics in relation to poverty, are listed in Table 8-1 below. On the basis of these characteristics, four of the systems were selected for more detailed analysis. These are described briefly below.

### Extensive Mixed Farming System (Cerrados & Llanos)

This system covers the Cerrados of Central Brazil (190 million ha) and the Llanos of Guyana, Venezuela and Eastern Colombia (40 million ha) and contains an agricultural population estimated at over 9 million and 31 million ha under cultivation. The zone varies from dry to wet sub-humid (1 000-2 000mm/year) with a clearly defined dry season. Due to its isolation and soil constraints, the system was historically judged suitable only for extensive grazing, with ranches over 500 ha predominating. As recently as the 1970s only 6m ha of the Cerrados was under cultivation but agricultural growth has been rapid in recent years. The Cerrados now contributes a major proportion of national output of soya (34 percent), maize (21 percent), rice (21 percent) and irrigated beans (20 percent), although yields are below national averages. Coffee production is also expanding. Large ranches now account for only 10 percent of holdings, but cattle populations are still estimated at 65 million head with some 45-50 million ha under grazing. Arable and coffee farms are typically in the 10-100ha size range and employ considerable seasonal labour. The agricultural potential of the Cerrados is estimated by EMBRAPA at 130 million ha, raising the possibility of more than 80million ha of expansion. The Llanos, with more serious soil suitability problems, has been seen less agricultural development and is still predominantly pastoral, although it could provide perhaps an additional 10-15 million ha of arable production in the coming decades. Poverty within the system is low, with less than 10 percent of holdings in the Cerrados under

10 ha. Two thirds of farms are owned, the remainder generally lacking title. There are, however, increasing numbers of landless labourers.

Due to historically low population densities, infrastructure and investment has been limited. The rate of system growth to 2030 will depend at least in part on the openness of international markets, but expansion is expected to be strong. Investment in transportation, processing and social infrastructure is anticipated, resulting in reduced transaction costs and increased off-farm employment, thus attracting more immigrants to the system. Overall population will likely double over the next 30 years. Livestock will almost certainly play a reduced role as crop diversification accelerates. Potential exists for acid-tolerant fruits and dry-season crops such as pigeon pea, especially among smaller producers. Increasing demands for irrigation water could lead to conflict if poorly managed. No-till cultivation methods, currently practised over one third of cultivated area, will expand.

Major gains in productivity are possible with appropriate integrated crop-livestock management practices, but the system is susceptible to degradation under poor management; an estimated 40 million ha of the Cerrados has already been severely degraded. Of equal or greater importance, however, will be the management of the human settlement aspect of system growth. It is essential to avoid conflict between large land owners and immigrants, particularly in light of the severe poverty in the neighbouring drylands system of N. E. Brazil.

### Dryland Mixed Farming System

This system comprises the North East of Brazil, encompassing approximately 20 percent of Brazil or over 100 million ha. The Yucatan peninsula of Mexico contributes a further 17 million ha to the system. Total cultivated area is estimated at 18 million ha and the agricultural population is estimated at under 0.5 million in Yucatan and approximately 10 million in Brazil. Annual precipitation ranges from 400-600mm in N.E. Brazil but is higher in the Yucatan. The long seasonal dry periods and frequent droughts typical of the system render crop failure common and reduce average yields. About 20 percent of the system in N.E. Brazil is undergoing desertification.

The main agricultural activity is subsistence production (cassava, maize, rainfed rice, beans and small stock), practised by more than 80 percent of the small

Table 8-1: Major Farming Systems in Latin America and the Caribbean

Farming Systems	Land area (percent of region)	Agric Popn <sup>a</sup> (percent of region)	Principal Livelihood <sup>b</sup>	Incidence of Poverty	Potential for poverty reduction	Potential for agric. growth
Irrigated	9	8	horticulture, fruit, cattle	Low/Moderate	Low	Moderate
Forest-Based	30	9	subsistence/cattle ranching	Low/Moderate	Moderate	Moderate/High
Coastal Plantation and Mixed	9	18	export crops/ tree crops, fishing, tubers, tourism	Low/Severe (highly variable)	Moderate	Moderate
Intensive Mixed	4	9	coffee, horticulture, fruit	Low (except labourers)	Low	Moderate
Cereal-Livestock (Campos)	5	6.5	rice & livestock	Low/Moderate	Moderate	Moderate/High
Maize-beans (Mesoamerica)	3	11.5	maize, beans, coffee, horticulture	Severe/Very Severe	Moderate/High	Low/Moderate
Extensive Mixed (Cerrados & Llanos)	11	8.5	livestock, oilseeds, grains, some coffee	Low/Moderate (smallholders)	Low (in system)	High
Intensive Highlands Mixed (N. Andes)	2	3.5	vegetables, maize + coffee, cattle / pigs, cereals, potatoes	Low/Severe (high altitudes)	Moderate/High	Moderate
High Altitude Mixed (C. Andes)	5	5.5	tubers, sheep, grains, llamas, vegetables	Severe/Very Severe	Moderate	Low
Mediterranean Mixed	2	2	wheat, olives, horticulture, fruit	Low	Low	Low
Temperate Mixed (Pampas)	5	6	livestock, wheat, soybean	Low	Low	Moderate
Extensive Dryland Mixed (Gran Chaco)	3	1.5	livestock, cotton, subsistence crops	Moderate	Low/Moderate	Moderate
Dryland Mixed	6	9	livestock, maize, cassava, labour	Severe/Very Severe (drought)	Moderate	Low
Pastoral	3	<1	sheep, cattle	Low/Moderate	Low	Low/
Sparse (forest)	3	<1	sheep, cattle, forest extraction, tourism	Low	Low	Low

Priority systems for poverty reduction and/or growth are shaded.

<sup>a</sup> Agricultural populations are defined as those working in farming, forestry or fishing and their dependants

<sup>b</sup> A slash (/) in the livelihoods column indicates distinct sub-systems.

farmers. Almost all of Brazil's goats and half of the sheep are found in the N.E. Land distribution is strongly bimodal in N.E. Brazil. 59 percent of the estimated 2 million farmers occupy 6 percent of the land (many as sharecroppers, tenants or squatters), while 8 percent of farmers occupy 61 percent of the land. Larger holdings typically focus on maize – often for feed – and livestock. The cattle population in N.E. Brazil previously accounted for 20 percent of the national herd, but drought has severely reduced numbers in recent years. In Yucatan, average holdings are 4 ha, but shifting cultivation is still practised. The system has abundant water conservation measures in place, including reservoirs, retention barriers and desalinisation works, but they are of only limited use in periods of severe drought.

More than 50 percent of rural families in N.E. Brazil live under chronic and severe poverty conditions, and even with one third of income deriving from migration and off-farm employment, average family incomes are only one fifth of those in the South. Further concentration of land holdings is expected in the future as poorer producers leave the system. Maize production may decline, but the production of cassava is expected to expand, as a form of insurance against drought, and an increased use of fodder species for feeding livestock is anticipated. Infrastructure throughout the marginal drylands system is poorly developed. Climatic changes may result in worsening drought conditions but expansion in irrigation systems (currently 0.4 million ha) is foreseen where water is available. Agro-industry and services offer some employment opportunities, as does tourism in coastal areas.

The operating capacity of public institutions is expected to increase, but linkage to the needs of poorer inhabitants remains a concern. Other major trends are the growing irrigation activity, with a projected doubling of irrigated area – primarily for fruit production – creating substantial employment.

#### Maize-beans Farming System (Mesoamerica)

Extending over 65 million ha, this system occupies primarily upland and slope areas of Central America and Southern Mexico and has only an estimated 6 million ha of cultivated land. It encompasses an agricultural population of some 13 million people, half of them in Mexico, and as much as 50 percent of the rural population of Guatemala. With a significant

indigenous population, a semi-subsistence production system – sales of surplus grains are supplemented by coffee and vegetables in some areas – and holdings typically under 5 ha in predominantly marginal lands, this system is associated with severe poverty. Seasonal and long-term out-migration are common. Few possess title to their land. The system is heavily dualistic, with large-scale estates often located in better areas. Productivity is low, with maize yields typically from 1-2 t/ha and beans only 0.6-0.9 t/ha. Nevertheless, substantial irrigated area (over 2 million ha) exists within the system, a significant portion of which is small-scale.

Growth of the rural population and the absence of land markets have contributed to reduced average holding sizes in recent decades. UN projections indicate a further 7 percent increase in system rural population to 2030, leading to increased pressure on natural resources unless productivity can be dramatically improved. Furthermore, due to income trends and trade liberalization, long-term trends for grain prices are downward, rendering a dependence on sales of maize and beans a losing strategy in the future. Increases in climatic variability and a reduction in rainfall are predicted as a result of global climate changes.

One likely response to these pressures will be to accelerate the process of diversification, already important in some areas. Increasing urban and international demand for new products will provide an escape from poverty for better endowed producers (land, water, market access, capital). New post-harvest technologies are likely to expand these opportunities. Many other producers will combine subsistence production with off-farm income generation. Inevitably, however, there will be producers who are unable to diversify or obtain off-farm employment due to location or other factors. They will thus face the prospect of deepening poverty.

#### High Altitude Mixed Farming System (Central Andes)

This system covers 110 million ha from Northern Peru through Bolivia into Northern Chile and Argentina, and includes 40 percent of the territory of Peru and Bolivia. The high altitude dissected valleys of the northern part of the system give way to a vast treeless plateau further south. Most of the system is over 3200m elevation and some agricultural land

reaches 4500m. Precipitation ranges from 150-1,000 mm per annum, rendering much of the system semi-arid. Soil fertility is typically low, and soil erosion is widespread.

The rural population, estimated at 6 million, is overwhelmingly indigenous and community organisation is often strong. Poverty is both severe and ubiquitous. Further rural population growth is projected (9 percent in Bolivia to 2030), despite extensive out-migration. Unusually for Latin America, there are few large holdings within the system. The cultivated area is about 3.2 million ha and approximately one third of this is irrigated. Production is subsistence based, and varies by altitude, but includes potatoes, native Andean grains, maize, barley and lima beans. Sheep are important in the Peruvian Sierra, while llama and alpaca dominate further south. Maize yields typically do not exceed 1 t/ha. Infrastructure (roads, electricity etc.) is poorly developed.

The widespread soil erosion already occurring will worsen without substantial changes in cropping patterns and natural resource management practices. Low labour productivity and weak markets make it difficult to justify input costs, thus leading to declining yields. Opportunities for crop diversification are more limited than in other systems, although expansion of irrigation and protected cultivation under plastic tunnels may provide limited opportunities. There is little off-farm employment. The best opportunities for growth and poverty reduction lie in improved producer organisation to benefit from market opportunities. Stronger marketing linkages to end-users (supermarkets, institutions, restaurants) and the processing of raw materials (milk, potatoes, grains) could significantly increase family earnings, while speciality products such as quinoa, and camelidae wool, may provide profitable export opportunities.

## REGIONAL STRATEGIC PRIORITIES

The region offers a sharp contrast between extensive frontier areas with low population densities and future growth potential, and established densely populated systems, many with a high incidence of poverty. Yet these two extremes share a number of common challenges that define a clear strategic focus for the LAC region over the next thirty years. These challenges can be summarised as:

- sustainable management of natural resources and the reversal of degradation;

- improved access to land by poorer rural populations;
- the capacity to respond to globalisation and market development.

However, these overall strategic thrusts require specific strategies and interventions in each of the five principal categories outlined in the introduction to this study. Each of these categories is briefly examined below:

### Natural Resources and Climate

Many farming systems within LAC are experiencing increasing levels of natural resource degradation. Predicted population increases in “poverty” systems, coupled with division of land on inheritance, will only increase these pressures. Although the solution to this problem may lie partly in the other strategic priorities outlined below, actions may include:

- the development and implementation of effective, community-level natural resource management plans, including technical assistance and incentives for adoption;
- an emphasis on demonstrating short-term benefits from watershed, forestry and other resource management activities;
- the probable increased frequency and severity of droughts as a result of global climatic changes is likely to make the incorporation of moisture conserving technologies increasingly important if desertification is to be avoided in drier areas. Ironically, torrential rains and flooding may also increase in frequency, highlighting the vitally important role of effective watershed – especially in Mesoamerica.

### Science and Technology

Experience in a number of pioneering projects indicates that technologies already exist for improved natural resource management and drought management, including:

- increasing soil organic matter content, e.g. through legumes;
- no-tillage cultivation on slopes and in semi-arid areas;
- using vegetative barriers, contour protection and increased permanent crops on slopes;

- zero or controlled grazing of livestock, especially goats, with fodder crops and trees;
- integrated management of fragile savannah soils in frontier savannah lands.

Increased research is needed, however, on short-season and drought tolerant crops suitable for small producers, as well as on increasing land and especially labour productivity, through improved cultivation and post-harvest procedures. Research will also be needed to increase the ability of smaller producers to compete effectively in growing international markets in such areas as:

- adapting existing and future post-harvest technologies to the needs of smaller producers;
- appropriate IPM and organic cultivation practices and tools (e.g. biological controls);
- field testing of new varieties/species and determining optimal agronomic practices.

### Globalisation and Market Development

The globalisation of trade and markets is putting increasing pressure on many traditional farming systems. A rapid transition to free market conditions will increase poverty levels in farming systems, at least in the short term, as producers struggle to adapt. Those systems already associated with high levels of poverty will be the most seriously affected as they often lack the human, financial and technological resources to change. However, a number of options appear to be available to producers in these systems, including diversification, off-farm employment and supported exit – but outside assistance is required to facilitate the process. Experience shows that, rather than create direct state-supported interventions, the most effective strategy is to promote an active and competitive private and civil sector in rural areas, by measures including:

- reducing barriers to entry and costs of operations for small-scale enterprises and organisations active in input provision, marketing, finance, land markets and other services;
- providing infrastructure development and human resource training to meet the needs of larger-scale organisations initiating or expanding processing and other forms of non-farm employment.

### Policies, Institutions and Public Goods

For the Mesoamerican and Drylands Systems (arguably less so for the Central Andean system), existing severe poverty levels are directly related to problems of access to, and control of, natural resources – primarily land. Across LAC, the dualistic nature of many farming systems means that a few producers occupy large areas of land which are often utilised only at relatively low intensities, while the large majority are constrained to small and increasingly less viable holdings. Civil conflict has often been a direct result. Effective land policies will be of importance also in frontier areas (e.g. frontier tropical savannas) where migration from neighbouring poverty systems could lead to conflict. Key strategic priorities for LAC include:

- improved functioning of land markets, through acceleration of cadastral and titling procedures;
- conflict resolution mechanisms, and changes in land transfer taxes;
- land banks to buy both marginal and large holdings and resell land with the objective of consolidating smaller commercial holdings;
- fiscal disincentives to under-utilised holdings and incentives for sale to land banks;
- supported exit for sub-marginal producers, including purchase of traditional rights to land.

Although infrastructure provision is increasingly recognised as a private sector activity, rural roads, electrification and small-scale irrigation are still predominantly public goods and their improvement is essential for market development in many areas. The withdrawal of the state from many rural institutional activities – banking, extension, marketing – makes support and oversight of civic and private institutions absolutely essential.

### Information and Human Capital

Accelerated rates of change appear inevitable in traditional systems, requiring improved information and human resources. Information provision by the public sector involves substantial recurring costs and is frequently irrelevant to real market needs, so the service is best provided by private sector buyers and traders.

It is, nonetheless, necessary to ensure competition in market operations by eliminating barriers to entry and improving rural infrastructure. Human resource development should focus on:

- skills training for youth (including farming system exit skills) and women (including marketing and post-harvest);
- linking training to employee needs in rural areas; whether agro-industry or non-agricultural activities.



## 9 Global Challenges and Priorities

Widespread and severe household food insecurity occurs in many of the farming systems analysed in this Study and it is expected to remain a major concern during coming decades. Food insecurity is both a cause and consequence of poverty. Poor households typically lack the purchasing power to acquire adequate food, while food insecurity also causes poverty – hungry persons generally have a greater incidence of illness, lower labour productivity and worse educational achievements. Targeted efforts to stimulate the agricultural productivity of food-insecure farm households, such as the FAO Special Programme for Food Security, can result in multiple benefits to both rural and urban poverty reduction, economic growth and balance of payments.

In all regions, poverty and household food insecurity are more prevalent and more severe in rural than in urban areas. There is a need to take deliberate steps to reduce poverty in rural communities, and programmes for immediate poverty alleviation should be complemented by measures for long-term food security and poverty reduction through a process of pro-poor economic growth and development. In many cases, transitory measures to safeguard minimum nutritional and livelihood standards will be necessary. Because of the impact of agricultural growth on urbanisation rates and food costs, small farm development may also be an effective instrument for combating urban poverty. The Study argues that there is a strong case for policy reform and expanded investment in public goods and services – at national and global levels – to support the development of sustainable farming systems in order to achieve the goals of food security and poverty reduction,

economic growth and sustainable natural resources management.

While detailed recommendations for the improvement of specific farming systems are presented in the separate regional volumes, this Chapter draws upon the results of the farming systems analyses in each region to identify common strategic challenges and priorities facing agricultural development in the first three decades of the 21st century. The areas of focus are: (i) natural resources management; (ii) science and technology; (iii) globalisation and market development; (iv) institutions, policies and public goods, and (v) information and human capital. Since it is evident that both farming systems and the individual farms within them have unique characteristics, the discussion of global challenges and priorities is preceded by a short section on the development implications of contrasting farm situations. This is approached in terms of farms of different size and contrasting quality of resource endowments.

### THE CHALLENGE OF CONTRASTING FARM CHARACTERISTICS

The Study illustrates how the livelihoods of most poor people living in rural areas depend directly or indirectly on the exploitation of natural resources<sup>39</sup>. All rural households derive a significant part of their income from activities based in various ways on natural resources, whether it be from agricultural wage labour, grazing livestock on marginal areas, gathering wild products from forest areas, or producing handicrafts from forest materials. Current livelihood levels and

<sup>39</sup> Idriss Jazairy, Mohiuddin Alamgir and Theresa Panuccio. 1990. "The State of World Rural Poverty." New York University Press for IFAD. Rome.

the potential for improvement thus depend upon the amount and the quality of available resources. This dependence of farm households on natural assets or resources, complemented mainly by human and social capital, is in marked contrast to the reliance of urban households on physical, financial and human capital. This contrast is even greater for those households in severe poverty.

Of more immediate interest, the contrasting resource endowments of different farms even within the same farming system, mean that opportunities for development are specific to each category of household. These contrasting characteristics are commonly expressed in terms of farm size and resource potential.

### **Contrasting Characteristics and Development Possibilities of Small and Large Farms**

Small and large farms are distinguished by the availability of resources in relation to the sustainable productive capacity of the farm unit. The asset mix and goal set of the managers of these two types of units tends to differ markedly. While small farmers depend heavily on natural, social and human capital, large farms resemble commercial businesses and tend to rely more on natural, financial and physical capital. Large farms generally have greater land-labour ratios and thus can generate larger market surpluses. Small farms have better social capital but weaker human capital. The different land/labour ratios lead to different technology requirements and, as development opportunities facing small and large farm households are very different, this implies the need for differentiation of support systems and development strategies.

Except in cases of sharp dualism such as Northeast Brazil, small and large farms generally represent the extreme ends of a size continuum. Farms shift both ways along the continuum, driven by population pressure, market incentives and regulations. In many of the high potential, low intensity farming systems with growth potential, e.g. the Extensive Mixed (Cerrados & Llanos) System in Latin America, average size of farm is expected to diminish over time as agriculture intensifies. In other farming systems such as the Rice-Wheat System in South Asia, farm size may well increase to take advantage of economies of scale. Additional impetus towards increased farm size

will come from agricultural policies, many of which have the explicit goal of redistributing land. However, in some situations, an increase in farm size alone may have only modest effects on household income and the extent of poverty<sup>40</sup>.

In some farming systems, notably in Sub-Saharan Africa and Latin America, small farms can grow as the agricultural frontier expands. However, in the other four regions there is little scope for area expansion, and small farm income will grow through intensification and diversification towards more profitable activities. Thus, sustainable and productive resource management, which underpins much intensification and diversification, will be relatively more important for small farms. The analyses show that improved soil fertility and water resource management is critical on small farms, whereas improved soil fertility alone is a strategic priority for many large farms, particularly in Eastern Europe and Central Asia.

The goals of farm management – notably the balance between food security and profit, and attitude to risk – are important determinants of livelihood patterns and incentives to adopt new technology. Livelihood patterns are much more diverse, both within and between small farms than is the case with large farms. Large farms also tend to employ more modern technology, because of better trained managers, more powerful equipment and favoured access to credit, input supplies, markets and information, plus a greater potential to undertake new risks.

### **Contrasting Characteristics and Development Possibilities of High and Low Potential Areas**

The nature or quality of the farm resource base also influences potential responses to changing constraints and opportunities. In particular, systems in low potential areas with low or erratic rainfall and poor soil fertility, tend to have relatively few agricultural development opportunities, and farmers may be more concerned with minimising risk than maximising food production or profit. The range of options open to smallholders for livelihood improvement in these low potential areas is also generally more restricted than for high potential areas. Furthermore, low potential areas tend to be highly risk-prone due to seasonality of rainfall, frequent drought and susceptibility to natural disasters. In contrast, farming systems in high poten-

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<sup>40</sup> A. Valdes supported this argument with data from Brazil, in a seminar in FAO during January 2001.

tial areas, with relatively fertile soils and favourable climate, typically have a wider range of agricultural intensification and diversification opportunities.

Examples of farming systems in low potential areas are: the Agro-Pastoral Millet/Sorghum System in Africa, Rainfed Mixed System in South Asia and the High Altitude Mixed (Central Andes) System in Latin America and the Caribbean. Examples of farming systems in high potential areas include; all Irrigated Systems, the Cereal-Root Crop System in the moist savannah in West and Central Africa, the Tree Crop System in East Asia and the Pacific, and the Extensive Mixed (Cerrados & Llanos) System in Latin America and the Caribbean.

## GLOBAL CHALLENGES AND PRIORITIES FOR COMING DECADES

Many crosscutting issues and priority areas are evident from the regional summaries in the preceding Chapters. The most important strategic priorities are discussed below under the five headings of: (i) natural resources and climate; (ii) science and technology; (iii) globalisation and market development; (iv) institutions, policies and public goods, and (v) information and human capital.

### Achieving More Sustainable and Productive Use of Natural Resources

Increasing pressure on the use of scarce land and water resources, environmental degradation, and the possibility of climatic change are challenging the sustainability of farming systems in all regions, even those with low population densities. Some key strategic priorities stand out:

- *Greater focus on improvements in the sustainability of natural resource use*

There is a heightened awareness, among both the public at large and farmers in general, of the need to better conserve and productively manage natural resources. Public interest assigns a high priority to the maintenance of the productivity of natural resources for future generations and to reducing global environmental damage. This provides the main justification for public funding towards the development and promotion of methods of natural resource management that maintain or enhance natural capital and increase global environmental

benefits (e.g. increased carbon sequestration through higher soil organic matter levels, reduced production of greenhouse gases and less pollution of international waters, etc.). It is anticipated that increasing public pressure and support will be focused on natural resource management and environmental protection in the future.

Falling productivity and farm incomes on degraded lands has highlighted the need for farmers to improve natural resources management. Farmer adoption of improved land management can be stimulated by the promotion of practices that not only generate environmental benefits but also rapidly yield tangible returns. Thus, public research and extension should focus on those measures that increase farm incomes whilst also conserving and enhancing the condition of natural resources. These measures are typified by minimum tillage technologies and integrated plant nutrient management, which simultaneously reduce production costs, improve *in situ* retention of moisture and raise soil fertility, thereby raising yields and reducing erosion.

In many situations, conservation agriculture, involving reduced tillage, offers promising possibilities for increasing labour productivity and the efficiency of input use, while simultaneously reducing moisture stress. Conservation agriculture has been promoted in a number of farming systems, and its performance in Latin America, and more recently in Africa, has been promising.

- *Requirement for recapitalization of soil fertility*

The loss of soil fertility, with the associated stagnation of productivity, cuts across most farming systems in all regions. The loss is particularly acute in most irrigated wheat and rice-based farming systems, some rainfed farming systems (e.g. the Maize Mixed Farming System in Africa) and highland farming systems (e.g. the High Altitude (Central Andes) Farming System). Because of declining commodity prices and economic liberalisation, application of mineral fertiliser has become less profitable and its consumption, especially by small farmers, has fallen sharply. However, farmers have not yet fully compensated for this loss through greater use of organic sources of nutrients.

Priority initiatives to rectify the situation include: (i) greater use of green manures, enriched fallows and organic materials; (ii) composting; (iii) expanded use of biological nitrogen fixation; (iv) better integration of crops and livestock; (v) wider adoption of inter-cropping systems; (vi) expansion

of silvo-pastoral systems, especially on steeper slopes, and (vii) improvement of fertiliser import and distribution facilities and services with a view to reducing the farmgate price of imported fertilisers.

Many of these initiatives place little reliance on external inputs (and hence on input supply and financing services), and some have the advantage of enabling farmers to increase the productivity of their land through converting labour resources, which often have low opportunity cost in the off-season, into productive assets. Such “sweat equity” investments can play a most important role in building-up soil fertility, improving land management (e.g. terracing steep hillsides, draining bottomlands) and intensifying land use (e.g. planting tree crops, building fishponds). The creation of a policy environment that gives smallholders confidence in the future of farming, including reasonable security of land tenure, is an important trigger for “sweat equity” investments.

- **Improvement in water resources management**

Although the adverse consequences of water shortages are more evident in regions such as the Middle East and North Africa, Central Asia and South Asia than in East Asia and Latin America, water supply constraints are important in specific farming systems in all regions, e.g. the marginal drylands of Latin America or the agropastoral systems of Sub-Saharan Africa. In many cases, the rising demand for water for domestic and industrial purposes associated with urbanisation will intensify the competition for available fresh water. Where farming systems are rainfed, strategies must focus on improving the capture of rainfall and the utilisation of soil moisture. Possible measures include: (i) making minimum and no-tillage technologies accessible to small farmers, as done successfully in Brazil and Argentina; (ii) providing true-breeding, short-season crop cultivars and drought resistant fodder species that can maintain livestock populations through dry periods, and (iii) expanding water harvesting efforts for small-scale capture and utilisation of run-off, as pioneered successfully in such countries as India and Niger.

Low water use efficiency is often the result of water being considered a low value or free public good. For irrigated farming systems, changes are needed in the key areas of water and rural energy pricing policy and strengthening local management of irrigation infrastructure; both of which are important elements in increasing the technical efficiency of water use.

- **Increased capacity to respond to climatic changes**

Changes in the frequency of extreme climatic events – whether it be temperatures, precipitation or atmospheric events – and shifts in agro-ecological conditions including those triggered by rising sea levels, are likely to completely alter farming practices in some vulnerable areas, such as coastal areas, semi-arid zones and steep lands. Droughts, floods and hurricanes or typhoons are all expected to become much more frequent.

A better understanding of the probable nature and impact of climatic changes is urgently needed, and appropriate adjustments of agricultural policies and projects are required to mitigate adverse effects. The development of watershed protection and anti-desertification measures is likely to take on more urgency. It is also necessary to establish a greater capacity, both nationally and internationally, to respond effectively to damaging weather events, such as floods and droughts, to minimise their long-term impact on resource management and rural livelihoods.

## Deploying Science and Technology for Poverty Reduction

The major part of the growth in food production in the past three decades has resulted from the adoption of productivity-boosting technology by farmers in areas of high agricultural potential, particularly those with relatively high and reliable rainfall or equipped with irrigation. A major challenge in the coming decades will be to generate technologies that contribute to increases in agricultural production and improvements in livelihoods in those areas where the potential for agriculture is lower.

For the longer term, there must be concern about the heavy reliance of intensive agriculture on technologies that have inherently limited sustainability. “Factory” livestock farming systems are faced with enormous problems of organic waste disposal and are increasingly seen as sources of food safety problems. Inappropriate nitrogen fertiliser application is leading to nitrate pollution of surface and groundwater resources, and pesticides are creating enormous health and environmental hazards. Equally worrying is the progressive narrowing of the genetic breadth of farm crop and animal species which, apart from increasing their vulnerability – especially to diseases – is also leading to a rapid erosion of the genetic resources on which future breeding programmes can

be based. The implication is that the technical foundations for “modern” agriculture can no longer be taken for granted and that there is a need to search for more sustainable pathways towards intensification. This task is urgent, given the very limited extent to which thinking has been focused on alternative and more sustainable technologies for high-intensity farming and the very long gestation period required to develop and disseminate new technologies. The analyses of farming systems in this Study suggest a number of important characteristics of technologies which are suitable for poor farmers and also some areas for technology development which offer opportunities for poverty reduction (see Box 9.1).

**BOX 9.1: PROMISING AREAS FOR PRO-POOR TECHNOLOGIES**

Ideal pro-poor technologies are characterised by increased long term productivity, labour intensity, suitability for women, adaptability to seasonality, stability and resilience, compatibility with integrated and diversified systems, low external input requirement and ease of adoptability. Promising areas include:

- Biological Nitrogen Fixation, and other nutrients
- Integrated plant nutrient management, including minor nutrients
- Water use efficiency, including water harvesting
- Integrated soil and water management
- Conservation agriculture
- Biomass production
- Managed carbon sequestration
- Customised varieties
- Integrated intensive farming systems
- Integrated pest management
- Horticulture, medicinal crops, spices and other minor crops
- Energy crops
- Gender selection in animals
- Genetic resistance to animal diseases

Except in some of the more intensively cultivated wheat and rice producing areas, few small farmers in developing countries are yet engaged in farming practices that are of doubtful sustainability because of their very heavy dependence on “modern” technology.

• *Focused technology through participatory research and development*

Except in regions where the Green Revolution has taken place, there are few opportunities for whole-

salting new agricultural technologies. Each farm tends to differ in its resource endowment, especially in the relation between land and labour resources, as well as in access to input and output markets and vulnerability to risk. It may also differ in its needs, particularly in the extent to which farmers see production as contributing mainly to family food security or to cash income. The need is, therefore, for participatory approaches to research and development which can engage farmers in diagnosing problems and in identifying possible solutions adapted to their particular circumstances. These approaches can also help to inform researchers of priority areas for investigation and to understand farmers’ viewpoints, thereby increasing the relevance of research.

• *Increased average crop yields in areas of high potential*

Technology does not move forward at an even pace. The major productivity gains made in rice and wheat, particularly in the 1970s and 1980s, have given way to a slower rate of growth in the last decade. Other technological breakthroughs appear to be on the horizon, including “golden rice” and biological nitrogen fixation in non-legumes, which can be expected to have a significant impact on farming practices within the next three decades. In the meantime, substantial gains are possible from raising average yields towards the yields obtained by the best farmers even under current technologies (see Box 9.2).

• *Increased labour productivity in low potential and low population density areas*

Low potential areas often face more serious labour availability constraints than land availability constraints. Where productive activities have to be dispersed (transhumant herds, scattered production plots, food gathering), and where the functioning of the household requires lengthy journeys for basic inputs such as firewood or water, labour can rapidly become a key factor limiting output. Such limitations will be exacerbated by out-migration or civil conflict, as has been the case in the Central Andean High Altitude Farming System or many parts of Africa. Yet research on production technology has traditionally focused more on maximising returns to land rather than labour, replacing labour with capital only in more intensive systems (e.g. two-wheeled tractors in intensive rice systems). In many systems there are good opportunities for improving labour productivity, for instance by altering the time

## **BOX 9-2: YIELD GAPS AND DECLINING PRODUCTIVITY GAINS IN RICE PRODUCTION** <sup>41</sup>

The Green Revolution of the 1960s enabled rice production to rise to meet the demands of a rapidly growing world population. The average annual growth rate (AGR) in yield ranged from 1.7 to 2.3% over the period from 1960-90. In the 1990's, however, rice yield AGRs have declined to only 1% and reports of actual declines in yields are being received from countries such as Thailand, India and the Philippines.

This deceleration of yield growth and productivity raises concerns for world food security and small-scale producer incomes; in 1996, nearly 3 billion people depended on rice as a major source of daily calorie and protein intake. More than 50m ha of land is devoted to intensive rice, producing two to three crops per year, with average paddy yields of about 4-6 t/ha per crop, or 10-15 t/ha per year.

Over the next 30 years productivity growth must once again be accelerated to ensure food security and poverty alleviation especially in Asia and Africa, either by lifting average yields closer to the current yield ceiling, or by raising the ceiling itself. It is probable that the theoretical maximum paddy yield is not very different from that of wheat, at 20 t/ha per crop. However, yield gaps of as much as 60% are observed in national production systems, offering a considerable potential in this direction as well. While one component of such gaps arises from underlying natural resource and environmental constraints, a significant proportion derives from management practices. Recent studies have generated the following recommendations:

- Maintain balanced nutrient applications;
- Make all stakeholders aware of the potential dangers of excessively intensive cropping;
- Incorporate yield stabilising traits in varieties through conventional and innovative breeding approaches;
- Build up levels of organic matter in the soil;
- Conduct fewer but more appropriate long-term experiments with more detailed, interdisciplinary measurements and observations;
- Monitor continuously yield and productivity trends, with due regard to multiple products;
- Develop location specific varieties and technologies, such as an integrated crop management approach like the "Rice Check System" used in Australia;
- Intensify technology transfer activities using successful models such as contiguous area demonstrations;
- Reduce post harvest losses;
- Improve linkages between research, development, extension services and farmers.

of land preparation from wet to dry season, by use of cover crops to control weeds, by investing in draft power and by simple improvements to hand tools such as punch planters.

Where shortage of labour constrains production and incomes and there is easy access to more land, there is considerable interest in labour-saving technologies such as zero tillage and the use of draft animals which offer an attractive route for the development of farming systems. There are also traditional systems (older rice-based systems for example) that have remained highly productive despite continuous cropping for centuries, where skilled labour and management have maintained productivity.

The focus of support measures should be on risk mitigation as much as on increasing productivi-

ty, particularly on the creation of assets that farmers or herders could use to buffer their livelihoods against the effects of external shocks. Given the right stimulus, rural families will often convert labour resources into productive assets. Other opportunities for cutting cash expenditures include substitution of nutrients from mineral sources by organic sources where feasible and changing from pesticide-based pest control systems to IPM.

### • *Increased land productivity in high population density areas*

Different sets of technologies offer opportunities for growth in areas with high labour to land ratios, where there are often attractive options for the labour intensive production of high value commodities. A variety of high-value enterprises should be

<sup>41</sup> For further details, see Tran, D. and N. Nguyen, 2001.

considered. Organic products offer one alternative (high value, high labour). Parts of many high-density systems are becoming peri-urban, providing good market potential in spite of population pressure, especially for vegetable growing and related agro-processing, small-scale dairying, small ruminant fattening and poultry production. Moreover, within these areas the abundant labour may be advantageously used to improve the productive capacity of land, for example through terracing or drainage.

- ***Biotechnology with safeguards***

Biotechnology offers a great potential for the customisation of new varieties of cash and food crops to specific farming systems and problems. The customisation of varieties, particularly those that can cope with abiotic stresses prevalent in low potential areas, has the potential to benefit the poor, if adequate safety standards are applied and provided that the new materials are affordable.

To the extent that the lead in biotechnology applications will lie with the private sector, deliberate measures will have to be taken at the international level to create incentives for expanded research on themes relevant to poor farmers in developing countries, whose needs would be bypassed if priorities were to be set by market forces alone. Such measures could include international public funding for biotechnology research and development focused on improving the performance of tropical food crops. There is also a need for safeguards and regulations to protect indigenous genetic materials from contamination and to prevent damage to natural ecosystems, as well as to guard against further erosion of genetic resources of farm crops and livestock.

### **Exploiting Globalisation and Market Development, whilst Protecting Vulnerable Farmers**

At present, the movement towards reduced barriers to international trade appears irreversible, although the pace of change is uncertain. This process will affect all but the most isolated producers in farming systems throughout the developing world. However, the type of changes induced, and their impacts on production, poverty and food security within individual systems, will depend on a variety of factors; most notably resource availability and market environment, and future advances in technology (preserva-

tion techniques, transport, communications and others).

Evidence from a number of systems (e.g. Maize-Beans Farming System in Mesoamerica, Maize Mixed Farming System in Eastern Africa in the 1980s, and Rice Farming System in East Asia) demonstrates that smallholder farmers can participate successfully in market-driven growth and significantly increase household incomes. Nevertheless, those farmers unable to make the required adjustments – due to a lack of resource availability, or an unfavourable policy and institutional environment (such as are now evident in the Maize Mixed Farming System in Southern Africa) – will continue to remain dependent on traditional staples. They will, therefore, face long-term declining incomes as reduced trade barriers and new technologies reinforce the downward trend in international prices of major food commodities.

- ***Focus by small farms on labour intensive or niche cash crops***

Although smallholders will inevitably wish to continue producing staple crops for food security and cultural reasons, major markets will generally find cheaper supplies from larger high-technology producers, often in other countries. However, as demand for specialist foods grows in cities and industrialised countries, and new post-harvest technologies extend the life and durability of perishable items, small producers will have increasing opportunities to achieve attractive cash incomes through the production of specialised products in which they possess a comparative advantage, e.g. where diseconomies of scale exist (labour intensive and niche horticultural products, fruits, spices, ornamentals, organics etc.). Small farm or holding sizes are not an impediment in these types of markets, which are expected to grow in importance. Even geographically isolated producers (e.g. the Highland Mixed Farming System in South Asia) have the potential to participate in these opportunities, through a focus on very high value-to-weight products (colourants, extracts, essential oils, etc.).

Proven techniques and technologies exist which can raise productivity through greater integration and synergy of system components. Diversification through the incorporation of higher-value crops or livestock enterprises is another major strategic thrust, particularly in the light of projected long-term declines in cereal prices. Diversification could involve non-traditional products, vegetables, intensive dairying, small-

scale pig and poultry production, and aquaculture. The transition to market oriented production of competitive products is seen as a crucial step in rural economic development and poverty reduction. Not only are incomes generated in those households directly engaged in production, but employment is also created in packaging, transport and related marketing activities, as well as in service provision to successful producers.

- ***Satisfaction of household food security needs during the transition***

The restructuring of farm activities to benefit from new market opportunities requires access to a minimum level of resources – especially human and financial – as well as the ability to accept a certain level of risk in the transition process. In many systems, only a minority of small producers can meet these conditions without external assistance. However, their adoption of market-oriented production, as well as activities of larger producers who are often pioneers in innovative crops, can facilitate the later entry of other, less well endowed, producers through indirect employment generation and the creation of demand for supporting mechanisms (extension, financing, etc.).

If the number of potential pioneers is too restricted there may be insufficient output to create a critical market volume for these products and the development of market-oriented production may fail. Farming systems with a high level of chronic and widespread poverty will generally face this barrier. Not only will farmers be more concerned about family survival than cash generation, but local buyers and service providers will be few and the establishment of market mechanisms more difficult. Assisting the transition to market-oriented production in high poverty-level systems may therefore be possible only once food insecurity is reduced, and a minimum level of cash flow is available through the sale of surpluses from traditional crops.

Attention in these systems will need to be focused first upon increasing output of food staples, family nutrition, and food security. This will require further investment in appropriate genetic material, food storage structures, natural resource management and education. Careful consideration will also need to be given to the feasibility of facilitating the reduction in rural populations through the provision of skills training and other programmes.

- ***Support for the role of the private sector – particularly small enterprises***

There is clear evidence that direct public participation in marketing operations is generally ineffective and often yields negative returns. Experience has shown that market development occurs most easily where private individuals – both producers and traders – play the lead roles in determining the functioning of markets. However, from the perspective of small producers who have very limited market power, a competitive market environment with a number of buyers is crucial. Small producers appear to benefit most strongly from the presence of a range of small traders, processors and other buyers. Such small-scale players are usually unable to control prices in the way that larger enterprises may, and are also more willing to purchase in small quantities from often-isolated locations. They may even be members of the same community in which the producer lives. Helping develop a favourable marketing environment for small producers often means supporting small-scale entrepreneurs in such areas as financing, information, simplification of bureaucratic procedures which only larger enterprises can manage, and the improved provision of public goods (see below).

That is not to say, however, that larger enterprises are always a negative influence for small farmers. The contributory role of larger farmers and processors as pioneers, buyers from outgrowers, and as sources of wage labour, should not be forgotten. Small-scale traders – especially in the case of export crops – must generally sell on their product to larger enterprises in the regional or national capital. Farmer associations may help small producers deal more equitably with larger enterprises, by increasing volumes and strengthening their bargaining power in general.

- ***Enabling environment for market development***

Although governments have little role in market operations, the transition of farming systems to market-oriented production can be greatly assisted by supporting an appropriate enabling environment, including: (i) appropriate rural infrastructure, especially roads, electricity and telecommunications; (ii) commitment to a stable and balanced exchange rate; (iii) monitoring and enforcement of trade agreements that have an effect on smaller producers, and (iv) encouraging small-business associations that can support the needs of their members.

Whilst large farms generally enjoy good market access, investment in improved access for small farms is required. The private sector is more likely to invest in such market development where policies are conducive and where small farmers concentrate on high value, niche products. In some situations, particularly in the absence of transport and communications infrastructure, special incentives for market development may be required.

Given the importance of agro-industry as a potential source of demand for rural production, and its potential to create employment, market development can also be assisted by removing disincentives to the location of processing and related operations in rural areas. In addition to ensuring adequate infrastructure, support may be considered for training of employees, organising assistance to input suppliers and favourable fiscal policies.

Finally, the public sector can support strengthened contractual arrangements between producers, intermediaries and processors. Such agreements may be for simple delivery of products, or may include co-operation throughout or in parts of the production process. Market development will be seriously impeded if such contractual arrangements are poorly defined or inadequately protected under law. Conflict resolution procedures need to be low-cost, timely and seen as fair by both parties, while enforcement of contracts should be guaranteed.

### *Refocusing Policies, Institutions and Public Goods*

Many countries have embarked on reforms that have led to a less interventionist public sector, opening new opportunities to provide a wider range of services to farmers. Growth in smallholder agriculture will, however, continue to be dependent on a range of services that only the public sector can supply. What is needed now is to ensure that enabling policies and effective institutions are put in place to underpin smallholder development. Macro and sectoral policies are biased against agriculture. There is a need to review the affects of policies and institutions on agriculture in general, and on poor and marginal producers in particular. In most cases, governments should withdraw direct public support from viable commercial farming and privatise associated services such as seed production and marketing.

However, in the public interest governments should continue to ensure reliable access to relevant public goods by the subsistence-farming sector and to

promote sustainable use of natural resources. Government effort should be devoted to clear cases of public goods supply, including research and extension programmes, addressed to the needs of poor farmers and marginal areas, and enforcement of regulations (e.g. fair trade, food standards), particularly those related to poverty reduction (see Box 9-3). Some success has been achieved with the outsourcing of public service and infrastructure provision to private firms, NGOs and universities, thereby achieving efficiency gains. However, local participation is critical for monitoring the private provision of goods and services. The private sector can play a key role in many areas, such as seed multiplication and varietal development. Exporters' associations can often implement phytosanitary inspection. Research budgets can be managed through competitive bidding and public-private cost-sharing arrangements.

#### • *Equitable, secure, transferable and flexible resource user rights*

The efficient and sustainable utilisation of land and other resources – both individual and common property resources – requires clear, enforceable and transferable user rights, as well as functioning markets for those rights and taxation policies which encourage productive and efficient resource use. Markets for labour, which are currently often heavily distorted, also need to be made more transparent and efficient through an appropriate and well-enforced legal framework. Advisory services will need to acquire more insight into the specific mechanisms whereby access to land, water, grazing rights, forest areas and other natural assets and their exploitation, are managed by communities. They also need to learn how such mechanisms can be reinforced through new technologies and investment, rather than being replaced.

One priority is support for land policies that are compatible with poverty-reducing growth. The recognition of customary land rights – especially rights to common property resources – is critical to ensuring their productive and sustainable use in many systems with low population density. In countries that have inherited dualistic agrarian systems, positive changes in land access can be encouraged through the phasing-out of subsidies to large-scale commercial farmers and the use of fiscal disincentives to the non-productive use of large-scale holdings. Land market development can often be advanced through the recognition of informal land rental and sharecropping markets, facilitation of especially peri-

### **BOX 9-2: RESEARCH FOR SMALL FARMERS AS A PUBLIC GOOD**

The role of the private sector in agricultural research is expected to continue to expand rapidly, particularly where it can generate privately appropriable benefits. Commercial products and services related to plant breeding, pesticides, veterinary products and farm machinery are likely to remain the foci of privately funded research. Biotechnology, which is attracting substantial private funding, will play an increasingly important role. However, on a global scale, the vast majority of private research will be targeted on raising production for developed country farm markets.

Some of the results of this private sector research will be relevant to small farmers in developing countries. However, there exist a number of technology areas crucial to small producers in developing countries, for which only limited demand can be foreseen in richer markets. There may be opportunities for public-private sector partnerships that provide mechanisms for sharing research costs while opening access to the resulting technologies to farmers in developing countries on affordable terms. For instance, small-scale irrigation or no-till technologies might find a small but lucrative market among smallholders and gardeners in high-income countries, whilst similar technologies could have wide applicability among poor farmers in developing countries.

Nevertheless, there inevitably remain many critical research areas in which the public sector would have to take the lead. For instance, commercial interest is unlikely in research on integrated natural resource and watershed management, on true-breeding improved varieties (a crucial area if average yields are to be increased and cultivars adapted to changing climatic challenges), or on raising small holder labour productivity (e.g. animal draught suited to the needs of women and, in areas suffering from AIDS, of children).

Given the long gestation period for most agricultural innovations, research priorities should be identified now which will respond to small farmers' greatest needs for new technology 20 to 30 years hence; and the appropriate roles of public and private sectors should be determined. Finally, there needs to be a new willingness to invest in research that will benefit not the farmers of today but a next generation of farmwomen and men.

urban land markets, and effective measures to protect women's (especially widows') access to land.

In the past, it was often argued that common property regimes constrained growth and led to environmental degradation, leading to the "tragedy of the commons." However, recent experience in Africa provides an innovative alternative to formal titling of land by recognising the customary land rights of communities and restoring regulatory authority to traditional authorities.

- *Sustainable provision of infrastructure to poor farming systems*

The rate at which farming systems develop towards market-based models is correlated with the availability of infrastructure. Road access and electrification have been particularly important in this regard, and communications are of growing importance. Transaction costs are reduced by access of farmers to basic economic and social infrastructure. Agriculture knowledge underpins the improvement of farming systems, and is usually associated with demand for improved educational services. Therefore, increased investment in rural infrastructure, especially focused on transport and low cost communications for small-scale farmers, should be a high priority for governments.

The main problems in the past have been: (i) urban bias in public expenditure; (ii) inability of local governments to generate enough revenue for infrastructure operation and maintenance (partly due to incomplete fiscal decentralisation); (iii) lack of consideration of maintenance and community ownership in infrastructure planning, and (iv) approaches that discouraged local initiative by encouraging passive dependence on the provision of government services. Because of limited investment capacity, targeting of infrastructure development to poor smallholders is crucial, especially with respect to market development and non-farm employment. Some cross-subsidies between urban and rural areas may be necessary to ensure adequate maintenance of infrastructure in areas of relatively low population density, at least during the period required to generate a production response.

It should be noted that the incidence of poverty is often high in low potential areas and agricultural growth prospects are often limited. The cost per household of service delivery tends to be higher than elsewhere because of the lower population. As a consequence, relatively little investment has been made, but the need is particularly high since little private sector interest can be attracted.

- *Irrigation investment concentrated upon small-scale farmer managed schemes*

In most situations, water resources development policies should give priority to small-scale, farmer managed irrigation, which is usually more sustainable and cost-effective than large-scale schemes. Rehabilitation of existing schemes should generally take precedence over construction of new schemes. In either case, an essential complement is the establishment of secure land and water rights and the building of effective user-driven local management institutions.

For existing large-scale schemes, the main thrust is to make them more sustainable and competitive, by encouraging greater farmer participation in their management, reducing O&M overheads and improving efficiency of water supply and use. These changes involve the formation or strengthening of water users' associations, and reinforcing farmers' skills in business and on-farm water management.

- *Further agriculture policy reforms and stronger meso-level institutions*

Most developing countries have already been through a process of structural adjustment. The current priority is the implementation of further reforms of agricultural policy and institutions, at both sector and meso-levels, aimed at reducing poverty and improving food security. The latter aim may require a combination of targeted short-term measures to assure access to adequate food and more structural steps to improve livelihoods through raising the productivity and resilience to risk of farming systems. In many farming systems analysed in this report, population pressure already exceeds theoretical sustainable levels and the challenge is to identify alternative livelihood opportunities either inside or outside the area. In some cases this may involve encouragement for out-migration, which may be facilitated through skills training, capital endowment and opening up of land markets. The priority is to complete policy reforms started by governments (especially in Eastern Europe and Central Asia), but at the same time safeguard poor rural communities and families whose vulnerability is often accentuated by adjustment processes, at least during the process of transition.

An important element of policy reform in many developing countries is the reduction of biases against agriculture and rural development, particularly those that disadvantage the poor. Some of these have their origins in the goal of providing

cheap food to cities, others are related to natural resource preservation and can have the effect of limiting access to resources by the poor more than the rich, as for example in the forest regulations in the Highland Mixed Farming System in South Asia. It is not only policies per se that disadvantage the poor, but also the way in which they are implemented, as this takes place at the local level in a manner that often favours the powerful and discriminates against the poor.

Improved techniques must be developed and disseminated that facilitate the assessment of risk in relation to policy and investment decisions, particularly in the light of the expected increase in climatic variability. All too often risk is not explicitly considered as a critical factor in small farmer decision making. Yet a wide range of decisions, including the choice of crop research priorities, the planning and provision of water and irrigation infrastructure, and the formulation of policies affecting land management, are all significantly affected by variability and risk, whether it be in rainfall, disease occurrence, prices, or exchange rates. The uptake of new technologies by small farmers is often inversely correlated to perceived risks of adoption.

There is an increasing recognition that many traditional farming systems incorporate features that permit participants to reduce risks, make efficient use of resources and resolve potential conflicts over resource allocation, while ensuring the long-term sustainability of the limited resource endowments. This has been especially the case with pastoral and dryland farming systems, where attempts to replace traditional systems with new production technologies have often failed dismally, leading to increased poverty and breakdowns in existing resource management systems.

Little progress has been made in creating effective insurance mechanisms for small farmers producing in such difficult environments, and further work is needed on risk mitigation mechanisms that combine low per capita costs, acceptability to participants, and effectiveness in cushioning unpredictable shocks. A degree of insurance can, however, be built into farming systems, through diversification, inter-cropping, crop-livestock integration and the use of crop varieties resilient to stress conditions.

- *Targeted safety nets*

As noted above, market-based development of smallholder farming systems offers good prospects for escape from poverty in many areas. Several case

studies demonstrate that even resource poor households can benefit from domestic as well as export market expansion. However, in the process of market integration some categories of smallholders will fail to benefit, at least during a transitional period. These include those living in low potential areas, with a limited resource base, little education, limited entrepreneurial ability and a comparative disadvantage in terms of market access. Small farms engaged in the production of food staples and with few opportunities for diversification are particularly vulnerable to loss of income as markets are liberalised, given the long term downward trend in international grain prices.

Governments have legitimate social priorities that transcend market functioning, particularly with respect to the protection of disadvantaged citizens (children, women, and refugees, those suffering from disasters). While social support programmes may raise issues of dependency, malnutrition and hunger must be addressed as a matter of urgency. Both on humanitarian and economic grounds, instead of attempting to replace markets through general price supports, subsidies or tariffs, government intervention can complement market functions. This could be achieved by providing carefully targeted support – for example through food security programmes in which communities are engaged in participatory planning to ensure adequate nutrition for all members. It could also involve adjustments in access to land and water resources, strategic changes in production systems (e.g. including backyard vegetable production) and improvements in feeding habits and sanitation. Food assistance for vulnerable groups who are unable, for lack of income, to translate their food needs into effective demand (e.g. school meals, food for work to create new infrastructure and productive assets such as small-scale irrigation), is also of great importance.

### Enhancing Agricultural Information and Human Capital

- *Wide availability of agricultural information, particularly to poor smallholders.*

Changes in farming system structure and outputs in response to globalisation and urbanisation, as well as the accelerating pace of technological change, are increasing knowledge requirements in all farming systems. New approaches must be developed to

support efficient flows of relevant information between farmers and formal knowledge sources, such as research institutions and markets, as well as horizontally among farmers. Small farms do not generally have the access to agricultural technology and market information that large farms often have. Thus, public investment in the dissemination of agricultural information is of particular relevance to small-scale farming systems. In some regions, information technology systems are already being adapted to respond to the information needs of small farmers, but further public support will be required before the full potential of information technology systems can be exploited, especially in areas where poverty is prevalent. It will be important to ensure that an appropriate sustainable agriculture orientation is maintained in publicly provided information.

More thought must also be given to the long-term sustainability and relevance of agricultural information systems, which generally require significant levels of operating resources. There is little evidence that users are willing to pay sufficient amounts to make such services self-supporting, and pressure on government recurrent budgets often mean that services descend to “least-cost” solutions once external financing is withdrawn. This all too often results in out-of-date information that is of little relevance to the real needs of the users (e.g. market prices are given for international markets because it is available free, while data for nearby markets is omitted because it is too expensive to collect).

- *Broad, systems-oriented, training of agricultural professionals and farmers*

Training and capacity building involves empowering community members – men and women, poor and non-poor – to identify their problems in a systems context, to analyse causes and effects, to assess options and arrive at well-informed decisions. Often this process requires the assistance of professionals to help find technical solutions, formulate and implement community action plans, monitor results and assess outcomes. This implies that extension services must reorient their operations to base them on facilitative rather than prescriptive approaches. This would involve the adoption of participatory diagnostic tools and experiential learning methods. An essential concomitant of this change is the formation and strengthening of common interest or resource user groups around shared

activities, which will often extend beyond what is strictly agricultural. Use of such methods will strengthen the problem-solving capacities and self-reliance of rural communities. Implementation is likely to involve partnerships between governments, private sector or NGO service providers, civil society organisations and community-based groups.

The analyses of farming systems clearly indicate that not all farm households can expect to escape from poverty through agricultural activities. They face such limitations of natural and human resources, financial capital or location that farm growth and development are difficult, if not impossible. Governments must address the needs of such groups to escape from poverty through training for alternative employment, whether in the rural setting or through migration to urban areas.

With the decline in public resources for research and extension, many systems are chronically short of people with skills related to systems analysis, participatory methods and qualitative analysis techniques. In order that training of agricultural support professionals is broadened – particularly in systems concepts and participatory practice – the curricula of agricultural training institutions should be revised.

## 10 Some Operational Implications

The focus of this Study has been on two main issues: (i) the identification and analysis of the challenges facing farming systems over the next thirty years, and (ii) determining strategic priorities for poverty reduction, food security and growth in such systems from the perspective of both national governments and international agencies. This final section touches on several general operational conclusions.

Probably the most important message that can be drawn from the report is the location-specificity of opportunities for improving rural livelihoods. While the Study has sought to chart the main potential directions of change in the major farming systems, ultimately what happens will be determined by the decisions of vast numbers of individual small-holders – men and women – each faced with different resource endowments, personal priorities, risks and opportunities. The main challenge for the future, therefore, is to create a policy and institutional environment that encourages these individuals to take farm management decisions which contribute to a reduction in rural poverty, including hunger, and to the more sustainable use of natural resources.

While much of the focus of interventions must be local, and to a large extent demand-driven, the Study also implies that there are a number of operational issues which have to be addressed on a global or regional scale. Some of these relate to the reorientation and reform of institutions, while others concern the search for new technologies on which to base future improvements in farming systems. There is also likely to be a requirement for new financing instruments which offer the required flexibility to respond to highly variable local opportunities and constraints, to ensure that there is adequate provision of the global public goods needed to develop small farm systems in the medium to long term. Finally, this Chapter also notes

the advantages of applying the farming system framework provided in this Study, as a basis for planning and assessing the impact of changes – for instance in factor prices – on livelihoods and production.

### EMPHASISING DEMAND-DRIVEN APPROACHES TO INTEGRATED RURAL DEVELOPMENT

The complexity of chronic poverty has led to the widespread recognition that development activities need to utilise both participatory approaches and systems perspectives in their design and implementation. Interventions to reduce hunger and poverty can only be planned and accurately targeted if the extent and underlying causes of the problem are well understood. Participatory analysis enables farmers to take the lead in jointly appraising local situations, together with professionals, and to choose solutions to the problems identified while taking advantage of selected opportunities. Local development strategies evolved in this way benefit from the insights of the resident community concerning the key interactions within their own livelihood systems. Moreover, if such diagnoses and action plans are periodically updated as stakeholders acquire more knowledge during the implementation process, and if all elements of the community are involved in the process, the resultant strategies will, almost by definition, be demand-driven.

#### Apply participatory systems approaches

Subsequent experience strongly suggests that the abandonment of integrated approaches to agricultural development was premature. Moreover, improved systems and participatory tools now exist that are well

suitable to multi-stakeholder processes. These can effectively underpin inter-disciplinary and multi-institutional implementation of a new generation of rural development projects. In many countries there is some capacity for applying these new methods; although it is clear that further capacity building is required. Several countries have made good progress in reducing the role of the state and in decentralisation, both of which tend to encourage client responsiveness within institutions. In essence, sustainable and financially viable institutional arrangements are required in order to respond to farmers' demands for integrated, client-oriented services.

Participatory diagnosis, technology development and dissemination have proved to be effective elements of the Farming Systems Approach. Moreover, as relevant technologies become more complex (e.g. integrated pest management, integrated nutrient management), participatory extension methods involving farmers in learning processes are much more effective than the more conventional top-down prescriptive methods of orthodox extension services. Not only does participation ensure that interventions – whether technological or support services related – are relevant and therefore likely to be effective, but it focuses activities on site-specific needs and local contexts. Above all, such approaches empower farm households and communities to make their own assessments of options and to arrive at well-informed decisions, taking account of local circumstances. It may well happen that before 2030, agricultural communities in developing countries will take the lead in the planning, implementation and evaluation of rural development activities<sup>42</sup>. However, it is also important to ensure a proper balance between the site-specific and often short-term goals of farmers and the long-term investment in public goods required for future generations (e.g. preservation of biodiversity, carbon sequestration). In this context, analyses of farming systems can provide critical inputs to the identification, formulation and impact assessment of policy changes (see below).

### Support farmer-led learning processes

Farm households have a great potential for experimentation, learning and exchange of experience; and it is such innovation and learning that lies at the heart

of the evolution of farming systems. Many communities benefit from this potential through informal mechanisms. There is considerable scope for investing in systematic support for all types of farmer-led learning and for the documentation of the results; for example, in testing and adaptation of technologies and farmer-to-farmer extension.

There is also scope for learning at the interface between the farm household and the development organisation or project. Efficient learning, whether of technologies, of institutions or of management, will depend on adequate community and grassroots capacity – particularly the ability of farmers to identify their own needs, monitor progress, draw lessons and assess outcomes. In addition, operational modalities need to foster learning and be sufficiently flexible to adapt to the lessons that emerge from the learning process.

Learning will be accelerated under conditions of stress, or if the community and organisational environment encourages innovation. Although the development of specific innovations cannot be planned, a number of measures, such as fostering adult learning, innovation circles, prizes and other forms of recognition, plus the systematic assessment and documentation of innovations, can accelerate the innovation process.

### Recognise gender and youth roles

There is considerable differentiation within and between farm households and farm workers. Female-headed farm households represent a disproportionate number of the chronically poor. During the implementation of programmes, it should be recognised that women are often confronted with more severe constraints than men are in otherwise similar situations. Moreover, from the viewpoint of different responsibilities and benefit streams, the roles of women and men need to be analysed separately in most situations.

It is now becoming apparent that the role of children also needs to be carefully analysed. The critical role that children play in farm activities, such as fetching fuel and water, weeding and livestock herding, competes directly with their schooling. Yet most studies show that rural schooling contributes greatly to the adoption of technology, the local devel-

<sup>42</sup> A promising model is the Land Care Movement, which has been widely adopted in Australia and is proving effective in the Republic of South Africa.

opment of alternative livelihoods and the out-migration to other areas.

## **RE-ENGINEERING SUPPORT SERVICES AND RELATED INSTITUTIONS**

The widespread adoption of participatory methods for analysis, planning and execution of development activities amongst rural communities calls for a radical shift in the thinking of a majority of personnel working within the relevant public sector support services. It also requires the overhaul of many current institutional strategies and work methods. The participatory, demand-driven and systems based approach to rural development advocated in this Study, implies the adoption of a new paradigm of development that can only be delivered by far-reaching reorientation and reform of institutions.

### **Provide integrated support services**

The integrated rural development projects (IRDPs) implemented during the 1970s and 1980s proved institutionally unwieldy and yielded poor results. However, from the experiences reported in the analyses of the farming systems and the associated case studies, it is clear that successful poverty reduction and agricultural growth are often the result of integrated approaches to agricultural development. This is not only true of intensive and complex farming systems in favourable areas, but also applies to risk-prone systems in less favourable environments.

In most cases, successful integration has been focused at the farm household, community or watershed levels, but several cases show the importance of supporting integrated service provision and marketing. The observed successes also demonstrate that improvements in resource management and the uptake of more productive technologies generally need to be accompanied by: (i) good access to input supply and produce markets; (ii) functioning rural financial markets; (iii) attractive input/output price ratios; (iv) an enabling policy and institutional environment, and (v) effective support services.

### **Improve models of decentralisation**

Under decentralisation, planning and implementation should be better tailored to the diverse needs of

local farming systems. All too often, however, decentralisation has been associated with a decrease in resources and expertise at the local level; and the capture of resources and services by local elites has sometimes been observed. When it occurs in the context of greater local control over resources and local capacity building, decentralisation brings decision-making closer to the level of farm household production and ensures more relevance in investment and service planning.

### **Establish stakeholder fora to harmonise rural development**

Decentralisation greatly facilitates the assembly of interested stakeholders in fora with the purpose of joint planning, implementation, oversight and evaluation. These can provide the institutional mechanisms that enable programmes to work directly with CSOs and the private sector on a wider scale. Closer working relations are required with these organisations as the role of government is progressively reduced from direct support of agriculture to a facilitating function. Such fora have an important potential role in the identification of constraints, and the planning, monitoring and evaluation of development activities.

## **BROADENING THE RANGE OF FINANCING INSTRUMENTS**

The growing demand for resources for development assistance is in marked contrast to the declining trend in available funds. International development assistance to poorer countries, overall and particularly for agriculture and rural development, has declined significantly during the past decade. There is a need for more resources and a wider range of financing instruments in order to address the diverse needs of farmers – particularly those associated with chronic poverty and hunger.

### **Identify new financing instruments**

A number of instruments introduced by the World Bank in recent years, especially the Learning and Implementation Loans (LILs), and the Adjustable Programme Loans (APLs), offer considerable advances in addressing some of the criticisms related to loan duration, inflexibility and size. LILs permit new and

### **BOX 10-1: FINANCING FOR RURAL DEVELOPMENT: ARE NEW TRANSFER MECHANISMS NEEDED?**

Loans are the main instruments available to the World Bank and other multilateral financing institutions for funding rural development. Many of the poorest countries, particularly the Low Income Food Deficit Countries (LIFDCs), are hesitant to use borrowed funds to finance programmes for poverty alleviation, food security and sustainable natural resource management. There is also chronic under-funding of global public goods in support of small farmer development in developing countries. Both these problems are likely to limit the effectiveness of the Bank in contributing to the changes in farming systems that are advocated in this Study.

In the environmental field, good progress is being made in developing non-lending transfer mechanisms. The *Global Environment Facility (GEF)* is not only emerging as a significant source of international grants but also demonstrating how such an instrument can leverage incremental domestic and external resources. Funds are also starting to flow between developed and developing countries to finance carbon sequestration and, once the *Clean Development Mechanism (CDM)* becomes operational, such transfers are expected to increase rapidly. There are promising opportunities for using GEF and CDM resources not only to attain environmental benefits but also to contribute to expanded agricultural production and to improve rural livelihoods. For instance a shift from conventional to zero tillage should simultaneously increase soil carbon levels, reduce erosion, raise crop yields by reducing moisture stress and – where land is plentiful – enable farmers to extend cropped areas. The transaction costs of enabling small farmers to access these transfers may, however, be high.

If non-lending transfer mechanisms can be successfully developed for global environmental purposes, an even stronger case can be made creating analogous mechanisms for funding poverty reduction and food security programmes in those countries least able to mobilise sufficient domestic resources to meet the development goals subscribed to by almost all nations at the global conferences of the 1990's and endorsed in the Millennium Declaration. One option would be to fund such transfers and the increased funding of global public goods for agriculture through establishing tradable per caput quotas related to the use of non-renewable natural resources such as oil and natural gas. Alternatively, funds could be raised through global taxes such as the proposed Tobin tax or taxation on international air travel.

innovative concepts to be explored, while APLs offer the promise of extended duration of implementation, with expenditures linked to performance during this period. These new instruments do not, however, deal with the issue of preparation and supervision costs (and, indeed, may be avoided by task managers because of their heavy demand on services). Nor do they address what is perhaps the most important underlying obstacle to increased financing of these activities, that is the reluctance of governments, and some staff in the Bank itself, to consider loans for perceived 'soft' areas with little apparent immediate payback – such as watershed protection, poverty alleviation, food security and long-term research oriented towards small farmers.

It is suggested that, particularly with respect to farming systems associated with extensive poverty, there may be a need to consider completely new approaches to financing development activities (see Box 10-1). These would provide an alternative to the seemingly endless cycle of loans and debt forgiveness so common with development assistance. This is particularly true for the provision of international public goods – such as agricultural research of relevance to

small farmers, food safety, trans-boundary crop and livestock disease control – for which loan financing is inappropriate and which has been chronically under-funded in the past.

#### **Promote the use of competitive matching grant modalities**

At the local level, farm development is often constrained by lack of capital. Recent experience with matching grants has been most satisfactory, and conforms to the spirit of participation and partnership. In a very practical way, matching grant schemes ensure that interventions respond to local priorities, for recipients will not contribute resources unless the intervention has the potential for satisfactory impact. The recipients' contributions also represent additional resources, which may not have been allocated to development in the absence of the scheme. Adding a competitive element can enhance the effectiveness of such grant schemes. Given both transparent criteria and selection processes, an open invitation for proposals generally results in an improved portfolio of activities.

## ASSESSING IMPACT OF POLICY AND INSTITUTIONAL CHANGES USING GLOBAL AND NATIONAL FARMING SYSTEMS FRAMEWORKS

The analytical work undertaken in this Study, if refined on the basis of more accurate field level data, would allow the simulation or monitoring of the effects of macro-economic and policy reforms, trade liberalisation and other market changes on rural livelihoods at the level of farm households. The lack of basic data, which has been a serious problem confronted by the current Study, could be overcome with moderate ease through: (i) re-building the capacity of statistical agencies – which has declined over time; (ii) the documentation and synthesis of existing survey data; and (iii) the assembly and storage of data on the basis of nationally-delineated farming systems. While maintaining a balance between quantitative and qualitative information, appropriate digitised databases for monitoring the effects of policy reform by farming system<sup>43</sup> should be constructed. Provision should also be made for periodic field verification of production and poverty trends.

The Study has highlighted the fact that most immediate problems of poverty eradication have been thoroughly analysed in many quarters. A great deal is known about the present, but possible future events and emerging situations have not been systematically

explored to the same extent. Nowhere is this more apparent than in the area of a possible future research agenda. Notwithstanding the recent analytical work on trends and projections completed by FAO and IFPRI among others, participants in the Study noted the important advantages that could be derived from purposive analyses of alternative development scenarios. Such analyses, which would most usefully be focused on the medium and long-term, could be based upon the farming systems framework developed during the course of the current exercise. In order to support both the improvement of field-level information and the proposed analyses of alternative development scenarios, the present regional farming systems frameworks could usefully be disaggregated to the national level.

A commitment by governments and international agencies to these improvements would require a substantial reorientation of information collection, service provision, and project preparation and supervision. Cost-effective modalities are required for participatory formulation of integrated programmes whose implementation would extend for much longer than the typical present five-year horizon. A start has been made in this direction in the form of financing mechanisms that foster learning and with the cross-disciplinary programmes under discussion in certain quarters of the World Bank.

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<sup>43</sup>This would also contribute to global efforts to monitor trends in poverty, under-nourishment and household food.