ISLAMIC DEVELOPMENT BANK

GRAIN PRODUCTION IN IDB MEMBER COUNTRIES: ISSUES AND PROSPECTS

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In the name of Allah, the Most Merciful, Most Beneficent

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Acronyms

AoA	Agreement on Agriculture
CAP	Common Agricultural Policy
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
EU	European Union
FAO	Food and Agriculture Organisation
FFS	Farmer Field Schools
GDP	Gross Domestic Product
HDI	Human Development Index
HYVs	High-Yielding Varieties
ICARDA	International Center for Agricultural research in the Dry Areas
ICBA	International Center for Biosaline Agriculture
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
IWMI	International Water Management Institute
LDCs	Least-Developed Countries
LDMCs	Least-Developed Member Countries
LEISA	Low External Input and Sustainable Agriculture
LIFDCs	Low-Income Food Deficit Countries
NARS	National Agricultural Research Systems
NEPAD	New Partnership for Africa's Development
NERICA	New Rice for Africa
NGOs	Non-Governmental Organisations
OECD	Organisation for Economic Cooperation and Development
PGRFA	Plant Genetic Resources for Food and Agriculture
PPP	Purchasing Power Parity
RWR	Renewable Water Resources
SFI	Soil Fertility Initiative
TFP	Total Factor Productivity
UAE	United Arab Emirates
UNDP	United Nations Development Programme
WANA	West Asia and North Africa
WARDA	West Africa Rice Development Association
WFP	World Food Programme
WTO	World Trade Organisation
WUAs	Water User Associations

PREFACE

Despite the fact that a vast majority of the member countries of the Islamic development Bank (IDB) have agrarian economies, a large number of them do not have enough domestic production to feed their growing populations. Therefore, they continue to depend on food imports. In 2000, for example, there were nine member countries, whose levels of food production had declined in absolute terms, as compared to their average production levels during 1989-91. The problem is even more serious if one also takes into account the population growth. There were 24 member countries, whose per capita food production had declined during the same period. This is a serious challenge not only for the member countries but also for the IDB.

Assistance to member countries in the area of agricultural development and attainment of food security has always been one of the major objectives of the Bank. The Bank organized its first annul symposium on this subject in Rabat, Morocco, in Rajab 1409H (February 1989). On the occasion of the Sixth Islamic Summit Conference, held in Dakar, Senegal in Jumad Awwal 1412H (November 1991), the Bank organized another symposium to focus on food security in the African member countries. The conclusion and recommendations emanating from these symposia have contributed in raising the awareness on the issues involved and added to the resolve of the Bank to help support its members in this important field. Not only that agricultural development and food security figured as one of the priority areas in the Bank's Medium-Term Strategic Agenda of the IDB that was adopted in 1994, but it continues to remain an area of high priority for the Bank. This is clearly reflected in the new strategic framework of the IDB, where it is reflected as one of the major priority areas of the Bank for the coming years.

In the context of food security it is natural to focus on the major grains that constitute the staple foods for the majority of the populations in the member countries. With this in view, the Board of Executive Directors of the Bank decided on the preparation of the present occasional paper that would assess the overall production and availability of the major grains in the IDB member countries. The focus is on the three main grain commodities namely, wheat, rice, and sorghum. The paper surveys and analyses the major constraints on, and issues concerning, grain production in the member countries. Particular emphasis is placed on the need to increase the yields to enhance the overall growth prospects in food grains production. In this context, key factors, such as farming systems, land and water resources, technology, domestic institutions and policies, as well as prospective roles of international institutions, including the IDB, and environment, are analyzed. The paper ends with a detailed set of recommendations that aim to help enhance grains production in the member countries.

It is hoped that the findings and recommendations of the paper would be found useful by leaders, in general, and by the concerned experts and policy makers in the member countries, in particular.

SUMMARY INDICATORS RELATED TO GRAIN PRODUCTION IN IDB MEMBER COUNTRIES

Indicator	Year	Least Developed IDB Member Countries	All IDB Member Countries
Total Population (million)	2001	**357.8**	**1,152.3**
Total Arable Land (000 ha)	2000	**2,537.0**	**7,870.5**
Total Cereal Output (000 metric ton)	2000-02	**65,692.2**	**262,996.8**
Total Wheat Output (000 metric ton)	2000-02	**4,829.3**	**89,117.7**
Total Rice Output (000 metric ton)	2000-02	**40,718.0**	**110,376.7**
Total Sorghum Output (000 metric ton)	2000-02	**8,013.0**	**9,798.0**
Total Cereal Exports (000 metric ton)	2000-01	**130.2**	**11,850.3**
Total Cereal Imports (000 metric ton)	2000-01	**6,958.6**	**79,996.7**

Source: Derived from Tables A1 – A6.

Executive Summary

In this study, five major aspects of grain (cereals) production in the member countries of the Islamic Development Bank (IDB) are explored. First, it examines the state of agriculture and recent trends of grain production and productivity, focusing on the Least Developed Member Countries (LDMCs) in particular. Second, it reviews the state of food security, and in this context the role of grains, in the member countries. Third, the study explains the basic characteristics of the major farming systems in the member countries. Fourth, it analyses the role of major proximate factors and constraints for grain production, including the natural resource base, farm inputs, technology, domestic institutions and policies, and the international environment. Finally, the prospects for growth in grain production are examined with emphasis on the likely role of resources, technology, domestic institutions (markets and state), and international agencies including the IDB. In conclusion, the study highlights the experiences, draws lessons and outlines some policy recommendations.

Farming Systems and Grain Production

A group approach is adopted for examining the role of proximate factors for grain production and productivity in the member countries. In each region, the focus is on the main farming systems for grain production. The analysis of resources and constraints in each region takes into account the requirements of the dominant farming system for cereal production (wheat and rice in particular).

1. Sub-Saharan Africa: Three farming systems dominate grain production: irrigated, cereal-root crop mixed, and agro-pastoral. Only three of the 21 IDB member countries in Sub-Saharan Africa are not included in LDMCs. Most of the African countries are more dependent on agriculture than countries elsewhere, but they are net importers of cereals. Their net imports increased from 4.86 million MT in 1990/91 to 6.72 million MT in 2000/01. The yield level of cereals is just over three-quarters MT per hectare or about one-quarter of the averages for countries in West Asia and North Africa and South Asia. Several countries have significant potential for expansion of arable land and raising the yield levels of grains.

2. West Asia and North Africa: The major farming systems are: irrigated, highland mixed, rainfed mixed, and dryland mixed. These countries are, with the major exception of Turkey, net importers of cereals and their net imports rose from 36.18 million MT in 1990/91 to 55.40 million MT in 2000/01. The yield levels of cereals are just about equal to the average for Central Asia, and lower than countries in South Asia and South East Asia.

3. Central Asia: The major farming systems in this region are extensive cereal-livestock mixed, sparse arid and agro-pastoral. The four IDB member countries have a population of 31 million, of which nearly one-half is in Kazakhstan. A high proportion of the population of these countries lives in rural areas, ranging from 55 per cent in Turkmenistan to 92 per cent in the Kyrgyz Republic. Kazakhstan produces more than 80 per cent of the region's wheat and is a large net exporter. The other countries are net importers of grains.

4. South Asia: There are three important farming systems in this region: irrigated rice-wheat, lowland rice, and highland mixed. Three of the four countries in South Asia, excluding Pakistan, are on the list of LDMCs. Nearly two-thirds of the population in Pakistan, three-quarters in Bangladesh and Maldives and more in Afghanistan lives in rural areas. In these countries, the average yield of cereals rose in the 1990s, significantly in Bangladesh, and was higher than the average of all IDB member countries in the early 2000s. Afghanistan, Bangladesh and Maldives are net importers of cereals, especially rice in Bangladesh, and Pakistan was a net exporter in the year 2000/01.

5. South East Asia: The region's three major farming systems are lowland rice, tree-crop mixed and sparse forest. The three countries in South East Asia have a population of 238 million people, with most in Indonesia (214 million), which is also the largest country in the group of LIFDCs. Nearly 60 per cent of the population in Indonesia is rural and 43 per cent in Malaysia. All three countries are net importers of cereals and the import volume rose from 5.04 million MT in the early 1990s to 9.58 million MT in 2000/01, but about 61 per cent of the net imports were in Indonesia. The average rice yield in Indonesia is reasonably high (4.4 MT/ha compared to 3.1 MT/ha in Malaysia), but it did not increase by much during the last decade.

Proximate Factors and Constraints in Grain Production

Several proximate factors and constraints affecting the state of grain production and productivity in each region and its farming systems have been identified and examined in some detail. Their roles tend to differ depending upon the circumstances and environment in the region or its farming systems and between countries in each region. The proximate factors are grouped into four categories and their role is analysed in the context of grain production in each region of the member countries: (1) resources and inputs, (2) technology, (3) post-harvest conditions, and (4) infrastructure, support services and policies.

A Perspective on Future Growth of Grain Production and Productivity

Three major issues analysed in this study define the contextual perspective for examining the growth prospects of cereal production and the role of factors on which they are likely to depend in the IDB member countries.

1. On the production side of grains in the member countries, low land productivity, expressed in output (yield) per hectare, is the basic problem and it is strikingly low in Sub-Saharan Africa. Also, the average yield level in the member countries increased only marginally during the 1990s—rose by only 15 per cent in Sub-Saharan Africa and fell by 20 per cent in LDMCs. Only a handful of countries have reasonably high yields—Egypt is by far the most productive in both wheat and rice—but they have significant yield gaps. In the major grain producing countries, barring few, the yield level has either been stagnant or rose very slowly in the last 10-15 years. The challenge for the member countries is to raise the average yield to significantly higher levels. They have to undergo the first Green Revolution in Sub-Saharan Africa and a second Green Revolution in Asia.

2. A majority of the IDB member countries are net importers of cereals and 33 of them are on the list of LIFDCs. In Sub-Saharan Africa, only six member countries have a self-sufficiency ratio of 80 per cent or higher. All countries in West Asia and North Africa, except Turkey and Syria, have ratios of less than 60 per cent (including Yemen). In Central Asia, only Tajikistan depends heavily on net imports, but Kazakhstan is a large net exporter of wheat. In South East Asia, Malaysia depends heavily on imported grains and Indonesia has a ratio of 88 per cent like Bangladesh in South Asia.

3. Nearly one-third of the population of 23 LDMCs is undernourished. The average daily calorie intake in most of these countries is less than 2,300 and most of it is obtained from cereals. These are important indicators of the household food insecurity. It seems that the major issue is not that many member countries depend on imported grains, but whether they can maintain national and household food security that includes (i) sustainable use of domestic and foreign resources and (ii) adequate nutrition to the vulnerable and marginalised individuals.

The study focuses on several factors that are likely to influence future grain production and productivity in the member countries of IDB. These factors are grouped into four categories: (1) land and water resources, (2) technology, including biotechnology, (3) domestic institutions and policies, and (4) international institutions, including the IDB, policies and environment.

Conclusions and Recommendations

The analysis contained in this study and the lessons drawn from it lead to several recommendations on a number of key issues for sustainable growth of grain production and productivity in the member countries of IDB.

1. In a majority of the member countries, land degradation and inadequate management of water are the most serious problems affecting the crop productivity. To alleviate the twin menace, a number of policy changes are needed at the national and regional levels:

    - Co-ordinated management of water at the regional level for the cross-boundary river systems, in which international agencies should participate with investment and technical assistance.
    - Increased level of investment in small-scale irrigation and water harvesting projects.
    - Devolution of water management responsibility to water users and cost recovery of the operations and maintenance of irrigation system or removal of subsidy on irrigation water.
    - Rapid dissemination of practices of zero-tillage and integrated soil, water and pest management on the farm.

- Increased financial and technical support by international aid agencies to conserve land and water resources and increase the institutional capacity of national governments and regional organisations to raise the level of grain productivity especially of small and poor farmers. Given the role played by IDB in the development of land and water resources in the member countries, it should consider raising the level of assistance (financial and technical) for both the country and regional projects, emphasising the direct participation of farmers in these projects.

2. In several countries in Sub-Saharan Africa, West Asia, North Africa, Central Asia, and South Asia, the issues of land titles, rights to land through ownership and tenancy, land concentration, and land fragmentation should be addressed with urgency to increase productivity, enhance food security, reduce rural poverty, and promote social harmony. International agencies should raise the level of assistance and institutional support to national governments.

3. National governments, supported by international agencies, should provide increasing technical and financial support to improve and build the rural infrastructure, including rural education, health care and roads, since they can make a significant contribution to productivity enhancement and rural poverty reduction.

4. Given the importance of technology in raising grain productivity, the emphasis should be on the development and transfer of technologies that can be adopted by farmers with reduced dependence on natural resources and inputs. Regional consortia for new technologies to reduce the yields gaps should be adequately funded and their work well co-ordinated with the NARS. IDB should provide financial and technical assistance, directly or through the regional consortia to organisations like WARDA for the development of rice in West African countries.

5. An important implication of biotechnology for future grain production in the IDB member countries—Indonesia, Pakistan and Egypt have established apparently strong institutional capacity for biotechnology in crop production—is that the national and international agricultural research systems increase the level of investment and integrate their work on regional basis. The regional consortia of donors and recipients on rice and wheat are a good beginning for addressing the yield gap issue in both Africa and Asia. However, it is important that the breeding programmes, using biotechnology to enhance productivity, should provide adequate protection to the indigenous strains of grains.

6. The on-going projects on integrated management practices, combining soil and water and pest control, with direct participation of farmers in several countries should be expanded.

7. National governments should not waste scarce financial and economic resources for general subsidies on farm inputs and credit since they distort

resource allocation and have perverse distributive effects. Similarly, they should remove all forms of implicit taxes on farm produce and create a competitive environment for farm inputs and outputs. To maintain output and price stability, governments should provide institutional support to the private sector with minimum direct intervention in the production and distribution of inputs and products. The government's role in the input and output markets should focus on the following.

- They should improve the regulatory and institutional environment for seed multiplication and distribution to farmers. Turkey has probably made the most significant progress in this respect. Private sector in the seed market needs proper incentives, information, and infrastructure. In addition, farmer organisations can play an important role in seed production and multiplication, as has been the experience in some countries of West Africa, at least at the local level.

- They should facilitate the integration of financial markets in rural areas and make credit accessible to small landholders. In several countries, the on-going group-lending programmes through community-based organisations should also be supported by changes in the rules and regulations governing the banking system. The experience in countries like Indonesia, Bangladesh and Pakistan is that these programmes facilitate the use of productivity-enhancing inputs and are also financially sustainable without subsidy. The centrally administered rural or agricultural development banks are costly and do not reach the small farmers.

- They have to find a balance between two apparently conflicting policies: provide food subsidy to consumers as a means to reduce food insecurity and give price support to farmers that maintains incentives for investment in productivity-enhancing technology. The food subsidy bill can be reduced significantly by (i) changing the administrative structure and mechanisms to reach the vulnerable groups and (ii) maintaining incentives for farmers to raise productivity so that the cost of food declines. Farmers everywhere tend to respond strongly to both price and non-price incentives. It makes little sense to provide price subsidy on inputs if it has little impact on productivity, distorts resource allocation between crops or enterprises, wastes scarce resources (e.g. water and fuel), and discriminates against small landholders. Similarly, governments have to find mechanisms, other than their intrusive involvement, to reduce price variability in the market.

- In the context of grain production in the future, with increased liberalisation of trade in agricultural products, governments should create conditions that allow farmers to develop and strengthen comparative advantage in producing grains. Food security cannot be increased by focusing on self-sufficiency without taking into account the level of productivity and production cost of grains. The regional consortia for productivity enhancement and the trade in grains between member

countries should receive high priority in the strategic plans of the Bank and governments.

8. Since many member countries are dependent on imported grains, including food aid from bilateral and multilateral sources, it is imperative that they pursue policies on two fronts simultaneously both at the individual and regional levels.

   - First, in the member countries of Sub-Saharan Africa where there is demonstrable potential for growth of production and productivity of grains, the level of funding and support by individual governments and international agencies, including IDB, should increase and be channelled to programmes and projects that have shown to be effective. IDB should consider involvement in the NEPAD initiative on a regional basis. The aim is to produce an exportable surplus based on comparative advantage, given the potential for area and yield expansion.
   - Second, in the member countries of North Africa and West Asia, excluding Turkey, perhaps Iraq and Iran, it may well be prudent to reallocate resources from grains to other products with higher productivity and economic returns to farmers. IDB should help some of these countries in the transition with financial and technical assistance and provide support for imported grains from other member countries with exportable surpluses. The existing or new bilateral and multilateral (regional) trade agreements, within the WTO framework, should be used to promote the grain trade between member countries.

9. There are substantial uncertainties about the effect of changes in (i) the trade environment for agricultural products, including grains, resulting from the on-going WTO negotiations and (ii) the global climate, especially the frequency and severity of floods and droughts. Governments should persist in their efforts, and seek support from the international community, to provide risk-mitigating mechanisms for the small grain producers and low-income consumers. These mechanisms, including financial assistance and food aid, should be well targeted and not distort incentives for resource allocation.

10. Given the challenges for future grain production, especially in the LDMCs, the Bank should make significant contribution to promote agricultural trade among member countries and support the existing regional institutions with assistance for information networking, and region-based development activities such as water conservation, building rural infrastructure, and improving agricultural research.

GRAIN PRODUCTION IN IDB MEMBER COUNTRIES: ISSUES AND PROSPECTS

Mahmood Hasan Khan[1]

CHAPTER ONE

INTRODUCTION

1. Nature of Issues Involved

Grains (cereals) constitute a large part of the food and feed supply in the world. They are particularly important to the poor populations, especially in rural areas, since they are a major source of energy and nourishment. This applies to both the small-scale producers of grains—who produce most of the food in developing countries and suffer more hunger than the urban poor do—and low-income rural and urban consumers. It is important for nations and states to meet the needs of food and feed of growing populations in the face of increasing constraints of natural resources and the environment. Grains as food are crucial for reducing poverty and enhancing labour productivity for sustainable development.

This study analyses the existing state of and future prospects for grain production in the member countries of Islamic Development Bank (IDB). It is premised on four important propositions that provide its context and define its scope as well.

First, the goal of grain production should not be self-sufficiency (autarky) without regard to its cost compared to the alternative uses of the scarce natural resources and human capital. Instead the goal should be food security for the population, particularly the vulnerable groups in each member country, since grains are an important part of the diet in most households.[2] At the household or individual level, food security implies the availability of adequate quantity of food at an affordable price (cost), including provision of safety nets for the poor and vulnerable in the society. Food insecurity is the cause of hunger

[1] Professor Emeritus, Department of Economics, Simon Fraser University, Canada. While I take full responsibility for the contents of the paper, I am grateful to several individuals in the Islamic Development Bank (IDB), Food and Agriculture Organisation (FAO), and the International Fund for Agricultural Development (IFAD) for their kind help in completing this study. I owe special thanks to Dr. Faiz Mohammad and Dr. Aftab Ahmad Cheema for their unstinting support and encouragement. Comments by them and their colleagues in IDB on an earlier draft have been a valuable contribution. Also, I thank Dr. Lahsen Esslimi for his help and guidance in making contacts and gathering the documents in Rome.

[2] The concept of food security is best used for individuals and not countries. Also, it is not unambiguous for several reasons, including the different ways in which hunger and under-nutrition can be measured (FAO 2003a). However, at the individual level, there is consensus that it implies a level of food consumption that provides adequate nutrition to the individual, according to age, gender, and work status, to perform normal functions. Food insecurity implies lack of means or entitlement to maintain this level of consumption. This can be caused by a variety of factors, including natural disasters, wars, and persistent or transitional poverty. The important point is that increased food production is only one aspect of ensuring food security since there is good evidence that the level of overall production or availability of food may or may not have a significant impact on food security particularly of the poor populations. In the context of countries, neither low income per capita nor dependence on imported food is by itself an indicator of food insecurity: some modest importers of food would be more insecure than larger exporters because they cannot afford greater imports.

and malnutrition and they in turn exacerbate poverty and reduce human productivity for future growth and development.

Second, agriculture is an important sector of the economy in a majority of the IDB member countries in terms of its contribution to the Gross Domestic Product (GDP) and employment of labour. Also, in many countries, a high proportion of the rural population depends on agriculture and the related small-scale industries for household income. Grain production in the future should be part of a sustainable agriculture system that (a) feeds the growing populations with changing tastes and preferences as incomes rise, (b) conserves natural resources, particularly land and water, and (c) protects the environment.[3] Technological change and institutional reforms are likely to play a central role in achieving sustainability. Sustainable agriculture is also a means to reduce rural poverty in developing countries, particularly those with a high proportion of labour engaged in agriculture and a majority of the poor people live in rural areas. In many IDB member countries, poverty is largely a rural phenomenon and agricultural growth can play a key role in reducing rural poverty.[4]

Third, it is essential to adopt a farming system approach to analyse the issues associated with the production of grains.[5] Typically a farming system is a complex and dynamic entity influenced by a myriad of interactive factors like the natural resource base, climate, demography, human capital, income, technology, markets and trade, culture (traditions), infrastructure, and public policy. In addition, there may be multiple farming systems, some distinct and others overlap, within a country and between countries with important consequence for the production and supply of food and raw material.

Fourth, globalisation—that includes liberalised trade in agricultural products, increased protection of intellectual property rights, and cross-frontier movement of capital—has serious implications for farmers with respect to investment, technology transfer, production, trade, prices, farm income, and food security.[6] There are both opportunities and risks for grain production in the IDB member countries. The risks associated with more open borders for agricultural commodities are serious enough to have attracted the attention of millions of farm producers and consumers. The opportunities are no less important, provided the necessary structural and institutional changes take into account the costs of adjustment to different groups nationally and internationally.

2. IDB Member Countries: A Brief Description

The IDB member countries represent great diversity with regard to their physical, natural, demographic, social, and economic conditions. This diversity has several important aspects of relevance to this study. Given the constraints of time and space available for the

[3] See Prescott-Allen (2001) for a detailed analysis of the issue of sustainable development that includes the conservation of resources and protection of the environment in measuring the quality of life.

[4] There are several important links between agricultural growth and reduction in rural poverty in a majority of developing countries, especially in sub-Saharan Africa. An analytical review of these issues has been done recently by Sarris (2001b).

[5] The concept of farming systems is interpreted in a variety of ways. A generally accepted definition of a farming system refers to "a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate." (Dixon and Gulliver 2001, p.9).

[6] Several recent studies have analysed these issues, particularly in the context of developing countries. See, for example, FAO (2002a), FAO (2002b), and Ingco (2003).

study, the countries are grouped together to facilitate the analysis. This study uses three criteria to differentiate the member countries, but recognises the fact that they are not the only criteria for classification. In addition, using these criteria, there are significant overlaps and associations among countries that may or may not help the policymakers to use the group or regional approach in designing and implementing plans and policies.

1. Geographic location
2. Development status
3. Farming systems

1. Geographic Location: The simplest way to group the 54 IDB member countries is to adopt the regional (geographic) approach used by most of the international agencies. The geography of countries, of course, plays an important role in the endowment of natural resources and climate that in turn have direct influence on the agricultural systems and development status. However, in the same country depending on its size and location, there may be significant diversity of microclimates, terrain, soil structures, water availability, and forest cover. These factors play an important role in the farming systems approach used at the national and regional levels. The regional groups of the IDB member countries are:

Sub-Saharan Africa	21
North Africa	5
Central Asia	4
South Asia	4
South East Asia	3
West Asia	15
South Eastern Europe	1
South America	1

2. Development Status: Since there is no overwhelming single measure or index of development that can capture all or most aspects of development, it is far more difficult to distribute the member countries into different groups than the simple grouping based on geographic location.[7] Generally there are close, but not perfect, associations between various development indicators. As shown in Table 1, using the World Bank classification of countries based on real income per capita, the IDB member countries can be separated into four groups.[8]

[7] The literature on development is quite rich and shows the complexities involved in defining and interpreting the concept (Sen 1999). There are many competing ways to measure development, given the diversity of interpretations and objectives. A commonly used indicator is the level of per capita income—notwithstanding its many limitations—to differentiate between countries and measure their economic development through time. The World Bank's classification of countries is based on the real per capita income measured in US dollars using the market exchange rate. Since 1990 the United Nations Development Programme (UNDP) has used Human Development Index (HDI) as a composite measure of development that includes (i) real per capita income in US dollars using the Purchasing Power Parity (PPP) exchange rate, (ii) literacy and school enrolment, and (iii) life expectancy. However, these indicators of development are not universally accepted as adequate representatives of the quality of life enjoyed by people in different countries (Prescott-Allen 2001).

[8] See World Bank (2003). These groups are defined on the basis of GNI per capita measured in US dollars: Low Income ($745 or less); Lower-middle Income ($746 to $2,975); Upper-middle Income ($2,976 to $9,205); and High Income ($9,206). The World Bank also ranks countries by the level of real per capita income measured in US dollars using the PPP exchange rate.

Table 1

Classification of IDB Member Countries by Income Level, 2001

Region	Low Income	Lower-Middle Income	Upper-Middle Income	High Income	All Income Groups
Sub-Saharan Africa	20	0	1	0	21
East & Southern	5	0	0	0	5
West Africa	15	0	1	0	15
North Africa	0	4	1	0	5
Central Asia	2	2	0	0	4
South Asia	3	1	0	0	4
South East Asia	1	0	1	1	3
West Asia	3	5	3	4	15
Southern Europe	0	1	0	0	1
South America	0	1	0	0	1
All Member Countries	29	14	6	5	54

Source: Table A1.

Twenty-nine IDB members are in the low-income group of countries: 20 of them are in Sub-Saharan Africa and the rest in Asia. Of the 20 middle-income countries—14 of them are lower-middle income—five are in North Africa and eight in West Asia. Only five are high-income countries and all of them are oil exporters, four of them in West Asia (Kuwait, Qatar, Saudi Arabia, and United Arab Emirates) and one in South East Asia (Brunei Darussalam).

In the context of this study, developing countries—that include the low and middle-income countries—should be differentiated further because of the wide disparity among them in terms of their state of development and their food status. Twenty-three IDB member countries are in the list of 49 least-developed countries (LDCs) designated by the United Nations and will be referred to as the least-developed member countries (LDMCs).[9]

[9] The LDMCs are Afghanistan, Bangladesh, Benin, Burkina Faso, Chad, Comoros, Djibouti, Gambia, Guinea, Guinea-Bissau, Maldives, Mali, Mauritania, Mozambique, Niger, Palestine, Senegal, Sierra Leone, Somalia, Sudan, Togo, Uganda, and Yemen.

While the problems of the LDMCs are far more acute than of the other developing countries, it is important to differentiate the member countries on the basis of availability of food as well. Since the late 1970s FAO has kept a list of low-income food-deficit countries (LIFDCs) in the context of food security issues.[10] The current list has 82 LIFDCs, which includes 33 members of IDB:

Sub-Saharan Africa	19
North Africa	2
West Asia	3
Central Asia	3
South Asia	4
South East Asia	1
Southern Europe	1

An important fact is that, among IDB member countries, 18 of the LIFDCs in Sub-Saharan Africa and three LIFDCs in South Asia are also in the list of LDMCs. The state of food insecurity is generally more severe in LDMCs than other members on the list of LIFDCs.

3. Farming Systems: The farming system approach takes into account the biophysical—soil nutrients and water balances—and socio-economic—food security, gender and profitability—aspects at the farm level where most of the production and consumption decisions are made. The biophysical factors define the possible set of farming systems and he socio-economic factors determine the actual farming system. The key determinants of the farming systems are both internal and external. The internal are those that the individual farm system controls in terms of production and consumption decisions, subject to the natural, physical, financial, human, and social constraints. The external factors include markets, public goods, institutions and policies, technology, and communal resources. The farming systems are not only complex but also dynamic as changes take place in the internal and external environments of the individual farm system. The strategies, plans and policies for grain production, as indeed for all agricultural production, should take into account the key characteristics of the farming systems in different regions of the world.

A joint FAO-World Bank study of the world's farming systems has identified several broad categories in each geographic region in which the IDB member countries are located.[11] It shows the complexity and dynamism of every major farming system and the role played by climate, terrain, population density, technology, human capital, and institutions. Also, it explains the existing conditions of agriculture, economy and poverty

[10] See the report of the Committee on World Food Security, 28th Session, June 2002, titled "The LIFDC Classification – An Exploration", for a detailed discussion of the classification and the current list of LIFDCs. The classification of LIFDCs is based on income and food deficit criteria, in which the cut-off income level is much higher than the World Bank's threshold for defining the low-income countries. The number of LIFDCs increased from 62 in 1986 to 82 in 2001. The FAO report has examined the changing composition LIFDCs in terms of the "in" and "out" countries. Many of the IDB member countries are, and have remained, on the list LIFDCs. The current list includes Benin, Burkina Faso, Cameroon, Chad, Comoros, Cote d'Ivoire, Djibouti, Gambia, Guinea, Guinea-Bissau, Mali, Mauritania, Mozambique, Niger, Senegal, Sierra Leone, Somalia, Sudan, Togo, Egypt, Morocco, Azerbaijan, Syria, Yemen, Kyrgyz Republic, Tajikistan, Turkmenistan, Afghanistan, Bangladesh, Maldives, Pakistan, Indonesia, and Albania.

[11] See Dixon and Gulliver (2001) for a detailed analysis of farming systems in different regions and their links to the larger regional and national economies.

and the potential for growth of different kinds of agricultural products and various options for the rural populations to reduce their poverty.

In the member countries of IDB, the agriculture sector functions in a range of farming systems with very diverse impact on the current state of agriculture and rural poverty and have equally different potential for growth and poverty reduction. These complex systems have evolved under the interactive influence of the forces of nature (geography and climate), demographic changes, economic growth, technology, markets, state policies, and traditions. The dominant farming systems in different regions can be summarised here to provide a frame of reference for examining the role of several proximate factors and constraints underlying the current state of grain production in the IDB member countries (Dixon and Gulliver 2001).

The agriculture sector in the member countries of Sub-Saharan Africa is probably more diverse than in other regions. It ranges from the tropical tree-crop areas to the semiarid and arid areas, and from the settled to pastoral agriculture. Six farming systems seem to dominate in the member countries: (i) cereal-root crop mixed (in West African countries and Mozambique), (ii) root crop (Sierra Leone to Cameroon in West Africa), (iii) sparse arid (Sudan, Mauritania, Niger, and Chad), (iv) agro-pastoral with Sorghum (Senegal to Niger), (v) pastoral (West Africa, Sudan and Uganda), and (vi) tree crop (Cameroon, Cote d'Ivoire and Gabon). There is limited irrigation, concentrated in Sudan, Somalia, Niger, and Mali. The countries in the region produce a large number of crops, most of which are food crops like cassava, yams, maize, sorghum, millet, pulses, and vegetables. The major export crops are cocoa, cotton, oil palm, coconut, and coffee. Food crops are dominated by cassava, maize, coarse grains, pulses, and vegetables. A number of the countries import wheat and rice, some of it through food aid. Sudan exports coarse grains to other African countries.

Most of the member countries in West Asia and North Africa are in the arid and sub-arid climates with a long history of settled agriculture. The Mediterranean coastline allows some of these countries to produce a variety of fruits and vegetables. Some of the countries have extensive irrigation systems such as Egypt, Iraq, Syria, and Turkey. The export crops include cotton and a variety of fruits and vegetables. Several countries import grains; only Turkey exports wheat and Egypt exports rice in significant quantities. Non-farm incomes, increasingly earned in the urban economy, are quite significant in many countries of this region.

Agriculture in the member countries of Central Asia is dominated by a largely unsustainable irrigation system that produces cotton (mainly in Uzbekistan and Turkmenistan) for export and wheat mostly for domestic consumption, but Kazakhstan is a major exporter of wheat. There is also an extensive cereal-livestock and arid farming system that produces wheat and other cereals, and livestock products. Large-scale farming is quite common in the sparse arid areas. The region's agriculture, as the overall economy, has experienced severe adjustment problems in the transition from a centrally planned to market-based system since the early 1990s.

In the member countries of South Asia, there are four dominant farming systems: rice farming (Bangladesh), rice-wheat mixed (Pakistan and Bangladesh), sparse arid and rainfed (Pakistan and Afghanistan), and a mixed pastoral system (parts of Afghanistan and Pakistan). Cotton, jute, wheat, and rice with a variety of fruits and vegetables are grown in

the region. The main exports are cotton, jute, and rice. Some grains are imported regularly by Bangladesh and Afghanistan and occasionally by Pakistan.

The South East Asian member countries, Indonesia and Malaysia and Brunei Darussalam, are dominated by humid and sub-humid climates. Their dominant farming systems include lowland rice, tree crop mixed, and upland mixed (intensive) crops. Some parts of the region are very dense in population (parts of Indonesia), but others quite sparsely populated (large parts of Malaysia). A large variety of tropical vegetables and fruits are grown together with rice and tree crops. The major exports of the region are timber, rubber, coconut, and palm oil. All countries in the region import grains, especially rice.

3. Scope and Limitations

In this study, five major aspects of grain production in the member countries of IDB are explored. First, it examines the state of agriculture and recent trends of grain production and productivity, focusing on LDMCs in particular. Second, it reviews the state of food security, and in this context the role of grains, in the member countries. Third, the study explains the basic characteristics of the major farming systems in the member countries. Fourth, it analyses the role of major proximate factors and constraints for grain production, including the natural resource base, farm inputs, technology, domestic institutions and policies, and the international environment. Finally, the prospects for growth in grain production are examined with emphasis on the likely role of resources, technology, domestic institutions (markets and state), and international agencies, including the IDB. In conclusion, the study highlights the experiences, draws lessons and outlines some policy recommendations.

A vast majority of the rural and urban households include grains as an important component of their diets—more so among the poor in rural areas. The dominant grains are wheat, rice and maize, followed by sorghum and millet. Rice, wheat, and sorghum have been selected for study because of their significance in both consumption and production in most of the IDB member countries. A review of literature, however, reveals that the existing knowledge and information are far more extensive for wheat and rice than other grains including sorghum. Also, these two grains are internationally traded commodities with significant marketed surpluses in the major producing countries. The other grains, sorghum included, are largely non-traded food commodities.[12] The study, therefore, concentrates on wheat and rice and to some extent on sorghum where the data and information permit.

The study has several limitations. First, it is based on secondary data, some of which are more reliable than others are. It uses the best available numbers used by agencies like FAO and the World Bank. Second, it makes no attempt to quantify the future demand for and supply of grains in the IDB member countries. Third, it does not analyse in any detail the issues and problems of each member country separately, except where it may be of relevance to the group.[13] It takes a group approach as indicated in the previous section,

[12] Grains like maize, sorghum and millet are an important part of the diets of the poor rural households and also used as fodder for livestock. The use of sorghum and millet in human diet has been declining with increased income, urbanisation, and change in tastes.

[13] Paucity of data is a serious problem for most small countries and those that have had severe political instability for some time. The paper, therefore, cannot make reasonable judgements about their state of agriculture and grain

with adequate notes of caution. Finally, the paper identifies some major policy guideposts, relevant to both national and international agencies, but it is not intended to serve as an operational document.

CHAPTER TWO

STATE OF THE ECONOMY AND AGRICULTURE SECTOR

1. Key Economic Indicators

The diversity of IDB member countries with regard to the state of economic development is clearly reflected in the data shown in Table A1. The total population of the member countries is estimated at 1,152 million, of which the largest proportion resides in South Asia—Bangladesh and Pakistan in particular—followed by West Asia—Turkey and Syria have the bulk of this population—and South East Asia, where Indonesia clearly dominates. In Sub-Saharan Africa, with 21 member countries, only Sudan has more than 30 million people; 13 countries have populations of less than 10 million. In most of the member countries, population growth has slowed down in the last 10 to 15 years, but this trend has been quite slow in Sub-Saharan Africa and in many countries of West Asia and South Asia. The growth rates are generally higher in countries with low levels of income and slow economic growth. But this association of high population growth rate and low level of income is not as strong.[14] The data on the rural-urban division of populations—which has important implications for agricultural growth and poverty reduction—show that in all countries the share of rural population has been falling, in some more rapidly than in others. However, more than 60 per cent of the people in Sub-Saharan Africa—Djibouti, Mauritania, Cameroon, Cote d'Ivoire, Benin, and Senegal are the exceptions—and in all countries of Central Asia and South Asia live in rural areas. More than one-half of the populations are still rural in countries like Turkey, Egypt, Indonesia, Turkmenistan, and Albania.

The lowest levels of income are in a majority of countries of Sub-Saharan Africa—Gabon, Djibouti, Cote d'Ivoire, and Cameroon are the exceptions—followed by countries in South Asia and Central Asia. Yemen is the exception in West Asia where most countries have reasonably high levels of income. According to the HDI rankings for 175 countries measured by UNDP, seventeen member countries in Sub-Saharan Africa, excluding Comoros, Gabon, Sudan, and Togo, are designated as countries with "Low Human Development"; Yemen and Pakistan are also in this group. Only five member countries—Brunei Darussalam, Bahrain, Kuwait, Qatar, and the United Arab Emirates (UAE)—are in the "High Human Development" group. It should be noted, however, that the HDI rankings of several IDB member countries with moderate to high levels of income per capita do not compare favourably with non-member countries with similar levels of income. In the last decade, only six countries reported five per cent or higher annual growth rate of GDP—Mozambique, Uganda and Malaysia exceeded six per cent—and all countries

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production. In addition, the data for the IDB member countries in economic and political transition are incomplete or incomparable for the pre-1990/91. Generally, the literature for these countries is sparse or not easily accessible.

[14] The high population growth rates and their somewhat slow decline in several countries are due to the rapid decline in infant mortality rate and a high total fertility rate in which the role of female illiteracy and traditions play a major role.

in Central Asia suffered significant annual losses in their GDP. Given the high rates of population growth in many low-income countries, the gain in per capita income was very modest. In countries like Cameroon, Chad, Niger, Sierra Leone, and Togo, there was either no gain in per capita income or it fell.

The data on poverty are quite sparse, hence difficult to use for a detailed description or analysis.[15] In general terms, a high proportion—ranging from 20 to 75 per cent—of the populations of most of the member countries of Sub-Saharan Africa and South Asia are poor. Poverty in other member countries, except for a few countries in West Asia (e.g. Yemen) and Central Asia (Tajikistan and the Kyrgyz Republic), is reasonably moderate. Also, the survey data show that rural poverty is far more dominant—two-thirds to three-quarters of the poor people live in rural areas—than urban poverty and the former is more persistent and severe (IFAD 2001). This fact has an important bearing on the analysis of the agriculture sector and grain production in many of the IDB member countries. It should be added that the small land and stock holders with meagre resources and the landless families dependent on wage labour constitute the two dominant groups of the rural poor in most of the IDB member countries, especially in Sub-Saharan Africa and South Asia. In some countries, refugees and displaced persons are among the poor often in dire circumstances for extended periods. The sparse data on the trend in rural poverty tend to show that it takes more than the average moderate growth in the agriculture sector to reduce persistent and high levels of poverty (IFAD 2001; Lipton and Ravallion 1995).

The economic structures of the IDB member countries are quite diverse in terms of size, production, exports and imports. Some of them have large size economies with high level of production in industries—e.g., Turkey, Indonesia, Malaysia, Egypt, and Pakistan—outside agriculture and they export a large variety of processed and industrial goods with some raw material. Their imports are equally varied, dominated by manufactured and intermediate goods, although some of them import food as well. A majority of countries in Sub-Saharan Africa, and some in West Asia, still depend on the production of food and raw material and their exports consist mainly of one or two dominant raw material, fuel or minerals. Their imports include food and manufactured goods. The exporters of primary goods and importers of food are particularly vulnerable to the world supply conditions and price fluctuations.[16]

Most of the 23 LDMCs—18 of them in Sub-Saharan Africa—share several important economic and social characteristics:

- low HDI ranking, ranging from 142 to 175;
- high proportion of population in poverty and undernourished;

[15] Poverty—perhaps best understood only by the individual who suffers from it—is far more difficult to capture by a single measure—even multiple or composite measures have problems—given the complex diversity of the human condition and its interpretation. However, contemporary social scientists, among them Sen (1999) in particular, have greatly expanded the frontier of knowledge about poverty, its measurement, and policy implications in diverse circumstance. A good review of the literature on poverty can be found in Lipton and Ravallion (1995). The report of the World Bank (2001) on poverty and the study of IFAD (2001) on rural poverty provide detailed analyses of the issues and policies.

[16] Several IDB member countries have been involved with the International Monetary Fund (IMF) and the World Bank in one or more structural and sectoral reform programmes since the 1980s. These programmes have been vigorously debated in the literature because of their controversial nature and impact on the economies. See Stiglitz (2002) for a critical analysis of the key issues and the role of IMF and the World Bank.

- high growth rate of population;
- high dependence on food imports and aid;
- high proportion of population living in rural areas;
- agriculture absorbs a high proportion of labour force; and
- agriculture contributes a high proportion of GDP and exports.

2. State of the Agriculture Sector

There are several constraints in making a comparative assessment of the agriculture sector in the member countries of IDB. For one thing, some of the countries are quite small in size and population with very little land used for crop production. In some countries, while the landmass is large, a very small proportion of land is usable for crop production. Many countries are in the arid and sub-arid climates and depend largely on rains that are highly variable. Other arid countries have developed large-scale irrigation systems without which they would be largely deserts. Countries on the West Coast of Sub-Saharan Africa and South East Asia are in the tropical and sub-tropical regions with heavy rains. Finally, there is a general scarcity of reliable data on different aspects of crop and livestock production in many countries.

As stated earlier, agriculture is still an important sector of the economy of a majority of the IDB member countries. For example, it contributes from 20 to over 60 per cent of GDP in Sub-Saharan African countries—exceptions are Djibouti, Gabon, and Senegal—around one-quarter in Bangladesh and Pakistan, 20 to 40 per cent in Central Asia—Kazakhstan being the exception—and nearly 50 per cent in Albania. Its contribution is relatively modest in most countries of West Asia, Azerbaijan and Syria being the exceptions. Labour in agriculture accounts for 50 to 80 per cent of the total labour force in Sub-Saharan African countries (the oil exporting Gabon being the exception) and between 45 and 60 per cent in some South Asian countries, Indonesia, Turkey, and Albania. Many countries also depend heavily on export earnings of raw material produced by the agriculture sector. More importantly, a high proportion of the rural population in many countries depends on agriculture and related small-scale industries. However, in several countries, especially in West Asia and North Africa, South and South East Asia, the urban/industrial sector has become an increasingly important source for rural households to reduce poverty.

The key activity of the agriculture sector is to produce food and feed for human and animal consumption. Production of food, including grains, is particularly important for the farm systems of small landholders to provide food security and avoid hunger. However, the increasing pressure for integration into the cash economy tends to make them more vulnerable to the changes in demand and prices. In the last decade, the overall performance of the agriculture sector was reasonably strong in most countries in Sub-Saharan Africa—following a disastrous decade of the 1980s—all countries in South Asia and North Africa, but in only a handful in West Asia. The Central Asian countries experienced substantial fall in both agricultural output and GDP. The level of agricultural productivity, as measured by output per unit of land and labour, is low in most of the Sub-Saharan African countries and in Bangladesh, Pakistan and Yemen. However, there is evidence that a large part of the agricultural growth was due to increased productivity in many countries outside Sub-

Saharan Africa, where the contribution of land and labour was far more dominant (Bruinsma 2003).[17]

It should be added that the variability of production per unit of land is much higher in some countries than others. It is generally higher in countries of Sub-Saharan Africa and in those parts of the member countries that depend on rains. Some of the African countries, such as the Sahel countries, Somalia, Sudan, Mozambique, and some parts of Asia, that do not have extensive irrigation have experienced severe drought for two to three years, with disastrous consequences for the production and availability of food for human and animal consumption. Extended periods of political turmoil and wars have also adversely affected the performance of the economy and agriculture sector in some countries of Sub-Saharan Africa (e.g., Sierra Leone, Togo, Chad, Somalia, Sudan, and Mozambique) and Asia (e.g., Afghanistan, Palestine and Iraq).

According to Table A2, which gives the data for the overall and per capita production indexes of all agricultural goods, food commodities and cereals, only few countries performed well in the last 12 years. The overall agricultural product index per capita rose significantly in only five Sub-Saharan countries, seven countries in West Asia and North Africa, and one each in South and South East Asia, and Albania. It fell in 22 member countries, of which eight are each in Sub-Saharan Africa and West Asia-North Africa, three in Central Asia, and Suriname. The index for food production shows a similar performance across the regions and countries. However, the per capita production index of cereals has a different story. It rose quite significantly in ten Sub-Saharan African countries, four in West Asia and North Africa, three in Central Asia, and one in South Asia. The important point is that it fell significantly in 20 member countries, of which nine are in West Asia and North Africa and six in Sub-Saharan Africa.

With regard to the availability and use of the main resources and inputs for agriculture, shown in Table A3, the IDB member countries present a variety of patterns.[18] The arable and agricultural land areas generally represent the potential and actual use of land for agriculture. The arable land area constitute more than ten per cent of the total land area in 22 member countries; in 19 countries—a large number of them are in West Asia and Central Asia—arable land is less than five per cent of the total land area. In per capita terms, 25 member countries—12 in Sub-Saharan Africa and nine in West Asia and North Africa—have one-quarter hectare or more of arable land per capita; 14 member countries—have one-tenth of hectare or less per capita of arable land.

The use of land for agriculture, however, presents a very different picture. In 33 countries, agricultural land forms more than one-third of the total land area—16 in Sub-Saharan Africa, 10 in West Asia and North Africa, all four in Central Asia, three in South Asia, and Albania. The land area under irrigation—small-scale to large-scale systems based on the surface and ground sources—is very limited in most of the countries in Sub-Saharan Africa. But it occupies a high proportion—over 50 per cent—of the land area in 11 countries of West Asia and North Africa, three of Central Asia, and one of South Asia. A

[17] A regional comparison of Total Factor Productivity (TFP) reveals that more than three-quarters of the increased output in most countries of Sub-Saharan Africa are due to the use of conventional inputs. However, in many countries of Asia—especially in South and South East Asia—more than one-third to one-half of the increased output can be attributed to the change in technology (Zepeda 2001).

[18] The qualitative aspect of resources and inputs and their efficient use are generally far more significant in the context of agricultural production and productivity.

similar pattern is observed in the consumption of fertilisers for crops. The use in Sub-Saharan Africa does not exceed 24 kg per arable hectare, whereas in many countries of West Asia and South East Asia the levels range between 50 and 300 kg with average of around 90 kg per hectare. The density of tractors is also very low in Sub-Saharan Africa; the high density is quite common in the West Asia and North Africa region, followed by Pakistan, Malaysia, Albania, and Suriname. Human labour—women provide a very large share of it—and small implements are a large part of the production systems in Sub-Saharan Africa as compared to the farms in many countries in Asia and North Africa.

CHAPTER THREE

RECENT TRENDS IN GRAIN PRODUCTION AND PRODUCTIVITY

1. Cereal Production

Grains are produced for three principal uses: direct human consumption, animal feed and other uses, including industrial consumption. They contribute 55-70 per cent of the total calories—as high as 85 per cent in the poor rural households—to the diets in developing countries. The domestic output of cereals in many IDB member countries has not kept pace with the growth in demand, although in some countries the yield levels have increased quite significantly. The regional distribution of harvested area, output and yield per hectare of cereals in IDB member countries shows some important differences and changes during the last 12 years (Table 2).

The share of IDB member countries in the cereal area and output of all developing countries rose from 26 and 19 per cent in 1989/91 to 31 and 23 per cent in 2000/02. Cereals occupy 58 per cent of arable land in the member countries, ranging from as low as 38 per cent in North Africa to 72 per cent in South East Asia. The average for LDMCs is 71 per cent or about the same as in South Asian countries. In absolute terms, the largest cereal area is in Sub-Saharan Africa and West Asia, followed by South Asia. It increased quite significantly in Sub-Saharan Africa and modestly in South and South East Asia, and fell significantly in North Africa. Most of the output is produced in South Asia, South East Asia and West Asia and they had similar levels of cereal output in the early 1990s. In the last decade, the most significant increase in output was in South Asia—Bangladesh accounting for most of it—followed by Sub-Saharan Africa, South East Asia, and West Asia. The major cereal producers are Indonesia (rice), Bangladesh (rice), Turkey (wheat), Pakistan (wheat and rice), Egypt (wheat and rice), and Iran (wheat). Sudan is by far the largest cereal producer in Sub-Saharan Africa, followed by Burkina Faso, Mali, and Niger. The average cereal output per capita in the years 2000 to 2002 was highest in Central Asia (396 kg), followed by South Asia (197 kg), North Africa and South East Asia (132 and 127 kg). The average for Sub-Saharan Africa and West Asia was 118 and 111 kg, respectively.

Table 2

Cereal Production in IDB Member Countries, 1989/91 and 2000/02

	Area (Million ha)		Per Cent of Arable Land Used for Cereals	Output (Million MT)		Yield (MT/ha) 2000-2002	
Region	1989-1991	2000-2002	(2000-2002)	1989-1991	2000-2002	1989-1991	2000-2002
Sub-Saharan Africa	27.70	33.24	54.0	18.20	25.33	0.67	0.76
West Asia	31.83	31.13	55.0	51.50	57.92	1.62	1.86
North Africa	12.42	10.77	38.0	24.52	26.71	1.97	2.48
Central Asia	--	14.90	50.0	--	18.43	--	1.24
South Asia	25.17	26.25	70.0	51.82	70.95	2.06	2.70
South East Asia	14.14	15.71	72.0	53.15	62.93	3.76	4.00
Albania	0.30	0.18	31.0	0.79	0.54	2.68	2.96
Suriname	0.06	0.05	83.0	0.23	0.18	3.75	3.79
All Member Countries	111.62	132.23	58.0	200.21	262.99	1.97	1.99
LDMCs	39.69	45.69	71.0	47.54	65.69	1.20	1.44
Developing Countries	431.63	430.32	--	1077.87	1160.47	2.50	2.70
Developed Countries	--	--	--	--	--	3.14	3.49

Source: Table A4.

The level and change in cereal productivity, measured by output per hectare, show wide regional differences. The highest yield levels are in South East Asia and Suriname, followed by countries in South Asia and North Africa. The Sub-Saharan African countries have less than one-quarter of the yield level in South East Asia and less than one-half of the average of all IDB member countries. The average yield level for the member countries rose only marginally between 1989/91 and 2000/02. The largest increase in the yield level was in South Asia (31 per cent), followed by North Africa (26 per cent) and a modest 6 per cent in South East Asia. The increase in Sub-Saharan Africa and West Asia was in the range of 15-17 per cent. The yield levels fell in 13 countries—six in Sub-Saharan Africa (Somalia, Sudan, Gabon, Guinea-Bissau, Senegal, and Sierra Leone) and five in West Asia and North Africa (Iraq, Saudi Arabia, UAE, Libya, and Morocco). The increase was no more than one per cent per year in 17 countries, seven of them in Sub-Saharan Africa, five in West Asia and two in South East Asia. Four countries in Sub-Saharan Africa (Mozambique, Cote d'Ivoire, Cameroon, Guinea, and Togo) and four in West and Central Asia (Azerbaijan, Syria, Iran, and Tajikistan) experienced yield increases ranging from nearly 3 to 10 per cent per year.

It should be added that the average yield level for the LDMCs is significantly lower than the average for all IDB member countries: 39 per cent in 1989/91 and 28 per cent in 2000/02. The average yield gap between developing countries and IDB member countries rose from 21 per cent in 1989/91 to 26 per cent in 2000/02 since there was almost no change in the yield level in the member countries during the period.[19] It should also be noted that the average yield level in developed countries is far higher than the average level in developing countries and the yield gap widened in the 1990s. The yield gap of the LDMCs, particularly those in Sub-Saharan Africa, did not decrease by much in the last decade. Most of the significant increase in the yield level of cereals—particularly wheat and rice—in some of the IDB member countries was experienced in the 1970s, followed by a declining rate of yield growth in most countries in the 1980s and 1990s. It should be added that in many countries of Sub-Saharan Africa there was little if any increase in the yield levels of cereals in the 1980s.

Table 3

Cereal Imports and Exports of IDB Member Countries, 1990/91 and 2000/01

Region	Imports (000 MT)		Exports (000 MT)	
Sub-Saharan Africa	4,984	7,015	140	197
West Asia	21,675	32,649	3,479	2,904
North Africa	18,116	26,673	143	924
Central Asia	--	796	--	4,838
South Asia	3,348	2,626	974	2,718
South East Asia	5,275	9,797	174	211
Albania	208	401	--	--
Suriname	53	41	60	59
All Member Countries	53,659	79,998	4,970	11,851

Source: Table A3.

In the context of cereal supply for food and feed in the member countries of IDB, it is important to look at the data for cereal quantities imported and exported during the last 12 years. As shown in Table 3, the member countries overall are net importers of cereals. Their cereal imports rose from 53.7 million MT in 1990/91 to 80.0 million MT in 2000/01 or by 50 per cent and the exports rose from 4.97 million MT to 11.85 million MT or by 138 per cent in the same period. However, if the exports from Central Asia in 2000/01 are excluded, then the increase was only 41 per cent. The differences between regions and countries are quite significant in terms of these changes. The countries in West Asia and North Africa—Iran, Egypt, Algeria, Saudi Arabia, Morocco, and Iraq—have the largest share of imported cereals, followed by Indonesia and Malaysia. The most significant

[19] Herdt (1988) suggests several ways to define the yield gap: (i) theoretical maximum levels, (ii) best yields on experiment stations with all inputs used at optimum level, (iii) average yield in varietal trials on experiment stations, (iv) yields on on-farm trials by researchers, (v) best farmer yields, and (vi) average farmer yields.

increase in imports was in Morocco, Iraq, and Albania. In Sub-Saharan Africa, Uganda, Cote d'Ivoire, Niger, and Burkina Faso experienced significant increase in their cereal imports. The imports into South Asian countries, Bangladesh and Pakistan in particular, fell quite significantly. The major exporters of cereals are Kazakhstan and Turkey—wheat in both—followed by Pakistan and Egypt (rice in both). It is important to note that the exports from West Asian countries fell, while they rose significantly from North Africa (Egypt) and South Asia. The Sub-Saharan countries exported very limited quantity of cereals in the two periods. The large import dependent countries—with high net import to domestic output ratio—are in North Africa and West Asia followed by Sub-Saharan Africa. During the period 1990/91 and 2000/01, the ratio rose from 73 to 96 per cent in North Africa, from 35 to 51 per cent in West Asia, and remained at 27 per cent in Sub-Saharan Africa. The South East Asian countries (Indonesia and Malaysia) experienced an increase in the deficit ratio from 10 15 per cent and in South Asian countries (Pakistan and Bangladesh) the ratio fell from 5 per cent to self-sufficiency. Kazakhstan is a major net exporter of cereals.

A close examination of the recent data on export and import of wheat, rice and sorghum for the member countries show the large extent to which they are dependent on wheat and rice imported from non-member (developed) countries.[20] The following figures represent annual average amounts for 1999/2001 (in Metric Tons):

	Wheat	**Rice**	**Sorghum**	**Total**
Export	5,609,795	2,798,358	103,575	8,511,728
Import	39,401,377	11,926,303	68,516	51,396,196

There are two important implications of the evidence on cereal export and import for the member countries. First, the high net importers of cereals have to either increase their production and productivity or earn enough foreign exchange from exporting other commodities. Of course, cereal requirements in the future will be determined by the rates of growth of population and income and the change in tastes and preferences. Second, member countries with the untapped potential for growth in cereal production and productivity should produce exportable surpluses for trade with other member countries, taking advantage of the new WTO trading framework for agricultural products.

2. Wheat, Rice and Sorghum Production

Wheat and rice are consumed in almost all member countries of IDB. However, wheat consumption is concentrated in the countries of West Asia, North Africa, Central Asia, and in Afghanistan, Pakistan, and Albania. The major wheat producers are Kazakhstan, Turkey, Pakistan, and Egypt. Rice consumption is concentrated in South East Asia, Bangladesh, and in some countries of West Africa. There is significant consumption of rice in countries like Pakistan, Iran and Turkey. Rice production is dominant in Indonesia, Bangladesh, Pakistan, Egypt, Malaysia, Iran, and Turkey, followed by some countries in West Africa like Cote d'Ivoire, Mali, and Guinea. Sorghum is produced mainly in countries of Sub-Saharan Africa, particularly Sudan Niger, Burkina Faso, Mali, and Chad. Yemen is the only country outside Africa where it accounts for a significant

[20] See the FAO database (FAOSTAT).

proportion of the crop area. It is also an important part of human diet in these countries. In several other countries, it is used as animal feed.

Table 4
Area, Production and Yield of Wheat, Rice and Sorghum in IDB Member Countries (Average 2000/02)

	Wheat			Rice			Sorghum		
	Area MHA	Output MMT	Yield MT/h	Area MHA	Output MMT	Yield MT/h	Area MHA	Output MMT	Yield MT/h
Sub-Saharan Africa	0.13	0.29	2.18	2.31	4.14	1.79	12.55	8.11	0.65
West Asia	19.08	38.61	2.02	0.69	2.50	3.62	0.57	0.59	1.03
North Africa	5.80	11.38	1.96	0.62	5.64	9.10	0.35	0.86	2.47
Central Asia	12.33	14.70	1.19	0.14	0.31	2.21	--	--	--
South Asia	10.76	23.84	2.21	13.21	44.19	3.35	0.37	0.22	0.60
South East Asia	--	--	--	12.33	53.43	4.33	--	--	--
Albania	0.10	0.31	3.10	--	--	--	0.02	0.2	0.94
Suriname	--	--	--	0.05	0.18	3.60	--	--	--
All Member Countries	48.20	89.13	1.85	29.34	110.39	3.76	13.85	9.80	0.71
LDMCs	2.74	4.84	1.77	12.76	40.72	2.96	12.51	8.01	0.64
Developing Countries	99.78	258.51	2.69	145.73	548.01	3.76	38.03	41.65	1.10
Developed Countries			2.76			6.48			3.44

Source: Table A5.

Note: MHA = million hectares; MMT = million metric tons; MT/H = metric ton per hectare.

In Table 4, the data on production and productivity levels of wheat, rice and sorghum in the IDB member countries for the most recent period (average of 2000/02) show several important features and regional differences. The member countries have nearly one-half of the wheat area of all developing countries and produce 35 per cent of the output; they have one-fifth of the rice area and output; and their share in the sorghum area is 37 per cent and 24 per cent in output. In the member countries, wheat, rice and sorghum are harvested on 70 per cent of the cereal area, in which wheat accounts for 37 per cent, rice 22 per cent, and sorghum 11 per cent. However, in the LDMCs, the three grains use only 43 per cent of the cereal area and almost the same proportion is harvested in Sub-Saharan Africa. Their share in the total cereal area is significantly higher in other regions, with 65 per cent in West Asia, 74 per cent in North Africa, 78 per cent South East Asia, 84 per cent in Central Asia, and 94 per cent in South Asia. Overall the share of wheat in the area used

for the three grains is 37 per cent, followed by rice (22 per cent) and sorghum (11 per cent). In the LDMCs, sorghum has 27 per cent of the area, followed by rice (10 per cent) and wheat (6 per cent). Wheat area is dominant in Central Asia (83 per cent), followed by West Asia and North Africa (61 and 63 per cent), and South Asia (41 per cent). It has very little area in Sub-Saharan Africa, Sudan is the major exception. Rice is harvested on 78 per cent of the cereal area in South East Asia, followed by South Asia (50 per cent). About seven per cent of the cereal area is used for rice in North Africa (Egypt) and Sub-Saharan Africa. Sorghum is dominant only in Sub-Saharan Africa with 38 per cent of the total area used for the three grains, followed by 4 per cent in North Africa.

In the member countries, wheat occupies much larger area than rice, but its average yield level is significantly lower. Sorghum occupies far less area than the other two grains and also has a significantly lower average yield level. The average yield of wheat for the member countries is 31 per cent lower than the average for developing countries and one-third lower than the average for developed countries. The yield level in LDMCs is even lower (1.77 MT/ha). The yield levels in Egypt, Saudi Arabia, Lebanon, and Albania are significantly higher than the average for developing countries. In the last decade, the yield level increased by 2-3 per cent per year in Sudan, Mali, Azerbaijan, Syria, Algeria, Egypt, Tajikistan, Turkmenistan, and Pakistan. Since the late 1980s, only Egypt, Sudan and Iran have nearly doubled the wheat yield, while the major producers like Turkey and Pakistan experienced more modest increases.

With regard to rice, the average yield level of the IDB member countries (3.76 MT/ha) is not significantly lower than the average for all developing countries (3.86 MT/ha). However, the average for Sub-Saharan countries is only 1.8 MT/ha because the yield level in all of the major rice producing countries in Africa ranges from 1.5 to 2.0 MT/ha. However, the annual yield increase in the major producing countries—Cote d'Ivoire, Guinea and Mali—was between 3 and 8 per cent during the 1990s. The very high yield level in North Africa is in of Egypt, where the average output per hectare rose from 6 MT in the late 1980s to 9 MT in the last three years. Among the large producers of rice, the yield level increased in Bangladesh by nearly 50 per cent in the same period. An important point is that the member countries and developing countries have the same yield level of rice, which is significantly lower than the average yield level in developed countries.

The area under sorghum contracted or increased only marginally in most countries. Similarly the yield level was either stagnant or fell in all IDB member countries, except Niger, in Sub-Saharan Africa. This trend in the yield level can be noted for the developing countries since the late 1980s (FAO 1996). The average yield in the major producing countries—located mainly in Sub-Saharan Africa—is much lower than the average reported for developing countries, which is only one-third of the average in developed countries. The neglect of sorghum reflects the fact that it is important only in the diet of the rural poor and their livestock and competes for resources against crops that are regarded economically more important or profitable.

3. Major Issues in Cereal Production and Productivity

The main results of the review of recent trends of grain production and productivity are summarised here to provide the context in which the role of proximate factors underlying these trends can be examined.

- Cereals occupy 58 per cent of arable land in the member countries, ranging from 45 per cent in North Africa to 72 per cent in South East Asia. Their share in LDMCs is 71 per cent and in Sub-Saharan Africa they cover 54 per cent of arable land.
- The average yield level of cereals in the member countries is significantly lower than in developing countries. The yield level in Sub-Saharan Africa is less than one-half-of the average for the member countries, but the average for LDMCs is lower by 28 per cent.
- The average yield of cereals in the member countries rose only marginally in the 1990s. The yield level in Sub-Saharan African countries rose by 15 per cent and by 20 per cent in the LDMCs.
- Seventy per cent of the cereal area in the member countries is used for wheat, rice and sorghum. Wheat uses 37 per cent, followed by rice (22 per cent) and sorghum (11 per cent); in LDMCs, sorghum uses 27 per cent of the cereal area.
- The share of wheat, rice and sorghum in the total area for cereals ranges between 65 per cent (West Asia) to 94 per cent (South Asia); its share is only 43 per cent in Sub-Saharan Africa and LDMCs.
- The share of wheat in the area used for the three grains is very high in Central Asia (83 per cent), followed by West Asia and North Africa (61 and 63 per cent). Rice dominates the area in South East Asia (78 per cent) and South Asia (50 per cent); and sorghum is important in Sub-Saharan Africa with 38 per cent of the total area used for the three grains.
- The average yield of wheat in the member countries is significantly lower than the average for developing countries; there is little difference in the yield levels of rice; the yield level of sorghum is the lowest and did not increase in the 1990s.
- The yield level of wheat increased annually between one and three per cent in the major producing countries; the rice yield did not increase by much in any of the major rice producing country, except in the minor producers like Pakistan, Egypt, Cote d'Ivoire, Guinea, and Mali.

The IDB member countries, with few exceptions, are net importers of cereals. The major importers are in West Asia and North Africa, but cereal imports increased quite significantly in some of the Sub-Saharan African countries as well. Only a handful of countries are net exporters of grains. The main issue in the net importing countries is how to meet their food and feed requirements and assure food security to their populations. A more important issue in many countries, especially the LDMCs and almost all member countries in Sub-Saharan Africa, is to raise the yield level of grains.[21] These issues are directly relevant to the state of food insecurity and undernourishment of populations—particularly of the rural poor—and the expenditure of foreign exchange to meet the annual requirements of food imports in several countries.

[21] The focus on yield should take into account (i) the cost of production or economic efficiency, (ii) sustainability of resources and the environment, and (iii) the technological, institutional and policy aspects.

CHAPTER FOUR

STATE OF FOOD INSECURITY AND THE ROLE OF GRAINS

The issue of food security has several important aspects. The first aspect is the overall supply of food from domestic sources and imports that are paid for or received as food aid. The second aspect is on the side of demand that the existing supply can satisfy. Finally, and what counts most, is the distribution of available food to meet the market demand and requirements (needs) of those who are poor and in a state of moderate to severe undernourishment. The state of a country's food security must be defined in terms of its ability to meet two conditions simultaneously: it is self-reliant and it can feed the poor at affordable prices. An issue common to all three aspects is the assessment of demand and requirements of food, grains included, in a country. Demand is an economic concept and depends on the level of income, prices, population and tastes and preferences. It is not, however, the same thing as food requirement (or need) to maintain a level of nutrition needed by the individual to be functional. The assessment of demand is far easier than food requirements since the latter involves complex issues of health, education, culture, climate, work, age, gender, etc.

In a number of developing countries, including several of the IDB member countries, the hungry and undernourished people, especially in rural areas, constitute a significant proportion of the population. They are insecure mainly because of persistent poverty. Expansion of a country's capacity to produce and purchase food from outside and make it accessible to those whose basic requirements remain unmet because of poverty constitute the key elements of a strategy to enhance economic growth and reduce poverty. The cost of persistent hunger and undernourishment of a significantly large proportion of the population in several countries is reflected in the high incidence of mortality, especially among children, morbidity, loss of productivity, fuels environmental degradation, and civil strife (FAO 2002c). Food insecurity for a substantial portion of the population, especially among the rural poor, is one of the most important issues in a majority of IDB member countries. It is, therefore, important that the evidence is reviewed to provide the context in which the problems of grain production and productivity can be assessed. In the late 1990s, nearly one-fifth of the import bill was for food and just over one-half of the bill for food imports was on account of imported cereals. The average for the Sub-Saharan countries was higher in both: 26 and 54 per cent, respectively. In South Asia (Bangladesh, Afghanistan and Maldives), 39 per cent of the food import bill was for cereals. The average share of food in imports was 27 per cent for LDMCs, but the share of cereals in food imports was similar to the average of the member countries. The average level of food aid to the IDB member countries in 1999/2001 was 2.75 million MT, of which LDMCs received 56 per cent. Bangladesh received nearly one-quarter of the total food aid.[22]

The indicators of food deprivation, nutrition and poverty show that they are strongly correlated (FAO 2002c). Hunger and poverty reinforce each other because the former reduces productivity of both adults and children, which, in turn, inhibits their capacity to earn incomes. Persistent hunger and poverty generally stay together. Large-scale prevalence of hunger and undernourishment impair the economic performance of

[22] In a recent five-year period (1997-2001), cereal deliveries to LIFDCs averaged annually around one per cent of their cereal output and 10 per cent of their cereal import. Thirty to thirty-five per cent of the food aid went to the countries in Sub-Saharan Africa (WFP 2002).

nations. In some parts of the world, concentrated mainly in Sub-Saharan Africa and South Asia, extreme hunger is caused by both natural calamities—drought in particular—and large-scale disruption caused by wars. Indeed, some of the IDB member countries have suffered from both of these events and in some countries the food problems of people living in the mountains is even more entrenched.

As shown in Table 5, the incidence of under-nourishment in the IDB member countries declined only slightly from 24 to 22 per cent of the population in the 1990s compared to the average for all developing countries that fell from 20 to 17 per cent.[23] The average for the LDMCs declined from 37 to 33 per cent in the same period. The highest incidence was in South Asia and did not change during the decade. The undernourished population in Sub-Saharan Africa decreased from one third to 28 per cent of the population. In West Asia and North Africa, ten per cent of the population remained undernourished. The lowest incidence of under-nourishment was in South East Asia. These regional averages conceal considerable inter-country differences. At the end of the 1990s, one-third or more of the population was undernourished in Mozambique, Somalia, Chad, Guinea, Mauritania, Sierra Leone, Yemen Tajikistan, Afghanistan, and Bangladesh. The state of under-nourishment is also reflected in the proportion of underweight children in the population under five years. One-fifth of the children under five in the IDB member countries, and 30 per cent in LDMCs, were underweight in 2002. Their proportion in Sub-Saharan Africa was 25 per cent and 45 per cent in South Asia. The exception is Indonesia where 22 per cent of the children were regarded underweight although the overall incidence of under-nourishment was only 6 per cent. More than one-third of the children under five years were underweight in Burkina Faso, Mali, Niger, Yemen, Afghanistan, Bangladesh, and Pakistan.

[23] FAO (2002c) defines under-nourishment as "food intake that is insufficient to meet the dietary energy requirements continuously."

Table 5

Food Insecurity and Under-nourishment in IDB Member Countries, 1990-2002

Region	Per Cent Population Undernourished		Per Cent Under-weight in Under-Fives	Dietary Energy Supply/ Capita kcal/day	Cereal Supply kg. per capita per year	Calories from Cereals per capita per day
	1990/1992	1998/2000	(2002)	1998/2000	1999/2000	1999/2000
Sub-Saharan Africa	33	28	25	2283	132	1127
West Asia & N. Africa	9	10	12	2928	185	1512
Central Asia	--	22	10	2515	177	1377
South Asia	41	41	45	2063	151	1331
South East Asia	6	6	22	2915	169	1484
Albania	--	8	14	2750	185	1433
Suriname	12	11	--	2630	129	1092
All Member Countries	24	22	20	2564	158	1313
LDMCs	37	33	30	2192	141	1203
Developing Countries	20	17	--	2500	163	1438

Source: Table A6.

At the end of 1990s, the average daily energy supply in the IDB member countries was 2,564 calories per person compared to the average of 2,500 in developing countries. However, the average for LDMCs among the member countries was 15 per cent lower than the average and 20 per cent lower in South Asia. The daily cereal consumption per capita in the member countries is similar to the level for developing countries, but there is wide regional variation, with the highest intake in the countries of West Asia and North Africa, followed by Central Asia and South East Asia. The lowest intake is in Sub-Saharan African countries. In fact, cereals supply one-half or slightly higher proportion of the daily calorie intake in many member countries, except those in South Asia and Central Asia where the share of cereals is 55 to 65 per cent. Comparing the regional distribution of the average daily per capita supply of the three grains, wheat is dominant in most countries of West Asia and North Africa—exceptions being Saudi Arabia and UAE—Central Asia countries, and Pakistan. In Sub-Saharan Africa, Mauritania and Gabon are the only countries in which wheat seems to appear in the diets. Rice dominates the diets in Bangladesh, Indonesia, Malaysia, and Brunei Darussalam, and is quite significant in Maldives, Guinea-Bissau, Sierra Leone, Cote d'Ivoire, Djibouti, Comoros, and Guinea. The Gulf states, including Saudi Arabia, have significant intake of rice. Sorghum as human food is quite important in Sudan, Burkina Faso, Mali, and Chad. In several countries, it is used as an important animal feed as well.

CHAPTER FIVE

FARMING SYSTEMS FOR GRAIN PRODUCTION

1. General Framework

As stated earlier, the farming systems approach provides a suitable framework to analyse the role of several proximate factors and constraints that influence the contemporary state of production and productivity of grains in the member countries of IDB. This approach allows a level of generalisation relevant to many countries at the regional level; references are made where necessary to specific countries or situations. However, given the constraints of time and data, the analysis cannot include many of the country-specific details of the farming systems and factors that may help explain the current state of grain production. This study focuses on the role of several factors, recognising that they are interdependent in their effect on the farming systems in their present and possibly future state of development. These factors can act as both facilitators and inhibitors of agricultural production and the wellbeing of the people directly or closely linked to the rural economy.[24] The analysis takes into account three important aspects of the agricultural economy in a majority of the member countries. First, grains have a special place for the individual farmer, especially the small landholder, and the national economies to assure food security. Second, grains compete for resources and inputs against other crops for economic gain. Third, the farmers' decisions on allocation and management of resources, and their ability to benefit from production, depend on the state of institutions, activities and services in the private and public sectors.

The farming systems framework outlined by Dixon and Gulliver (2001) is also used in the present analysis with notes of caution where necessary. A group approach is adopted for examining the role of proximate factors for grain production and productivity in the member countries. In each region, the focus is on the main farming systems for grain production. This will highlight the specificity of the farming systems and regions and allow comparisons. The analysis of resources and constraints in each region takes into account the requirements of the dominant farming system for cereal production in general and the main grains in particular. The member countries are grouped into following regions with their major farming systems:

1. Sub-Saharan Africa
   Irrigated; cereal-root crop mixed; and agro-pastoral farming systems
2. West Asia and North Africa
   Irrigated; highland mixed; rainfed mixed; and dryland mixed farming systems
3. Central Asia
   Extensive cereal-livestock; sparse arid; and agro-pastoral farming systems

[24] Needless to say that farmers are at the centre of the process of agricultural growth since they are the decision-makers and prospective beneficiaries. There is abundant evidence that, *ceteris paribus*, private and public investment in their health and knowledge can generate high rates of return to individuals and society. In addition to human capital, research and transfer of technology, public investment and prudent policy, political stability, and good governance are generally identified as the major factors affecting the level of production and changes in agricultural productivity (Zepeda 2001).

4. South Asia
   Irrigated rice-wheat; low land rice; and highland-mixed farming systems
5. South East Asia

   Lowland rice; tree-crop mixed; and sparse forest farming systems

These farming systems have been selected because of their importance to the production of grains in the member countries. It is recognised that some of the area and population of these countries are also part of other farming systems that produce food and generate income for farmers.

2. Sub-Saharan Africa

There are five major agroclimatic zones in which the IDB member countries are located. The desert in the north runs from Mauritania to northern Sudan and parts of Djibouti and Somalia. South of the desert are the arid and sub-arid zones across the countries from west to east. Finally, the sub-humid and humid zones cover almost all of the West African countries and large parts of Uganda and Mozambique. The arid and semiarid zones cover most of the land area of the member countries, but in West Africa nearly three-quarters of the population lives in the subhumid and humid zones. Dixon and Gulliver (2001) have identified 15 major farming systems in Sub-Saharan Africa. Some of them are more dominant than others and also overlap each other. Four of these farming systems—irrigated, cereal-root crop mixed, root crop, agro-pastoral, and sparse arid—seem to be quite important in the member countries.

1. Irrigated farming system: The largest irrigated system is in Sudan between the Blue and White Nile, where the dominant crops are sorghum, cotton, and groundnuts. In addition, there are large-scale irrigation schemes along the major rivers in West Africa as well as the small-scale dug-well-based irrigation in the West African wetlands. There are small-scale irrigation projects under way to harvest water from rains in other farming systems. The large irrigation based systems, as in Sudan, Mali and Gambia, were expensive to build, have high operational costs, and poor water efficiencies. Low output prices and less than anticipated levels of output have made these schemes financially unsustainable. Since the early 1990s the attempts by governments to restructure the parastatals, liberalise trade, and privatise the major services have been disappointing. Rehabilitation of the large-scale irrigation schemes has become as necessary as it is expensive to undertake without external support. Recent experience in Mali and Guinea-Bissau tends to show that, provided there is favourable policy environment, smallholders can develop and manage small-scale irrigation schemes. There is high potential for growth through intensification and crop diversification provided low-cost techniques are available for water harvesting in some countries subject to seasonal flooding and occasional droughts.

2. Cereal-root crop mixed farming system: It is found mostly in the dry subhumid zone on the northern and southern Guinea savannahs that extend through most of the countries in West Africa. Most farmers produce grains like sorghum, millet and maize, with cassava and yams, as food crops and cotton for cash. There is abundant cultivated land and is underutilised because of the low population density, poor transport and communications, and labour shortages. Soil degradation is a serious problem because of long fallow periods, low level of fertilisation, particularly for cereals, and prolonged use of implements on land preparation in the northern areas. In the 1980s, the introduction of early maturing varieties of maize, with supportive government policies on credit and subsidy on fertiliser, allowed small farmers to displace sorghum and root crops by maize and cotton. But this has proved

to be unsustainable after the adoption of trade and price liberalisation policies. The success of the tsetse fly control programme has opened up large areas for farmers to cultivate and raise livestock. There is considerable potential for growth of cereals and other crops with investment in roads and communications and widespread adoption of the no-till (conservation agriculture) technology on farms.

3. Agro-pastoral farming system: It is predominant in the dry subhumid zone, from Senegal to Niger and in parts of Sudan and many parts of Somalia. Crops and livestock are of comparable importance. The rainfed sorghum and pearl millet are the main sources of food and little if any of the output is marketed because of the producers' vulnerability to drought. The cultivation practices are based on hoe, oxen and camels. Livestock not only provides farm power but also acts as an insurance against drought. Food insecurity is a persistent problem for most of the households. The infrastructure and support services are quite deficient even in the areas where the population density is reasonably high. The constraints on crop production include declining soil fertility, weed infestation, and high cost of inputs. In this system the effect of crop failure is made more severe because the grain price rises sharply and the livestock price collapses.

3. West Asia and North Africa

In this region, most agricultural production is in the Mediterranean climate characterised by long dry summers and mild and wet winters. These moderately humid zones account for less than 20 per cent of the land area but have more than one-half of the agricultural population. The arid and semiarid areas with low and variable rainfall are more extensive in terms of the land area but have less than one-third of the agricultural population. There are three agroclimatic zones (ICARDA 1999): irrigated arid and semiarid; favourable rainfed arid and semiarid; marginal arid and semiarid; and highlands. Dixon and Gulliver (2001) have identified eight farming systems for the region, of which four are the most relevant for grain production in the countries of the region: (1) irrigated, (2) highland mixed, (3) rainfed mixed, and (4) dryland mixed farming system.

The sparse arid farming system covers about 50 per cent of the land area, and includes desert lands, but no more then 3 per cent of the population thrives in the oases with small irrigation schemes particularly in Libya, Tunisia, Algeria, and Morocco. In addition, in almost all countries of the region, there is a pastoral farming system that covers more than one-quarter of the land area. In some areas, pastoralists are able to grow some crops on a limited scale where water is available. These grains are produced for the consumption of the household and its livestock.

1. Irrigated farming system: Except for Algeria,, Morocco, Tunisia, Libya, Syria, Yemen, and Turkey, in all countries of the region more than one-third of the arable land is irrigated by the surface and ground water sources on large and small scales. In some countries, irrigation is the main source of agricultural production, e.g., Egypt, Azerbaijan, Iraq, Iran, Saudi Arabia, and the smaller Gulf States. The irrigated farming system has been of great importance to many countries because of the arid and semiarid landscape and the availability of water from the Nile and Tigris-Euphrates river systems with extensive groundwater aquifers across the region.

The large-scale irrigation system is prominent in Iraq, Syria, Turkey, Egypt, and Morocco and small-scale irrigation is found throughout the region, including Iran, Turkey, Syria, Oman, Yemen, and the Maghreb. The large-scale irrigation system is dominated by intensive year-round cropping with cropping intensities ranging from 120 to 160 per cent.

The major crops in the system include cotton, sugarbeet, sugarcane, cereals, fodder, vegetables, and other high-value crops. In many areas considerable size of livestock is integrated with crops. Many irrigated areas have a mix of state-owned and private land ownership with a variety of tenancy arrangements. The irrigation system is centrally managed with its associated problems of poor water management resulting in waste and soil degradation. In recent years, large-scale fully irrigated schemes have been developed in some countries, e.g. Yemen, Morocco, and Lebanon, using groundwater. However, these high-volume schemes are contributing to the declining water tables and also affecting the availability of groundwater to the small-scale traditional (lift) irrigation systems.

The small-scale irrigation system is within the boundaries of the larger rainfed areas providing water to the small landholders (owners and tenants). This system is quite common throughout the arid plains and on the terraced hillsides in the region, particularly in Yemen. In most areas, it has existed for centuries and is based largely on traditional technology and institutions. Most of the crops grown are for home consumption (cereals) and local markets (fruits and vegetables). The water supply is limited—it uses the water from wells and after the occasional floods and runoff—so the cropping system has to adapt to the availability of water. Food deficit is widespread due to the shortage of water.

2. Highland mixed farming system: It covers extensive areas in the Maghreb countries, Turkey, Iran, and Azerbaijan and some areas of Iraq, Syria, and Lebanon. The system depends largely on the high altitude arable and common grazing lands. Cereals, particularly wheat and barley, dominate the monoculture cropping system and the cropland is surrounded by the highland common grazing grounds. Overgrazing of mountain grasslands is quite common and is seriously affecting the environment and livestock productivity. In Yemen, on the high altitude sloping lands, fruit trees, olives, coffee, and vegetables are planted on terraces created many centuries ago. Soil degradation through erosion is a common problem for the system. The economy of this system is not too strong and the household labour is increasing its dependence on off-farm work or moving out to other areas. In Turkey, for example, many farms are too small to be viable and the tenancy arrangements do not create adequate incentives for long-term management of resources. In some countries, import subsidies on animal feed grains have severely affected the competitive position of local producers.

3. Rainfed mixed system: It is found in the dry-moist subhumid zones of the region. Reasonable quantity of rainfall and a long growing period allows farmers to grow a wide variety of crops and trees in this system. Tree crops like olives, fruits and nuts tend to dominate the more humid climate and when young they are intercropped with cereals and vegetables. Wheat, barley, pulses, fava beans, potatoes, sugarbeet, and chickpeas are the major annual crops. Cash crops, including flowers, are also grown extensively in controlled environments destined mainly to markets in Europe. A high proportion of the farms is highly capitalised and farmers are market-driven. Poultry and milk enterprises are also common. In the drier areas, cereals are far more dominant and farmers exchange labour and equipment quite widely.

The system is under pressure from different sources. In the coastal areas, in countries like Turkey, Lebanon, Morocco, and Tunisia, expanding urban settlements and tourism are raising the price of land opening the door to some farmers to leave agriculture altogether. In the cereal growing areas, legumes and fodder are replacing wheat and barley with the increased commercialisation and integration into profitable markets. In addition, there are two opposite trends in terms of farm size and access to land: large farms are

growing larger and the small farms are getting subdivided. Most small farmers are increasingly dependent on urban jobs and off-farm income. Mechanised farming is adding to the problem of rural unemployment, especially among women. Finally, increased intensification and diversification of farming is contributing to land degradation especially on the slopes and exposed soils.

4. Dryland mixed farming system: This system is mainly in the subhumid and semiarid zones and covers a significant proportion of the arable area in the region. Wheat and barley grown in a single or double season fallows dominate the cropping system. There is strong integration of small livestock (sheep in particular) with cereals, but its has been changing because of the rapid increase in rural-urban migration, price policies, and deterioration in the quality of land. The cropping system is very unstable because of its vulnerability to the highly variable rainfall with respect to quantity, time and area. In recent years, the area in wheat has been declining, being replaced by indigenous barley varieties. As in other areas, there are serious problems of land tenure and land subdivision that reduce farmers' access to good quality land. A high proportion of the household income is derived from remittances to provide food security and reduce poverty. In the marginal lands of more arid areas, the problem of soil erosion due to strong winds during the dry season is reducing the land resource base as well.

4. Central Asia

Four farming systems are most relevant to grain production in Central Asia: extensive cereal-livestock, irrigated, sparse arid, and pastoral (Dixon and Gulliver 2001). Arable land is plentiful in Kazakhstan but far more scare in Tajikistan and the Kyrgyz Republic. Wheat is the major grain, produced in large quantities only Kazakhstan, with some rice on irrigated lands in Kazakhstan and Turkmenistan.

1. Extensive cereal-livestock farming system: It is extensive in the semiarid plains—the domain of the *steppe*—of Kazakhstan, especially its northern parts, and parts of Turkmenistan and Uzbekistan. Historically these lands were for the extensive and migratory grazing of livestock, but were transformed under communism into large-scale and highly mechanised collective and state farms for wheat production. Besides wheat, fodder is grown for the cattle and sheep. The wheat production system was highly input-intensive to offset the variability of climate. Of course, dependence on the high intensity of machinery, chemical fertilisers, pesticides, and water have had severe effects on the quality of land and the environment. Since the collapse of the communist system in the early 1990s, farm productivity has fallen due to the breakdown of the economic structure and the erratic transition due to difficult socio-political conditions.

2. Irrigated farming system: The extensive irrigation system from the waters of the Amu and Syr rivers and their tributaries—they originate in the Tien Shan range of Tajikistan and the Kyrgyz Republic and drain into the Aral Sea—was developed to supply cotton to the Soviet Union. This system also produces some rice, tobacco, fruits and vegetables. However, the excessive use of water and mismanagement of the system over time have caused an environmental disaster for the entire region—Turkmenistan, Uzbekistan, and Kazakhstan in particular. It includes the drying out of the Aral Sea, widespread salinisation of soils, extensive desertification, pollution of water for human use, and human health. The high concentration of salts in soils with poor drainage, combined

with poor maintenance of the system, has affected the yield levels and the irrigated area has contracted as well with scarce chance of recovery in the near future.[25]

3. Sparse arid farming system: It is quite significant in most parts of Turkmenistan and Uzbekistan and a large strip of Kazakhstan. Nomads tend to dominate the driest parts. In the more favourable areas, extensive cereal production, supplemented by small livestock (sheep), is done with a fallow of one year to conserve moisture. Large farms dominated the landscape until the early 1990s, but they are in a state of disrepair with workers leaving the area for towns. The prospects for irrigated agriculture are very limited since the existing water withdrawals are excessively high and the irrigated system is in crisis.

4. Pastoral farming system: This system dominates the economies of the Kyrgyz Republic and Tajikistan. Most pastures are in the high mountain areas or in the surrounding dry zones. While pastoralism is common, in the favourable mountain valleys, cereals with fodder crops and potatoes are grown mostly for household consumption. Excessive animal populations, overgrazing, deterioration in the vegetation and soil erosion have become serious problems. Wool production was a very important economic activity until the early 1990s, but has fallen significantly and replaced by meat production. The incidence of rural poverty is particularly high in both Tajikistan and the Kyrgyz Republic.

5. South Asia

The agroclimatic conditions in South Asia vary from the large semiarid and arid zones in Afghanistan and Pakistan—both countries in their northern parts also have high mountain ranges—to the subtropical and tropical conditions in Bangladesh and Maldives. The large-scale surface and groundwater irrigation system in Pakistan allows the country to produce a large number of crops, including grains, pulses, fruits and vegetables with high cropping intensity similar to Bangladesh.[26] There are small-scale irrigation schemes in the rainfed farming system in Afghanistan and Bangladesh as well. There are five major farming systems in these countries, of which three are important in the context of cereal production (Dixon and Gulliver 2001). They are the rice-wheat farming system (quite extensive in the Indus plain of Pakistan and northern parts of Bangladesh), rice farming system (quite extensive in Bangladesh), and highland-mixed farming system (extensive in central Afghanistan and northwest Pakistan). The other two are the sparse arid farming system (widespread in the west and Southeast Pakistan), and pastoral farming system in the high mountains of Afghanistan and Pakistan.

The sparse arid farming system gets limited and highly variable rains, hence subject to occasional droughts, and supports small and large ruminants. There are scattered settlements where the groundwater or harvested water can be used to produce grains, fodder and vegetables. The rest of the area is utilised for grazing depending on the availability of water. In parts of Afghanistan and Pakistan, there is a gradual transition from the pastoral system to this system. The pastoral farming system is quite widely distributed throughout Afghanistan and extends into western part of Pakistan. Small and moving populations look after their herds and in scattered pockets cultivate land if water is

[25] Among others, Kharin (2002) gives a detailed account of the environmental disaster in and around the Aral Sea region caused by years of bad economic planning and bureaucratic mismanagement of resources for agricultural production.

[26] See Kaosa-ard and Rerkasem (2000) for a recent review of the agriculture sector with regard to its growth and sustainability in Asia, including South Asia.

available. Off-farm work income is an important source of income since the meagre nature resource base is quite vulnerable to periodic and occasionally severe droughts.

1. Rice-wheat farming System: This system is common in both dry and subhumid areas, like the large irrigated plains of Punjab and Sindh in Pakistan and the northwest of Bangladesh. The system is characterised by a summer paddy crop followed by an irrigated winter wheat. It has a significant level of crop-livestock integration. The production is based primarily on the household labour of millions of small landowners and landless tenants. There is considerable heterogeneity with regard to the access to land and water resources. This system produces a large proportion of the marketed grain in both countries. The adoption and diffusion of high-yielding varieties (HYVs) of rice and wheat, in collaboration with IRRI and CIMMYT, have brought about remarkable increases in grain production. In recent years, however, the yield levels have remained stagnant or declined in large areas. The decline in soil productivity, especially in Pakistan due to excessive reliance on chemical fertilisers, misuse of the irrigation water, soil salinity and sodicity, and high primary tillage, has tended to depress the yield levels of grains. This has created enough concern about the growth prospects of the rice-wheat system and its capacity to provide food security with growing populations and income and declining quality of the natural resource base at least in the large-scale irrigated areas.

2. Lowland rice farming system: This system is found almost exclusively in the humid wetlands of southern Bangladesh. Rice is grown in the wet season and a second crop of rice or less water-demanding crop is grown in the dry season. The system is supplemented by irrigation in the monsoon season and full irrigation in the dry season. High population density and proximity to urban centres provide good opportunities for off-farm work. Owner-operators tend to dominate the farming system, although there is sharecropping tenancy as well on larger size farms. Generally, the landholding size is small and subdivided. There is limited fodder except for paddy straw used for ruminants that provide milk and draught power. In recent years, farmers have shied away somewhat from adopting the new rice varieties because of lack of high quality seed, low tolerance to early or late transplanting, poorer taste of the varieties, and modest increase in the yield level. There is great diversity in the system with transitions to the rice-wheat system in the north and aquaculture and livestock in the south. Low and declining paddy prices with rising production, especially labour, cost provide little incentive to increase the rate of fertiliser application for higher paddy yield.

3. Highland mixed farming system: This system is quite significant in the rainfed areas between the plains and high mountains in Pakistan and Afghanistan. A range of cereals, but wheat dominates, with fodder, oilseeds and vegetables—sparsely irrigated by old wells or small dams—are cultivated with small herds of livestock. In some of the higher altitudes there is reasonable forest cover, but it has been declining because of excessive harvest and mismanagement of the state and community forests. A high proportion of the population living in these areas is dependent on remittances of migrant workers and off-farm incomes. Generally these areas are net importers of cereals because of the high variability of production due to poor soils and unreliable supply of water.

6. South East Asia

Indonesia is an archipelago with hundreds of dispersed islands and Malaysia comprises the Malaya peninsula and the northwest part of Borneo (Sabah and Sarawak). Brunei Darussalam occupies a small area on the island of Borneo. The agro-climatic

conditions in the three countries are humid and subhumid vegetation with dense tropical forests and lowlands, particularly on the Indonesian islands of Java, Sulawesi, Bali, and parts of Sumatra. There are, however, hilly areas with variable altitudes with conditions that range from humid to temperate. There are four major farming systems in Indonesia and Malaysia: lowland rice, tree crop mixed, upland intensive mixed, and sparse forest (Dixon and Gulliver 2001). The sparse forest system is of limited importance for agricultural production, although it covers large parts of the Indonesian islands, except Java and Irian Jaya, and Malaysia with small and scattered settlements that depend on upland rice, root crops, ruminants, and wild plants and animals.

1. Lowland rice farming system: This farming system is widespread in the humid and moist subhumid agroclimatic zones, particularly in well-watered flat landscapes on the island of Java and some parts of Sumatra in Indonesia and the Malaya peninsula. It is dominated by rice grown two to three times in the year and supplemented by a variety of other crops with high cropping intensities, depending on the availability of irrigation water, distribution of rainfall and the growing season. Rice is grown on puddled lowland soils that are generally heavy and very fertile. But soil fertility has been in decline because of excessive cropping and poor nutrient balance used in fertilisers. The high-yielding varieties of rice are grown widely and respond well to the high levels of organic and inorganic fertilisers. Livestock are well integrated into the system for draught power, milk, meat, and as risk reduction assets. The average farm is very small due to high population density and limited cultivated area, but the land rights are relatively secure to both owners and tenants. The system provides adequate food security to farm households who are also able to sell surplus of vegetables and livestock products.

2. Tree-crop mixed farming system: This farming system is found in similar agroclimatic conditions as the rice farming system, but the landscape is not necessarily flat and the soils are not as fertile. It is quite extensive on the islands of Sumatra and Kalimantan (part of Borneo) in Indonesia and large parts of Malaysia, including the peninsula, Sabah and Sarawak. Tree crops, like rubber, oil palm, coconut, and coffee, are quite widely grown on both small landholdings and large-size plantations. Small landholders grow rice and other food crops with a variety of livestock. Tree crops have received particular attention of governments and the private sector, especially in Malaysia, since they are major providers of income and employment and support many agro-processing industries. A majority of small landholders practice intercropping and have been diversifying their cropping system in recent decades. Governments have tried cooperatives for the smallholders involved in tree crop production, but they have not performed well.

3. Upland intensive mixed farming system: This system is widespread in the upland and hilly areas throughout the islands of Indonesia and central parts of the Malaya peninsula. Most agricultural production, that includes all major grains—rice is the staple in the lower slopes and wheat is more common on the higher slopes—is under rainfed conditions, but terraced irrigation from the local streams and rivers is also used quite widely. As with the other farming systems in both Malaysia and Indonesia, livestock is an important part of the average farm household. Some forested areas are scattered throughout the system, but they have been depleted because of unsustainable logging practices. Soils are particularly prone to erosion and their inherent fertility is not high. Extensive cultivation on the slopes and high population density with inadequate management of land and water have made the system vulnerable to crop failures due to natural disasters. The

state of food security is quite variable in this system because of the depletion of the natural resources base, poor management practices, and relatively poor rural infrastructure.

CHAPTER SIX

PROXIMATE FACTORS AND CONSTRAINTS IN GRAIN PRODUCTION

1. Overview

Several proximate factors and constraints affecting the state of grain production and productivity in each region and its farming systems can be identified. Their roles tend to differ depending upon the circumstances and environment in the region or its farming systems and between countries in each region. The proximate factors are grouped into four categories. A general description of each is given to provide a framework for the regional analysis.

1. Resources and inputs
2. Technology
3. Post-harvest conditions (storage, transport and markets)
4. Infrastructure, support services, and policies

1. Resources and inputs: In a given agroclimatic environment, land and water are the key scarce resources to sustain farming systems. They are interdependent in terms of their effects on crop and livestock production. The separate and joint effects of land and water can be explained by examining their quantitative and qualitative aspects in a dynamic context. The common issues to both land and water are their conservation and efficient management for crop and livestock production. With regard to land, the main issues of concern include its availability for agriculture, intensity and efficiency of its use, its quality including the soil structure and fertility, the rights of ownership and usufruct, and investment in its conservation and development. With regard to water, the main issues are its availability on a stable basis, efficiency in its use, farmers' rights to water, and investment in its conservation and development.[27] In addition to these resources and their own labour, farmers use a number of inputs, including seed, fertilisers, implements, and pesticides. For most small farmers, the ability to use these inputs hinges on their access to credit since they are perennially short of cash. In fact, the lack of access to adequate credit is often the most severe constraint on their ability to take advantage of technology and markets.

2. Technology: It includes a variety of activities and inputs that enhance the productivity of all resources. The important ones for grain production include the quality of seed in combination with other farm inputs to optimise production, cultivation practices like land levelling, tillage, irrigation, fertilisation, weeding, pest control, harvesting, and post-harvest management of the produce. In addition, there are issues of production, transfer, adoption, and diffusion of new technologies that enhance productivity, save scarce resources, and are profitable. The role of the public and private sectors is crucial in all of these aspects.

[27] See FAO (2003b) for a brief review of the issues related to the availability and productivity of water for agriculture.

3. Post-harvest conditions: The post-harvest conditions, including storage, transport, and markets, make a big difference between the levels of production and marketed surplus available for consumption because of the potential for losses and the level of profits that the farmers can make. They create signals to farmers to reallocate their resources between enterprises or crops. In many countries, post-harvest losses can account for 25-30 per cent of the grain output. Generally, small landholders experience far more severe constraints than other producers of marketable surplus do, resulting in loss of income from sales. There is copious evidence from many countries that the public sector can make a big difference by investing in the infrastructure, providing support services and prudently regulating (not controlling) the markets.

4. Infrastructure, support services and policies: These factors play a very important role in the plans and decisions of farmers and they are controlled or strongly influenced mainly by the various agencies of the public sector in all countries. The infrastructure and support services are public goods—the important ones are roads and communication network, irrigation, education and health, and agricultural research and extension services—with significant (positive) externalities. Several government policies—the important ones are spending and taxes, regulation of property rights, prices of outputs and inputs, interest rate, exchange rate, foreign trade, and quality standards for outputs, seeds, fertilisers, pesticides, and machinery, and subsidies—affect the production and trade of grains and other agricultural products. In many countries, the growth of agriculture and grain production has been impeded by low level of investment in public goods and wrong-headed (excessively) intrusive government policies. The international environment and institutions also affect the agriculture sector and farming communities. The most important aspects in this regard are trade (market structure and prices), investment, aid, and transfer of technology.

2. Sub-Saharan Africa

Only three of the 21 IDB member countries in Sub-Saharan Africa are not included in the list of LDMCs. Also, while most of the countries are more dependent on agriculture than countries elsewhere, they are net importers of cereals and the net imports increased from 4.86 million MT in 1990/91 to 6.72 million MT in 2000/01—most of the increase was in Central and West African countries. Their yield level of cereals is just over three-quarters MT per hectare or about one-quarter of the averages for countries in West Asia and North Africa and South Asia. Many countries in Sub-Saharan Africa have significant potential for expansion of arable land and raising the yield levels of grains, rice and wheat in particular. A critical review of the literature on the conditions of agriculture and grain production in these regions, as indeed in many countries of Sub-Saharan Africa, reveals several important factors and constraints that may explain the low productivity of grains and food insecurity in many member countries, especially the 18 LDMCs.[28]

[28] The crisis of agriculture in Sub-Saharan Africa has drawn wide attention since the early 1980s. National governments and international agencies, particularly the World Bank and FAO, have published several studies that try to address the key issues in the context of persistent and high levels of rural poverty and food insecurity in a majority of the countries. The most recent examples of these studies are Dixon and Gulliver (2001) and FAO (2002d).

1. Resources and inputs: In several IDB member countries of Sub-Saharan Africa, there is plenty of arable land, except in Somalia, Sierra Leone, Gambia, and Mauritania. However, in these countries there are three basic problems with land. First, the soil structures are fragile they have relatively low fertility. Second, the rate of land degradation has been rising rapidly. Third, the land tenure system is in a state of flux, characterised by ill-defined property rights on land and layers of tenancies with little protection. In some countries, this problem is exacerbated by the small size of farm of a majority of landholders that produce grains.

It has been reported that the extent of land degradation in Central and West Africa—especially in the arid and subhumid zones—caused by extensive agriculture, deforestation and overgrazing, has reached alarming levels. About one-half of the farmland suffers from soil erosion and up to 80 per cent of range lands are degraded in some ways due to use beyond carrying capacity (IFAD 2002).[29] In many countries, the widespread incidence of soil degradation is caused by overgrazing, deforestation, shifting cultivation, mismanagement of soil and water resources, insecure land tenure, population pressure, and poverty. In addition, soils in many countries are inherently low in fertility and receive little replenishment of nutrients. Soil erosion due to wind and water combined with loss of organic matter, degradation of soil structure, toxicity due to acidity and pollution are the major causes of loss of soil fertility. While the nutrient depletion rate in these soils is high compared to other regions, the average fertiliser use is only 10 kg (nutrients) per arable hectare.

The productivity of agricultural land is also seriously impaired if the rights of ownership and access to land are not well defined and secure. In several IDB member countries, as in other countries of Sub-Saharan Africa, the rights on land were historically based on tribal membership and lineage, regulated by customary laws. In some of these countries, however, the powerful tribal elite developed private property rights to some of the land, especially in parts of Senegal, Mali, and Niger. The tribal or communal ownership system was reasonably adequate (efficient) as long as there was little population pressure, land was plentiful and the structure tribal society was stable. All of these conditions started to change with the introduction of colonial administration and due to the demographic changes. In the last fifty years, the land tenure regimes in many countries have been in a state of flux and confusion.[30] Private property rights are now well established only in Cote d'Ivoire. In other countries, e.g. Chad, Mali, Sierra Leone, Uganda, Senegal, Cameroon, Sudan, and Togo, the individual ownership right coexists with the customary (communal) rights and state ownership of land. In Mauritania and Mozambique, the ownership title is vested in the state with occupancy and use rights given to individuals, although Mozambique has been moving towards a communal ownership based on customary norms

[29] See FAO (2001a and 2001b) for a detailed analysis of the problems of land degradation and loss of fertility in Sub-Saharan Africa, including their socio-economic consequences, and some holistic solutions. Large-scale and relatively rapid desertification, especially in the Sahel countries, is a major loss of the natural resource base for people and their livestock. There are integrated soil fertility management (ISFM) programmes under way in some countries (e.g. Guinea, Niger, Mali, and Togo), in which farmers play the key role. See, for example, the *Low External Input and Sustainable Agriculture* (LEISA) Magazine, Vol. 18, No.3, October 2002.

[30] See Platteau (1992) for a critical analysis of the land tenure systems in Sub-Saharan Africa and the implications of attempts to introduce land reform—which means individualisation of land tenure—for agriculture and rural development.

and practices since the mid-1990s.[31] In most countries, there is rapid increase in the individualisation of the tenure, with or without formal titles, with considerable state of uncertainty in both ownership and tenancy rights. In addition, the problem of availability of land has become more acute together with subdivision of land into smaller units. The present state of land tenure also contributes to the socio-political tensions and conflicts that the governments are generally unable to pacify.

Rains are the predominant source of water to crops and livestock in almost all IDB member countries: in only four countries—Sudan, Somalia, Guinea, and Mauritania—10 to 20 per cent of the arable area is irrigated by large and small scale irrigation systems. The variability of rains, particularly in the Sahel countries, is a major cause of soil degradation and instability in crop and livestock production. Water productivity levels are low due to lack of water harvesting in the countries that experience variable natural precipitation. The large-scale irrigation systems, concentrated in Sudan, Mali, Senegal, and Mauritania, have been plagued by centralised control, high cost of operations and maintenance, and lack of investment for rehabilitation (e.g. in Sudan). In addition there are very high losses of water both in the system and at the farm level. The high cost of irrigation water and its poor management impair the capacity of farmers to use the high-yielding varieties (HYVs) and apply optimum quantities of fertiliser. There are, however, small-scale irrigation schemes, especially in West Africa, in which the direct involvement of farmers improves water management and reduces the cost of operation and maintenance.

While the problems of degraded land and mismanagement of water act as major constraints on production and productivity of grains, they are made more serious by the fact that the use of good seed, chemical fertilisers, and machinery is very limited as well. This applies particularly to small landholders that produce grains mainly to maintain household food security. There are numerous problems with the quality of grain seed, including the low-yielding varieties, untreated and mixed seed thrown into the soil in excessive quantity. The high-yielding varieties, especially of rice, are still limited to the irrigated areas. Since the seed market—from seed multiplication to sales—is not well developed and regulated there is little quality control. In fact, in the case of sorghum, especially in the arid and subhumid zones, farmers face shortage of seed because of poor harvest in the preceding season.[32] As stated earlier, the average fertiliser use in the member countries in Sub-Saharan Africa is incomparably lower than the averages in all parts of Asia and North Africa: about 6 kg per hectare compared to 100 to 150 kg per hectare. The use of fertiliser on grains is even lower and has been declining in the last decade with economic restructuring, reduction in subsidies and withdrawal of the public sector from the distribution system.[33]

The dominant source of farm power in the IDB member countries is human labour—as in Mauritania, Mali, Niger, Togo, Sierra Leone, Zambia, Somalia, and Mozambique—combined with draft animals (donkeys and oxen) in the rest of West and Central African countries. Sudan is the only country in which there is significant use of

[31] As cited by Dixon and Gulliver (2001), a community-based land tenure system is being gradually expanded in Mozambique that grants rights to the community for distribution of land to its members and provide access with legal contracts to outsiders as individual and corporate investors.

[32] An IFAD-supported project for sorghum seed production and distribution in Mali has demonstrated that farmers' involvement in local seed enterprises can alleviate the problem of seed quality.

[33] See Byerlee, Heisey and Pingali (2000).

tractors.[34] A vast majority of farmers use the hoe and other traditional tools with oxen or donkeys for land preparation compared to the widespread use of tractor driven ploughs in the member countries throughout Asia and North Africa. Grain production in Sub-Saharan Africa is a very labour intensive activity dependent on manual labour, especially of women.[35]

The role of finance capital in facilitating the use of farm inputs and taking new risks is well known. Credit can act as the bridge from subsistence to commercial farming. A vast majority of farmers in Sub-Saharan Africa generally meet their credit needs for consumption and agriculture from the local informal credit system, including friends and family. It is both inadequate and costly. The formal institutions, like the agricultural development banks, in many countries have attempted to provide subsidised credit, but it has been misused and channelled towards large farmers and used for packages of technology that are not adapted to the local farming systems. Their operations have been expensive and inefficient as well. The private commercial banks have been involved mainly in commercial crops grown on a large scale since they consider small farmers both risky and high cost, especially in areas with low population density.

2. Technology: The low-yielding varieties of cereals commonly used by most farmers in IDB member countries is a reflection of the failure of public and private sectors to transfer profitable packages that the farmers can adopt and afford. No country has experienced the Green Revolution mainly because of the weak agricultural research and extension services, low investment in rural infrastructure, and perverse policies on trade and prices. There is evidence that modern varieties cover only 55 per cent of the area planted in wheat compared with the average of 82 per cent for developing countries. Similarly in rice—a grain for which the demand in West and Central Africa has been rising rapidly—the proportion of area given to new varieties is around 30 per cent compared to the average of nearly 80 per cent for developing countries. The reported varietal improvements in hybrid sorghum have had almost no effect on the average yield level in any of the member countries.[36]

The conventional tillage method of soil inversion by the hoe and plough common to every part of Sub-Saharan Africa substantially reduce organic matter, creates soil compaction, induces rainwater runoff, and increases greenhouse gases. It exacerbates the conditions of land degradation due to other causes, hence contributes to low productivity. Since grains, especially sorghum, are cultivated more on marginal lands, the conventional tillage damages the soils even more seriously. In several developing countries, especially in Latin America and South Asia, the alternative methods of no-till farming (conservation agriculture) have shown that small farmers can adopt these practices and integrate into their

[34] See FAO (2002d).

[35] See IFAD (1998) for a detailed study of the tools and implements used by women labour in Burkina Faso, Senegal, and Uganda.

[36] The average yield level of sorghum declined in most countries, especially in the largest producer (Sudan) declined in the two decades from 1979/80. Several international agencies that collaborate in research with the National Agricultural Research Systems (NARS) in IDB member countries have documented the problems and constraints in the introduction and diffusion of new varieties of grains. Since rice is emerging as the most important grain among the three, especially in West and Central Africa and Mozambique, it has been studied more extensively than others. See, for example, two detailed studies reported in the proceedings of the Expert Consultation in September 2000 (FAO 2001c) and a survey of rice production in Sub-Saharan Africa, including the IDB member countries, (Maclean *et al*. 2002). Also see *FAO Rice Information*, Vol. 3, December 2002.

farming system.[37] In addition, a vast majority of farmers, especially in the subhumid and arid zones have serious problems of weeds—*Striga* in particular—and insects that they are unable to control because of lack of knowledge and resources to use chemicals and adopt the Integrated Pest Management (IPM) practices.

3. Post-harvest conditions: As stated earlier, there is little marketable surplus of grains with most small farmers. In only some of the countries and on large-scale farms, in rice and wheat, a substantial part of the output is brought to the market. The three important post-harvest constraints are inadequate storage, poor transport, and unregulated markets that directly affect grain production and its profitability for most farmers. Of these the most serious one is the bad state of roads. People have to travel long distances on poor roads and tracks. In several countries, walking is the major means of transport. This raises the cost of transport and reduces access to markets for both inputs and outputs. A vast majority of the small farmers make individual arrangements for grain storage to assure food supply for the household. However, for decades, pervasive involvement of governments in large-scale grain storage through the grain marketing boards was a very expensive and inefficient system. In almost all IDB member countries, governments effectively controlled all major markets with little influence of the limited private exchanges.

This situation has changed significantly since the early 1990s when almost all countries started to undertake wide-ranging structural adjustment and economic reform programmes. Small farmers no longer have an assured market for their produce at fixed prices that concealed a large tax on the value of the marketed surplus. Similarly, they no longer have predictable supply of inputs at subsidised prices. There is increased uncertainty in the marketplace as the role of the public sector has receded in terms of the prices of output and inputs. New commercial relations have started to emerge with the multiplicity of suppliers and buyers. For small farmers in particular, the consequences have not been altogether positive since they have experienced significant increases in the prices of inputs and are unable to negotiate reasonable prices for their produce. By and large, these farmers are ill equipped to benefit from the new market structures and relations. There is evidence that the price variability for grains and increased prices of inputs may have forced farmers in some of the West African countries to move from grains to root crops (Byerlee *et al*. 2000).

4. Infrastructure, support services and policies: Generally governments in these countries have underinvested in public goods and intervened excessively in the distribution system for inputs and products. The most affected public goods by the low level of investment—which fell in several countries as part of the structural adjustment programmes in the 1990s—are rural roads, schools, hospitals, and support services like agricultural research and extension. In some countries, the irrigation infrastructure, on which a large part of agricultural investment was made until the late 1970s, has suffered from lack of resources for its operation and maintenance and rehabilitation (e.g. Sudan and Mali). The problem, however, is not that the investment level in public goods has been low but also it has not delivered good quality of service (FAO 2002e). As in other parts of the world, there is evidence that investment in agricultural research and extension services in these countries has a high payoff. However, the research infrastructure and services have faced several problems. The investment level is low and has fallen over time; available resources

[37] See Pieri *et al*. (2002) for a discussion of the general issues and Ekboir (2001) for a detailed analysis of the experience of no-till methods for wheat on small farms in several developing countries, including Ghana in West Africa. Cote d'Ivoire is the only country where the new methods are now being tried on rice.

are spread too thinly over too many activities; existing regional and sub-regional research programmes are not fully used; linkages between the research system, extension services and farmers are weak; and the system depends too heavily on donor funds, hence unsustainable.

With regard to policies, governments in most countries have been slow in strengthening the institutional capacity to establish secure property rights on land and far too active in intervening in the production and distribution networks for most agricultural inputs and products.[38] There is good evidence in these countries that the so-called price support to farmers was a means to transfer resources from farmers to urban consumers; input subsidies to compensate for the revenue loss were not received by majority of small farmers. In addition, the regulatory framework and the government's near monopoly in the production and import of seeds, fertilisers, pesticides, and machinery, and in the financial markets created few incentives to improve the quality and access to these inputs. The receding role of the state in the agricultural economy since the adoption of structural adjustment programmes in almost all of the member countries has not been altogether beneficent to the small producers of grains. However, it seems to have created new and profitable opportunities for large farmers, producers of cash crops for both domestic and foreign markets, and large traders of inputs and products. The concern about the expanding role of the private sector and increased integration into the world economy has several aspects of direct relevance to the state of grain production, productivity and the wellbeing of small farmers.[39]

3. West Asia and North Africa

The countries in West Asia and North Africa—of which Palestine and Yemen are among the LDMCs—are, with the major exception of Turkey, net importers of cereals and their net imports rose from 36.18 million MT in 1990/91 to 55.40 million MT in 2000/01. The major net importers are Iran, Algeria, Saudi Arabia, and Morocco. The yield levels of cereals, though significantly higher than the average in Sub-Saharan African countries, are just about equal to the average for Central Asia, and lower than countries in South Asia and South East Asia. Egypt is the exception among the IDB member countries in that it has the highest yield levels of grains, wheat and rice in particular, and they increased significantly during the 1990s. While the countries in West Asia and North Africa have a common history and similar culture, they are characterised by great inter- and intra-country diversity of conditions for agricultural production and performance of the agriculture sector due to the differences in agroclimatic conditions, water availability, infrastructure, institutions, investment, and policies. However, in most countries, the most important factors and constraints directly relevant to the state of grain production and productivity are quite similar.

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[38] Generally the relatively poor economic performance of some countries has been due to prolonged civil strife, war, misrule, and misguided experiments in centralised control of the economy by the one-party state.

[39] These issues are not specific to the IDB member countries in Sub-Saharan Africa, although the impact of some of these changes seems to be far more serious on small farmers and low-income urban consumers in these countries. See, for example, FAO (2002a). In specific terms, at least in West Africa, there is strong preference for rice imported from Asia because of its lower price compared to the more costly domestic rice (Maclean *et al*. 2002).

1. Resources and inputs: The land base for agriculture is quite limited in per capita terms in most of the countries. The exceptions are perhaps Iran, Turkey, Libya, and Syria. The narrow land base will shrink further with the growth of population and non-agricultural use of land. In some countries, marginal lands have been brought under cultivation exposing them to further degradation. In addition, the high concentration of land ownership, falling access to land for the small owners and tenants, and subdivision of holdings has serious effect on rural poverty and household food security. The region has even more serious problem of water scarcity and the effects of its waste for cereal production in both the irrigated and rainfed areas.[40]

The land question for cereal production in the region has two important aspects. The first aspect is the quality of land. The second one is the access to land. With regard to land quality, it should be noted that a high proportion of land is not of good quality, especially in the sparse arid areas and in the deserts. Also, land degradation has become a serious menace to productivity due to erosion in the rainfed areas and overgrazing in the highland and dryland areas in several countries.[41] In the irrigated areas, especially in the large-scale irrigated plains, salinity and sodicity have been the major contributors to soil degradation. With regard to the issue of access to land, in some countries land concentration is high and the tenure reforms have not improved the access to land for small landholders, tenants and small owners (IFAD 2001; World Bank 2003b). In addition, subdivision of land has added to the problem of unsustainable size of holdings for small farmers. The experience of the state-owned (or state-controlled) large holdings has also been quite disappointing. In some countries—Egypt is a good example—the experience of small private (graduate) farms developed at a very high cost on the state lands, has also not been altogether successful in generating new income and jobs and almost no impact on productivity.

The region has the lowest overall and per capita quantities of water compared to the other regions of the world. The water scarcity is extreme in countries like Libya, Algeria, Tunisia, Jordan, and all countries in the Arabian peninsula since their renewable water resources (RWR) are below the "poverty threshold"—500 cubic meter per capita per year—of the internal and external RWR (ICARDA 1999; Solh *et al*. 2003). The conditions are more favourable in Egypt, Syria, Iraq, and Turkey because of the external RWR, but they create inter-country tensions because of the disputes about the distribution of water from the trans-boundary rivers and aquifers. In addition, the exploitation rate of water is over 50 per cent in Egypt, Syria, and Tunisia, and much higher in some other countries (e.g. Jordan and Libya). The irrigation systems have very low water-use efficiency rates with losses of up to 60 per cent. The high level of waste is the result of several factors: poor operation and maintenance of the system; high level of subsidy on surface water; and poor irrigation practices at the farm level. The effects of supply-oriented and centrally-managed surface irrigation systems in most countries of the region contribute to the depletion of aquifers, rising water tables, salinity and sodicity, declining organic matter, water pollution,

[40] See, for example, the water study by IWMI (2001).

[41] Droughts and desertification are also very important factors in several countries, especially in North Africa, that degrade the land with long-term consequences for the sustainability of productive agriculture and cereal production for food (Solh *et al*. 2003). It should be added that the weather conditions in the region were particularly variable during the 1990s, resulting in sharp fluctuations in the annual production of cereals. In countries like Egypt, Algeria, Tunisia, Morocco, Turkey, and Syria, governments pursued aggressive policies to expand the irrigated area and reduce dependence on the highly variable rainfed agriculture.

and low crop yields. The excessive exploitation of groundwater, encouraged by governments in several countries, is exacerbating the problem of water scarcity.

In the irrigated and cash-oriented areas of the region—plains and coastal areas of the Mediterranean—most farmers have access to well developed markets for farm inputs for all crops. The most developed seed market system is in Turkey, followed by Egypt and a few smaller countries. However, small farmers, growing cereals in the highland and dryland areas, depend on local markets where the quality of seed is not assured. A vast majority of farmers, except those in Yemen and in the marginal lands of North Africa, Iran and Turkey, use high levels of chemical fertilisers; tractors are used quite widely on all types of farms. In fact, the average level of fertiliser used per hectare of arable land in this region far exceeds the average in other regions. The markets for fertilisers, pesticides and tractors are reasonably well developed in a majority of the countries. However, there are serious problems of quality control and the intensive (indiscriminate) use of chemicals that degrade soils and pollute the water supply systems. In the large-scale irrigated areas, the effects of residues from fertilisers and pesticides have become a source of major concern in Egypt, Turkey, Jordan, Iraq, and Morocco.

One of the facilitators for the generally high levels of inputs used on crops in the region has been the state-supported credit system providing credit at subsidised rate and often tied to the delivery of inputs and products. This has worked well in the irrigated and cash-oriented areas for all types of crops, including cereals, and other farm enterprises. However, the state credit system has been expensive to the society in terms of its unsustainable burden on the government budgets. In the 1990s, as part of the structural adjustment and economic reform programmes adopted by governments, the state support to farm credit was reduced significantly. The private sector has not expanded its credit activities, except where the commercial banking density is high and the cost of administration low. This has forced small farmers, especially those who produce cereals, to fall back on the informal credit sources.

2. Technology: Wheat is the dominant cereal in the region, grown in almost all the major farming systems. Rice is cultivated on a significant scale only in Egypt (Nile delta), followed by some areas in Iran and Turkey. Egypt is an exception in the region in that its average yield levels of wheat and rice are among the highest in the world with over 6 MT of wheat per hectare and 9 MT of paddy rice per hectare. Also, the yield level of rice in Egypt increased significantly during the 1990s. About two-thirds of the wheat area—close to 90 per cent in North Africa and 60 per cent in West Asia—is planted with high-yielding (semi-dwarf) varieties developed in collaboration with CIMMYT. They are more dominant in the irrigated areas and on larger farms. For rice, almost all of the area in Egypt is covered by the IRRI-based varieties of rice, but in Iran and Turkey indigenous and aromatic rice varieties tend to dominate.

The cultivation practices vary a great deal in the region. In the more developed and irrigated areas, farmers use the modern crop management practices, including low-tillage, land levelling, controlled irrigation, and pest and weed control. The problem, however, is that most farmers depend heavily on the use of chemical fertilisers and chemicals to control pests and weeds rather than adopt methods that reduce dependence on fertilisers and shift to the IPM practices. The high cropping intensity observed in the irrigated areas and on the Mediterranean coast in some of the countries adds pressure on land and water without the shift to new practices. The excessive dependence on and waste of surface and groundwater, while it allows crop intensification and diversification, has

become unsustainable in many countries. In the rainfed areas where a high proportion of farmers cultivates wheat, they are greatly handicapped by the shortage of high-yielding drought-resistant varieties. Their cultivation practices depend heavily on high level of tillage—which damages the soil structure—and high doses of fertiliser and chemicals to control pests. Some of it is due to the failure of the research-extension system to demonstrate the advantages of modern practices within the constraints of farm resources. In addition, the price and regulatory policies of governments have provided little or no incentive to conserve scarce resources and reduce dependence on chemicals for high levels of production and productivity.

3. Post-harvest conditions: There are great disparities in the post-harvest conditions within each country between the irrigated and rainfed areas and within each area between the large-scale and small-scale producers of cereals. The harvesting practices rely heavily on human labour—that includes family, exchange and wage labour—and conventional implements on small farms even in the irrigated areas. Large size farms, both in the private and state sectors, however, use harvesters and threshers, especially in the irrigated areas. The storage facilities are likewise more *ad hoc* and limited for cereals with a vast majority of small producers; they rely on local merchants and the state for storage. The losses due to poor storage and transport to the market are substantial. However, the large-scale storage facilities in the state sector also incur losses of 20-30 per cent due to poor maintenance, pests, and leakage. Private large-scale storage facilities are being encouraged in several countries.

The rural transport network in some countries is of reasonably good quality, as in Egypt, Turkey, Lebanon, and Iraq, except in the more remote desert and hilly areas. There is reasonably adequate integration of local and regional markets as well. In almost all countries, until the early 1990s, most of the cereal trade, including storage, transport and marketing, was done by the state agencies as part of an elaborate and generally subsidised system of procurement, processing, and supply of grains (and flour) to the urban consumers. This system left little or no room for private initiative or enterprise and was demonstrably quite expensive in financial and economic terms. However, the receding role of the state in cereal production and trade has not been altogether favourable to the small producers as the private sector is unable to make profit by engaging in high-risk activities of storage and marketing. In some countries, cooperative management of marketing on a limited scale seems to work quite well. But there are more reported failures than successes of cooperatives, especially if they are rigidly managed or controlled by the state functionaries.

4. Infrastructure, support services and policies: The most important economic and social infrastructure, that affects agricultural production and productivity, includes the network of irrigation, rural roads and communications, electricity, and rural schools and hospitals. The large surface irrigation systems have a poor record of sustainability, hence governments are making attempts to decentralise the administration, increase the participation of water users, and expand the role of private sector. However, the legal and institutional constraints have hampered the process, and there are unresolved financial issues related to the responsibility of water users for organisation, management and cost recovery. It is important that water users regard irrigation water as a private and not public good. Also, investments and incentives are required to promote better on-farm water management through Water User Associations (WUAs).

Several countries in the region have lower density of roads, electricity, schools, and hospitals in their rural areas compared to other countries with similar levels of income per capita. In the last decade, governments have started to shift their investment priorities in favour of the rural sector—traditionally they had little rural focus—with increasing assistance from donor countries. This applies in particular to the expansion of basic education and health care, especially for women. There are encouraging examples in Egypt, Morocco and Yemen. Inadequate provision of and access to education and health care are a major source of rural poverty and low productivity in a majority of countries.

The agricultural research and extension services have concentrated their resources on raising crop yield per hectare, especially in the irrigated areas, irrespective of the cost of high intensity of land use, water, and associated inputs. There was some success in developing packages of technologies and their transfer to farmers in the highly stressed environments in collaboration with ICARDA (Solh *et al*. 2003). However, the research and extension services, exclusively controlled and managed by the state, have not taken into account of the resource constraints of small farmers, especially in the rainfed and dryland areas. In recent years, governments in several countries, both at the national and regional levels, are experimenting with programmes that depend on farmer participation, including integrated research sites and Farmer Field Schools (FFS). The multidisciplinary and integrated approach is forcing the agricultural research systems to reduce rigid division of disciplines and multiplicity of expensive research institutes. The governments are also moving away from dependence on the conventional army of extension workers with weak links with the research system and farmers, especially small farmers producing cereals in the rainfed highland and dryland farming systems (Solh *et al*. 2003).

In many member countries of the region, governments for too long controlled and managed rigidly the production and distribution systems in agriculture and adopted policies to increase self-sufficiency in food in general and cereals in particular. They tried to fulfil two objectives through a state-managed system of production and distribution. One was to meet the food (cereal) requirements of urban populations at affordable (subsidised) prices. The other was to foster cereal production and productivity by offering subsidies to farmers for key inputs. However, the state involvement in the pricing and procurement of cereals kept the domestic price of grain tightly controlled at levels far below the border price. The subsidy to farmers on inputs involved waste and misallocation of resources and inequity, although the relative stability of output prices insulated the producer from substantial annual and seasonal price variations. In several countries the large food subsidy to consumers drained the government budget, led to rent-seeking, wasted food, and increased the demand for food since the domestic production did not rise *pari passu*.

In the last decade, most governments have moved away, in some with greater success than in others, from the state-managed production and distribution system for food (including cereals). The economic reform programmes, with the financial support of donor agencies, involve gradual liberalisation of trade in inputs and outputs and substantial reduction in subsidies to both producers and consumers. Of course, some of the effects on both small producers and poor urban consumers have not been quite as positive as was claimed or anticipated. Also, it is not clear if they have had a significant impact on cereal production and productivity in the last ten to twelve years.[42] In addition, policies that

[42] A detailed discussion of these issues can be found in several documents. See, for example, Rosegrant, Paisner, and Meijer (2001).

encourage overgrazing of the rangeland areas and extension of crop production to the fragile (marginal) rainfed lands, guided by the desire to improve food security, will deplete the natural resource base in the long run. In some countries, the government's inability to address the problems of high land concentration and insecure tenancy rights also seriously impedes agricultural growth and reduction in rural poverty (IFAD 2001; World Bank 2003b).

4. Central Asia

The four IDB member countries in Central Asia have a common history and culture. They have a population of 31 million, of which nearly one-half is in Kazakhstan which is also in size the largest country in the region. A high proportion of the population of these countries lives in rural areas, ranging from 55 per cent in Turkmenistan to 92 per cent in the Kyrgyz Republic. Kazakhstan produces more than 80 per cent of the region's wheat and is a large net exporter. The other three countries are net importers of grains. The landscape of Central Asia is dominated by vast desert plains devoid of surface runoff, piedmont plains and oases of irrigated soils (Turkmenistan and Kazakhstan) and high mountain ranges in the southern and eastern parts (Tajikistan and Kyrgyz Republic).

Like Albania and Azerbaijan, the Central Asian countries started to make their economic and political transition from communism in the early 1990s. The transition in Central Asia has been both slow and painful: the economies have contracted and most people have experienced significant loss in income and increased poverty.[43] The agriculture sector, which is still quite important in three of the four IDB member countries, is undergoing radical transformation in institutions and policies, which has dented the levels of production and productivity and lowered the standard of living of rural people.

The centrally planned economies of Central Asia were integrated into the larger economy of the former Soviet Union for over 60 years. The agriculture sector was required, under the Soviet plans, to deliver increased supply of food (cereals), cotton and wool to the economies outside Central Asia. The rural physical and social infrastructure—of irrigation, transport, and education—and support services were developed to meet these basic objectives. Kazakhstan was the third largest producer of wheat, after Russia and Ukraine; all of the cotton was produced in Turkmenistan, Uzbekistan and Kazakhstan; Tajikistan and the Kyrgyz Republic exported large quantities of wool.

The production and distribution system of the economies, including the agriculture sector, were completely controlled by the state agencies. Large-scale collective and state farms—peasants were allowed small plots of agricultural land for private use—were given plans to produce certain level of output and they were assigned inputs to meet the seasonal and annual output targets. The emphasis was on the level of output to be delivered to the state system and not on the unit cost of output in terms of the used inputs, including land, water, fertilisers, pesticides, and machinery. The support services of agricultural research and extension were integrated into the specific and regional production systems and tailored to the needs of collective and state farms. The state also controlled the distribution of raw material and food crop output to the processing industries and consumers. Planners established prices of inputs and products without necessarily taking into account the conditions of supply and demand, resulting in endemic shortages and waste. The growth of the economy in general, and the agriculture sector in particular since it was the most

[43] Several studies of the transition economies in Central Asia are available. See, for example, Pomfret (1995), Csaki and Tuck (2000), and Spoor (2003).

important sector of the Central Asian economies, depended largely on extending the area of cultivation and high intensity of water, fertilisers, pesticides, and machinery. By the mid-1980s it was obvious that the economic system was unsustainable because of its excessive demand on resources with its negative impact on the natural resource base and the environment. This context is necessary to assess the effects of the transition on the state of agriculture, including cereal production and productivity, since the early 1990s.

1. Resources and inputs: With regard to the land base, two issues are of direct relevance to the production of grains and livestock. The first is about the quality of land and its deterioration. Land quality has deteriorated in large areas because of a highly intensive and mismanaged irrigation system in Turkmenistan and south Kazakhstan used for cotton, wheat and rice. The pasture lands, especially in the arid areas of northern Kazakhstan, that were brought into cereal production with emphasis on expanded area and intensive use of inputs, have suffered from degradation and their productive capacity has been greatly impaired. In recent years, the area given to cereals has been falling and more of it is being used for livestock. In the high-mountain and valley pastures of Tajikistan and the Kyrgyz Republic, large-scale overgrazing and mismanagement of pastures for decades have degraded the land and reduced vegetation. The shift from sheep to cattle in some of the areas has not arrested the menace. The loss of productive capacity of these lands combined with reduced use of fertilisers has affected the yield levels of grains quite significantly.

The second issue is about changes in the rights to land ownership and cultivation. Reform of the land tenure system—in which only the state had the right to own and use land—continues to be the subject of heated debates in all countries, but little progress has been made in Central Asia (Spoor 2003). Unlike Albania in Southern Europe, where all state lands have been transferred to private ownership, only one-quarter of the farm land in Kyrgyz Republic, one-fifth in Kazakhstan and very little in Tajikistan and Turkmenistan, has been transferred to the individual, cooperative or corporate ownership. The governments have, however, granted the right to the private sector to hold land in lease from the state. Large size farms, managed by the state and corporate entities, still dominate the landscape in Central Asia. A dualistic structure has clearly emerged in terms of farm sizes and ownership throughout the region. Given the receding role of the state in providing subsidised inputs and support services, the emerging bimodal structure has serious implications for productivity and equity. The legal and institutional restrictions on land transfer and valuation inhibit the development of an efficient land market and maintain a state of uncertainty for long term investment.

As stated earlier, the misuse of water and mismanagement of the irrigation system in Central Asia has created conditions that are not only impairing the capacity of soils to increase productivity but also damages the environment and human health on a large scale. Radical changes are under way in terms of cropping intensity, cropping pattern, productivity, and human and livestock habitation in large parts of Uzbekistan, Turkmenistan and some parts of Kazakhstan. The investment and institutional requirements for arresting the damage are beyond the means of these countries; several international agencies are now providing financial and technical assistance to improve the resource base for the region's agriculture.

The agriculture sector in all Central Asian countries depended heavily on subsidised inputs supplied by the state until the early 1990s. The collapse of the centrally-planned economy and its agricultural system, and the reforms undertaken, have had several important consequences for the use of inputs like seed, machinery, fertilisers, and

pesticides. Governments have drastically reduced investment in agriculture in favour of the energy and other extractive sectors. As part of the market and trade liberalisation policies, prices of farm inputs were allowed to rise sharply, reducing the demand for fertilisers, machinery and pesticides. On the large state-managed farms, agricultural machinery and tools have suffered serious disrepair or illegally privatised. Shortages of inputs and their high prices have increased the cost of production. The withdrawal of the state financing system for the farm sector has not been replaced by viable private or public rural financial (credit) institutions. This has further constrained the agriculture sector from using productivity-enhancing inputs and technology. In some areas, the migration of labour has also become a serious constraint on agricultural production because of the opportunities for off-farm employment or migration to the cities. This is particularly evident in the areas with marginal lands or little prospect for economic growth.

2. Technology: In the centrally-planned economic system, given the importance of supply of food and raw material from agriculture, the state industrial enterprises were given resources to supply farm inputs and give technical support to the collective and state farms to meet their targets. The yield levels of wheat were maintained at reasonably high levels, even in the marginally favourable areas, by costly technology packages of seeds and complementary inputs. The farming system for cereals and cotton was controlled on a large scale by mechanised methods of cultivation, including land preparation, fertiliser application, pest control, weeding, and harvesting. Similarly, the post-harvest management of the crop, from storage to distribution and processing, was controlled by one or more centralised state agency. In these activities, the mechanised methods, no matter what their cost, were quite dominant. Since the early 1990s, with the economic reform programme, private sector agencies or decentralised state (corporate) agencies have not been able to fill the gap left by the dismantling of the state controlled system. A general state of technological stagnation seems to have dominated the transition so far in the major cereal production areas of the Central Asian Republics.

3. Infrastructure, support services and policies: The rural physical infrastructure, transport and electricity in particular, was comparatively well developed because of the requirements of the Soviet economy for food and raw material from Central Asia. However, this was not matched by the state of social infrastructure, especially health care and technical education. The irrigation infrastructure claimed the largest share of state investment for over thirty years. It was, however, in a state of decline as the other infrastructure, by the early 1980s. The endemic shortage of resources and waste were the major reasons for the deterioration. Since the beginning of the transition, public sector investment in the rural infrastructure has fallen, raising the cost of transport, water supply, education, health care, and the rest. International donor agencies have provided some assistance to improve the conditions as part of the economic reform packages.

All agricultural support services, especially agricultural education, research and extension, were integrated with the collectives and state farms until the early 1990s. Agricultural specialists and research institutions were reasonably strong and well supported, particularly for wheat and cotton, in Kazakhstan, Turkmenistan and Uzbekistan. They were not as strong in the livestock sector and pasture management in Tajikistan and the Kyrgyz Republic. The centrally managed irrigation service has, however, inflicted a heavy cost on the society and economy through wasted water, salt accumulation, and desertification for at least two decades. Since the early 1990s, most of the support services have declined in numbers and quality because of the reform policies and alternative sources

are both inadequate and costly for the farmers. The reduced level of spending on services for education and health care add to the predicament of the rural sector in almost all countries in Central Asia.

Agriculture was the Achilles' heel in the centrally planned economies of former Soviet Union for nearly 60 years. The rigid state control of every aspect of allocation of resources, production and distribution of output left little incentive for initiative and risk taking. The agriculture sector was forced to transfer annually huge surplus for the state to build the rest of the economy. The rural economies of Central Asia were important in this transfer of resources. One of the major aims of the wide ranging reform programme introduced in the early 1990s was to make the economy responsive to the forces of domestic and foreign markets. However, changes in government policies affecting the agriculture sector have not materialised the gains for most agricultural producers in these countries. In addition, some of the reforms have been far too slow or poorly implemented whereas the state support and investment have fallen and some of the market reforms have raised the cost of production significantly.

5. South Asia

The four countries in South Asia—in which the island country of Maldives has only 300,000 people—account for more than one-quarter of the population of all IDB member countries. Three of them are in the list of LDMCs, i.e. Afghanistan, Bangladesh and Maldives. Nearly two-thirds of the population in Pakistan, three-quarters in Bangladesh and Maldives and more in Afghanistan lives in rural areas. Bangladesh has a high density of population with only 0.06 hectare of arable land per capita, followed by Pakistan (0.15 hectare) and Afghanistan (0.3 hectare). The irrigated area occupies 30 per cent of the land area in Afghanistan, 50 per cent in Bangladesh and nearly 85 per cent in Pakistan. Afghanistan has suffered from civil strife and war for over 20 years—rendering millions of persons displaced and refugees—and occasional droughts of variable severity.

Agriculture is the mainstay of the economies of Afghanistan, Bangladesh and Pakistan, but the fishery dominates the islands of Maldives. The agriculture sector grew robustly in both Bangladesh and Pakistan throughout the 1990s. Bangladesh and Pakistan are large producers of cereals, particularly rice in Bangladesh and wheat in Pakistan. Afghanistan produces mainly wheat. In the three countries, cereal output grew annually at 3.0 per cent in Bangladesh, 2.5 per cent in Pakistan, and fell by about 0.5 per cent in Afghanistan. In these countries, the average yield of cereals rose in the 1990s, significantly in Bangladesh, and was higher than the average of all IDB member countries in the early 2000s. Afghanistan, Bangladesh and Maldives are net importers of cereals, especially rice in Bangladesh, and Pakistan was a net exporter in the year 2000/01.

The relatively impressive rate of growth in the agriculture sector, and substantial increase in the output of grains, in both Pakistan and Bangladesh, has been contributed by a reasonably high growth in TFP. However, as stated earlier, the yield levels of wheat and rice have not reached the full potential—as evident in the large yield gaps—and they have either stagnated or increased more slowly with increasing demand on inputs. It seems that land degradation and loss of soil fertility in the intensively cultivated areas is a major factor in explaining the stagnant or declining grain yields.[44] In addition, there is the dichotomy in

[44] This issue has been extensively explored and analysed in the literature. See, for example, Pingali (1999), Pingali (2001), Pingali and Rosegrant (2001), and FAO (2001c).

the performance of small and large farmers because of the differences in their resource endowments and institutional constraints.

1. Resources and inputs: The land and water resources and the constraints on them are not similar in the two major grain-producing countries. There is relatively plentiful arable land in Pakistan but very limited in Bangladesh. However, soils are generally more fertile and richer in Bangladesh because of the floodplains of its major rivers. The alluvial soil is continuously enriched by heavy silt deposited by the river flooding in the rainy season. The water resources are quite different as well. Pakistan depends almost entirely on a large-scale irrigation system based on the surface and ground water of the Indus and its tributaries. In Bangladesh the flood plains of about 230 rivers and their tributaries and the monsoon rains provide most of the water, although in the northern and eastern parts ground water has also become important for irrigating wheat and rice.

The land base for most of the agricultural production in Pakistan is under a vast irrigation system initiated in the late 19th century and expanded significantly after independence in 1947. Land quality has deteriorated quite significantly in the irrigated plains because of salinity and high water tables in about one-third of the area. Marginal lands, not very suitable for crops (including cereals), have been brought under cultivation because of the expansion of subsidised water supply. The other issue, particularly in Pakistan, is the distribution of land: a high proportion of the land is owned and controlled by a small proportion of owners with insecurity of tenancy for sharecroppers, and land fragmentation of the small landholdings. There is good evidence that the average farm size is increasing, because small farmers are leaving the land, and the sharecropping tenancy is falling since the alternatives are more profitable for the large landowners. To some extent similar problems, especially of tenancy, exist in Bangladesh. Much has been said about the need for land tenure reform in both countries, but little progress has been made.

While the quantity of available land is a major constraint in Bangladesh, water is certainly far more important in Pakistan. In Bangladesh the water problem appears in the form of occasional but severe flooding that destroys crops and seriously damages the human and animal habitat with considerable loss of life as well. Without the supply of surface and groundwater in the Indus basin, Pakistan would be a desert. However, the large irrigation system, developed and operated by the public sector agencies at a very high cost, has created serious problems for land quality and sustainability of agriculture. For one thing, the surface water system is supply-oriented that takes little or no account of changes in the demand for water. In addition, the demand for water has been rising rapidly because of changes in the cropping patterns and intensity in response to the subsidised price of water. In addition to the waste of water in the irrigation system and on farms, the drainage system is woefully inadequate. Large areas of the Indus basin have serious problems of high salt concentration and rising water tables. The dramatic expansion of tubewells to mine the groundwater, with price and non-price incentives, has been of great value to both large and small farmers in the Punjab plains. But it has increased the pressure on aquifers and added to the problem of soil salinity in some areas. In Bangladesh, on the other hand, the rapid development of shallow tubewells, induced by public policy and private initiative, in the 1990s has been a major source of increased fertiliser use, grain production, and farm income. However, there are growing concerns about the environmental and health effects of overexploitation of the groundwater. The water problem in Pakistan is reflected by not only the loss of soil productivity but also increasingly serious disputes between provinces

on the distribution of canal water. The importance of water scarcity was most keenly felt in the recent drought years.

In both Pakistan and Bangladesh, HYVs dominate the harvested area of wheat and rice. For wheat nearly 90 per cent of the area is sown with these varieties. For rice, in Bangladesh, HYVs cover nearly all of the irrigated rice and nearly one-half of the spring and winter rice. In Pakistan, almost all of the rice area in Sindh is covered by HYVs, but the aromatic (*basmati*) rice occupies most of the area in Punjab. The problem in both countries is that the seed market is not well developed; annually only about one-third of the seed requirements are met by the market. A high proportion of the farmers, particularly small farmers, use their own seed or purchase it from local merchants without assurance of its quality. This seed covers 70 to 80 per cent of the sown area of grains. Since HYVs are highly responsive to chemical fertilisers, provided they get stable and adequate supply of water, fertiliser use has increased quite significantly. The average fertiliser dose is slightly higher in Bangladesh than Pakistan. There is, however, evidence that (i) the nutrient content of fertilisers is not balanced and (ii) the use of fertiliser may have levelled off due to unfavourable prices of fertilisers and rice and wheat in recent years. The use of pesticides, to avert significant losses from attacks of insects and pests, is far higher on rice than wheat. The indiscriminate (ill advised) and large-scale use of different pesticides separately or as cocktails has created health and environmental problems, disturbed the host-predator relationship, and induced resistance in insects and pests. The practice of IPM has not taken off on any significant scale in either country.

As in many other developing countries, there is a dualistic rural financial system, in which the informal sources at the village level play a major role—merchants, landowners, and friends—to meet the seasonal and consumption needs of most small producers. The formal commercial institutions are very limited and cater mainly to the investment needs of large farmers and rural entrepreneurs. The state-managed development banks have not been too successful in reaching the small producers and have been a major financial drain on the budget because of the high cost of business. In both Bangladesh and Pakistan, the expansion of several community-based credit programmes, organised by Non-Governmental Organisations (NGOs), have reduced the credit constraint for increasing number of the weak and poor farmers and rural entrepreneurs.

2. Technology: Most farmers in Pakistan and Bangladesh are aware of the importance of good seeds, fertilisers and pest management. However, they are not as aware of or prepared for adopting cultivation practices that can reduce the intensity of input use and raise productivity. These include precision land levelling, no-till, on-farm water management, and IPM. Some progress has become visible at least in the wheat-rice areas of Pakistan—especially on medium and large farms—with respect to precision land levelling, no-till, and on-farm water conservation with improvement in watercourses and new methods of irrigation. The no-till technology, however, increases the demand for herbicides unless new crop rotations are adopted to reduce the cost (Pieri *et al*. 2002). The widespread use of tractors and tractor-driven machinery has facilitated the rapid extension of precision land levelling in many areas of the Indus basin. Likewise, in Bangladesh, most farmers have shifted to small tractors and tractor-driven implements. They have not, however, integrated the new tillage and pest management practices. The availability of the relatively cheap pesticides and lack of knowledge have been the two major factors impeding the adoption and diffusion of IPM.

3. Post-harvest conditions: The post-harvest losses in both wheat and rice are quite high, ranging from 10 to 40 per cent, in all parts of Pakistan and Bangladesh. The losses are due to delayed harvesting, manual hand-pulling and shocking and stacking of straw, followed by threshing with stationary-mechanised threshers—quite commonly used in Pakistan—or on oxen-trodden threshing floors. The physical losses are greater in wet season harvests, as is the case with rice in Bangladesh, due to the drying problems and antiquated mills. Small farmers have some on-farm storage, but the rest is delivered to merchants or government procurement centres. A major problem, especially in the hilly areas of Pakistan and the delta region of Bangladesh, is the high cost of transport because of bad roads and tracks that are hard and expensive to use.

The large-scale storage facilities, particularly in the state sector, are plagued by problems of pilferage and pests. The processing mills are largely in the private sector and use a range of technologies dominated by labour-intensive methods subject to loss of grains and quality of milled rice in particular. Farmers use several market channels, depending upon the volume of sales, prices, credit and storage facilities, and transport. The state sector has to compete with the private sector for procuring grains in both Pakistan and Bangladesh since it is still involved in providing subsidised milled grain and wheat flour to the urban areas. Markets are relatively well integrated in the plains of Pakistan and some areas of Bangladesh, but generally most small farmers are severely handicapped by numerous constraints to take the same advantage as do the large farmers from market integration. They remain dependent largely on local shopkeepers and merchants of grains. In the rainfed and mountain areas of Pakistan, and to a large extent the same is true for some areas of Bangladesh, small farmers have little marketable surplus of grains since they do not produce much and their most important goal is to maintain household food security.

4. Infrastructure, support services and policies: The IDB member countries in South Asia are particularly deficient in the rural physical and social infrastructure, except for the high levels of investment made in the large and small-scale irrigation projects and schemes in Pakistan and to some extent in Bangladesh. Rural roads, schools and health care centres have started to get relatively greater attention only in the last decade. The infrastructure is inadequate in numbers, of relatively poor quality and badly maintained by the state agencies. In fact, a major problem of the government has been its low management capacity and the exclusion of rural people in almost all aspects of the provision of public goods. Recently there has been some movement to involve the rural people as participants in constructing and maintaining some of the infrastructure, e.g. WUAs for the maintenance of watercourses, and village organisations for establishing community schools and health centres. The patchy evidence is that there is reluctance to devolve authority and decentralise administration in both Pakistan and Bangladesh. However, with the encouragement and support of the donor agencies, a variety of NGOs and community organisations have become quite active and governments are making attempts to coordinate some of their work with rural community organisations and NGOs. In Pakistan, the irrigation infrastructure is facing a severe problem of rehabilitation and development of the drainage infrastructure.

In both Bangladesh and Pakistan, the most important support services for agriculture are the state-managed education, research and extension services. The investment in these services was reasonably high until the last decade and their work was important in the introduction, adoption and diffusion of HYVs of wheat and rice. However, as in many other developing countries, these services are excessively labour-intensive,

particularly extension services, suffer from too much of overlap and poor coordination. In recent years, the research and extension system has also experienced falling investment in real terms and contraction in services. The experiment of the training and visit (T&V) method was almost a complete failure, at least in Pakistan. In both countries, community participation is still quite weak and most of the extension work targets at large farmers in favourable environments. Attempts are under way to integrate the research and extension services and use community organisations and farmer associations, like WUAs, to reach small farmers. The private sector concentrates largely in the distribution of fertilisers and pesticides and on a limited scale provides advisory service about their use. It plays almost no role in the research system and has little interaction with extension services.

Governments have also been involved in providing subsidised credit to farmers through the state-controlled development banks. The experience, especially in Pakistan, is that a large proportion of the credit is used for agricultural machinery, appropriated mainly by large and well-connected farmers and entrepreneurs, inconvenient and costly to small farmers, plagued by rent-seeking, and financially unsustainable. As stated earlier, the rural credit system in both countries, and especially in Bangladesh, has been strengthened by the involvement of community-based networks that reach the poor and small producers. However, it is quite inadequate in meeting the credit requirements for agricultural enterprises, including land development, purchase of seasonal inputs, and marketing of products.

A wide range of government policies on land administration, pricing of inputs and products, regulation of markets and trade and consumer subsidies, and rural investment affect the production and productivity of grains. The administration of land rights—to which many other rights are closely connected—in Pakistan has been particularly inadequate in terms of land redistribution, protection of tenancy rights, land fragmentation, and land records. In Bangladesh, the issue of land redistribution is not equally important, but the issue of land records, protection of tenants, and land fragmentation are no less serious. The lack of will on the part of successive governments and weak administrative capacity remain the major bottlenecks. Similarly, governments have made almost no progress in changing the administration of the irrigation system and pricing of water. In both countries, governments have made significant progress in deregulating the markets for other inputs and for grains, although the grain procurement system and price support remain significant because of the pressure to provide subsidy to grain consumers in urban areas. They have also introduced new laws and regulations to create a favourable environment for the private sector to enter into or expand its involvement in the production and distribution of seeds, fertilisers, pesticides, and machinery. Some of these changes seem to have had positive effects on the economy. However, the reduction in subsidies on inputs, including electricity, fuel and credit, with stagnant or falling prices of grains, have created pressure on farmers to reallocate their resources and reduce the level of purchased inputs. In addition, the intra and inter-seasonal variability of prices has a particularly negative effect on small farmers.

6. South-East Asia

The three countries in South East Asia have a population of 238 million people, with most in Indonesia (214 million) and only 300,000 in Brunei Darussalam which has the highest average income and standard of living—based on oil and gas—followed by Malaysia. Indonesia is the largest country in the group of LIFDCs. Nearly 60 per cent of the population in Indonesia is rural and 43 per cent in Malaysia. Agriculture plays a far

more important role in Indonesia compared to Malaysia. In Indonesia, it contributes 16 per cent of GDP and engages 55 per cent of the labour force, but in Malaysia its accounts for only 8 per cent of GDP and just over one-quarter of the total labour force. In both countries, the GDP growth was reasonably high in the 1990s, but the growth of agricultural output barely kept pace with the growth rate of population. These countries have very little arable land or just about 0.08 ha per capita; a high proportion of the land is in forest. All three countries are net importers of cereals and the import volume rose from 5.04 million MT in the early 1990s to 9.58 million MT in 2000/01, and about 61 per cent of the net imports were in Indonesia. Rice is the dominant grain in the three countries. While the average yield level in Indonesia is reasonably high at 4.4 MT/ha—Malaysia's average is 3.1 MT/ha—there was marginal increase in the rice yield in both countries during the last decade.

The decade of the 1990s was not altogether good for the agriculture sector in both Malaysia and Indonesia. The weather, droughts and floods, was one major factor for the disruption, especially in Indonesia. The other factor was the reduced support to the agriculture sector in terms of subsidies and prices and reallocation of investment to other sectors of the economy. Finally, the extended political crisis in Indonesia was exacerbated by a severe financial and economic crisis towards the end of the decade, leading to significantly increased imports of rice. It should be added that in Malaysia rice is far more costly to produce than the imported rice. The rapid industrial and urban growth, combined with rising wages in and outside agriculture, and reduced state support to the agriculture sector have made the economics of rice production more unfavourable in Malaysia. In Indonesia, on the other hand, production of rice is reasonably competitive and it occupies a far more important position in the overall economy.

1. Resources and inputs: The land and water resources in both countries are not a major constraint on the production of rice and other crops in spite of the limited arable area, particularly in Indonesia. The soils are generally fertile and water is quite plentiful. However, serious problems have developed with both land and water. Erosion has become a serious problem because on steep slopes the fields are neither bunded nor terraced. It is also increasing sedimentation in the lowland irrigation systems. In addition, the upland soils are more weathered and leached, leading to toxicity and phosphate deficiency. Deforestation contributes to the problems of erosion and reduced biodiversity and brings into cultivation lands that are not very fertile. In Indonesia and Malaysia, governments have invested substantial resources in the development of new lands—involving large-scale relocation of people between islands in Indonesia—through forest cutting and provision of surface irrigation to give cultivable lands to the migrants and settlers. While the irrigated areas are generally well served with stable water supply, a high proportion of the cropped area depends on rains that can be highly variable. Indeed, in the 1990s, Indonesian farmers suffered serious damage to their rice harvests because of the effects of El Nino—responsible for droughts—and La Nina—responsible for floods—throughout the 1990s. The El Nino effect was serious enough on irrigated lands as well that the area used for rice was reduced significantly. The governments in both Malaysia and Indonesia have been quite successful in reducing land concentration and improving the rights on land for both owners and tenants. However, the subdivision of land has continued to be a serious problem on the island of Java in Indonesia.

In both Malaysia and Indonesia, a vast majority of small and large rice farmers have used HYV in combination with water, in some areas more stable and controlled than

others, and high doses of organic and inorganic fertilisers. The problem in the upland rice areas is that rice seed is of uncertain quality as most farmers, especially the small holders, use their own seed. In the lowland rice farming system, seed market is far more developed and accessible. Farmers have adopted both large and small size machinery and reduced their dependence on draught power of animals. There is also extensive use of fertilisers and pesticides, but the high level of dependence on these inputs has created problems of soil degradation and polluted environment. The rural credit system in these countries is far more advanced than in many other countries, using the state and private sector institutions on a large scale. The credit network has been a major facilitator of access for small and large farmers to inputs and markets.

2. Technology: In the monoculture of the lowland rice farming system farmers have started to diversify to take advantage of market demand and relative prices. Crop diversification, especially legumes, counters the incidence of soil degradation due to high cropping intensity under one (rice) crop. In the upland mixed farming system, poor watershed management and poorly regulated logging have been responsible for soil erosion and loss of nutrients. The irrigation system, both in the lowland and upland areas, are reasonably well managed, especially in the areas in which farmers have a measure of control on the system. New irrigation technology, especially on large farms, is being adopted to improve water efficiency. Cultivation practices are still quite labour-intensive, but in parts of Malaysia farmers are either shifting to mechanised rice cultivation or reallocating their lands to other products. Labour shortages in parts of Indonesia are also forcing farmers to search for new methods or shift to other less labour-intensive enterprises. Generally rice farmers seem to have slowed down the adoption of new varieties of rice, improved inputs and practices because of the relatively unfavourable changes in the prices of inputs and outputs in the last decade.

3. Post-harvest conditions: The post-harvest conditions vary significantly between farms and regions. Small farmers, especially in the tree crop mixed and upland mixed farming systems, do not have much surplus rice to sell on the market. In the lowland rice farming system, on the other hand, there is well developed marketing structure, dominated now by the private sector that provides a variety of services including storage, transport and processing. Large and small-scale rice milling and processing plants are quite widespread in both Malaysia and Indonesia. Since the rural infrastructure, especially in most parts of Malaysia and some parts of Indonesia, is of reasonably good quality, the cost of marketing is not high and the losses are limited. A relatively high level of rural literacy with active community organisations at the village level also facilitates the operations of local and regional markets.

4. Rural infrastructure, support services and policies: As stated earlier, in both Malaysia and Indonesia, governments made significant investment in land development, irrigation networks and transport infrastructure in the 1970s and 1980s. In addition, they paid particular attention to rural education and health care and integrated family planning campaigns in Indonesia. The research and extension services have been quite strong, especially for the lowland rice farming areas in Indonesia and the tree crop farming systems in Malaysia. Their active collaboration with IRRI since the early 1970s has been a major contributor to the development of HYVs and strengthened the research systems. As in many other countries, the research system is better equipped to deal with the problems of cash (tree) crops than food crops.

As part of the strategy to achieve food (grain) self-sufficiency in both Malaysia and Indonesia, governments were very active in regulating the markets and intervening in the production of grains, especially rice, by a system of price support and input subsidies throughout the 1970s and 1980s. Indonesia was able to reduce its imports significantly by the mid-1980s and continued at those levels until the early 1990s.[45] However, these policies have undergone significant changes in the last decade because of sharp reduction in subsidies on inputs, exposure of farmers to highly variable market prices, and reduced investment in the agriculture sector. In Malaysia, these policies, combined with rapid migration of labour into industries and services, have resulted in stagnation in the area, output and yield levels of rice. The lower cost imported rice provides little incentive to farmers to produce it compared to other crops. In fact, in both countries market liberalisation and reduced support to rice farmers may have been the major contributors to the relative stagnation in rice. In Indonesia, the extension of rice cultivation to marginal lands has impaired its productivity.

CHAPTER SEVEN

GROWTH PROSPECTS FOR GRAIN PRODUCTION

1. Major Issues: A Perspective

Three major issues define the contextual perspective for examining the growth prospects of cereal production and the role of factors on which they are likely to depend in the IDB member countries.

1. On the production side of grains in the member countries, low land productivity, expressed in output (yield) per hectare, is the basic problem and it is strikingly low in Sub-Saharan Africa. Also, the average yield level in the member countries increased only marginally during the 1990s—rose by only 15 per cent in Sub-Saharan Africa and fell by 20 per cent in LDMCs. Only a handful of countries have reasonably high yields—Egypt is by far the most productive in both wheat and rice—but they have significant yield gaps. In the major grain producing countries, barring few, the yield level has either been stagnant or rose very slowly in the last 10-15 years. The challenge for the member countries is to raise the average yield to significantly higher levels. They have to undergo the first Green Revolution in Sub-Saharan Africa and a second Green Revolution in Asia.

2. A majority of the IDB member countries are net importers of cereals and 33 of them are on the list of LIFDCs. In Sub-Saharan Africa, only six member countries have a self-sufficiency ratio of 80 per cent or higher. All countries in West Asia and North Africa, except Turkey and Syria, have ratios of less than 60 per cent (including Yemen). In Central Asia, only Tajikistan depends heavily on net imports, but Kazakhstan is a large net exporter of wheat. In South East Asia, Malaysia depends heavily on imported grains and Indonesia has a ratio of 88 per cent like Bangladesh in South Asia.

[45] In the late 1960s, the Indonesian government created a special agency (BULOG) to implement its food policy and expanded its role in the food production and distribution system in the wake of the world food crisis of 1973-74. See Gerard and Ruf (2001) for a review of food policy and analysis of recent problems of food security in Indonesia.

3. Nearly one-third of the population of 23 LDMCs is undernourished. The average daily calorie intake in most of these countries is less than 2,300 and most of it is obtained from cereals. These are important indicators of the household food insecurity. It seems that the major issue is not that many member countries depend on imported grains, but whether they can maintain national and household food security that includes (i) sustainable use of domestic and foreign resources and (ii) adequate nutrition to the vulnerable and marginalised individuals.

A broad-based strategy for sustainable agriculture—that conserves the natural resource base, including water, and economises on other inputs—is necessary to address these issues since agricultural growth is demonstrably the key factor for reducing rural poverty and food insecurity both at the household and national levels. FAO has recently published a detailed study analysing the future—towards 2015 and 2030—growth of agriculture, particularly food including cereals, based on long-term projections of the world demand and supply conditions (Bruinsma 2003).[46] It expects significant overall improvement in the state of food insecurity and undernourishment in developing countries. In several IDB member countries, especially LDMCs, cereals are likely to remain a major component of the diet of a vast majority of people even when account is taken of the slowdown in population growth and assuming moderate rates of growth of income per capita. The shift from consumption of coarse grains to wheat, rice and maize is also expected to continue, especially in Sub-Saharan Africa. In the more developed IDB member countries, as the dependence on cereals for human consumption goes down, the demand to feed livestock will accelerate. In terms of the balance between the growth of demand and supply, countries in Sub-Saharan Africa are likely to maintain their current level of self-sufficiency, but most countries in West Asia and North Africa may have to depend more on imported cereals. The conditions in South Asia and South East Asia may improve, except for countries like Malaysia. The Central Asian countries, including Kazakhstan, may experience no improvement without radical changes in the institutional structure, investment level, and management of land and water resources.

2. Factors In Enhancing Future Grain Production

There are two sources of growth in grain production: area harvested, which in turn is a function of (a) expansion in arable land and (b) cropping intensity, and output per hectare or the yield level. Intensification—higher cropping intensity and yield level—is expected to play a major role because of two reasons:

First, in many countries in West Asia and North Africa, South East Asia, and South Asia, there is little additional arable land or it is too costly to expand. In fact, they have to grapple with the widespread problem of land degradation—acute in arid and semiarid areas—and reduce the use of marginal lands for grain production. In many countries of Sub-Saharan Africa, there is seemingly high potential for expanding the arable area. However, it can be argued that the investment in arresting or reversing the incidence

[46] A similar study was done earlier for the World Bank on the future prospects of agricultural growth based on projections of demand and supply for the period from 1997 to 2020 (Rosegrant, Paisner, and Meijer 2001). In the last two years, the World Bank has also published a series of papers on Regional Rural Development Strategy separately for Africa, South Asia, Middle East and North Africa, and Central Asia. These papers contain useful analysis of the role of agricultural growth and the factors necessary to sustain it over time.

of land degradation even in these countries may be as if not more important for productivity gains and quality of the environment.

Second, in several IDB member countries, particularly in Sub-Saharan Africa, the high yield gaps reflect a large potential for significant growth in output. In fact, there are very few countries, in which the yield gap for the three grains is not significant. The yield gaps can be explained by a variety of factors: biophysical, managerial, socio-economic, institutional, and technical. The contribution of yield to future grain production will also depend on the share of irrigated agriculture since it is more intensive (and reliable) than rainfed agriculture.[47] Of course, intensification of agriculture with irrigation—increased cropping intensity—can be risky in terms of its harmful effects on soils and the environment as has become evident in several countries of Asia and North Africa. The important point is to find a balance between intensification and sustainable use of the natural resource base.

Cereals are grown in a variety of environments in which generally they compete against other crops (or enterprises) for land and other inputs. Admittedly they are, and likely to remain, an important source of food security for a vast majority of the poor farming and non-farming households. However, with increased integration into the market economy, farmers must consider prices and profits of other crops in making decisions about producing cereals. In many areas, particularly in North Africa and West Asia, high-value crops are replacing cereals with important implications for future changes in the production and productivity of cereals. Cereal profitability is being squeezed because of the fall in prices—a trend that is likely to continue as borders become more open for trade—and the rising cost of production in many developing countries. The focus, therefore, has to be on raising productivity and reducing the cost of production. A related aspect is the shift in demand for grains individually and collectively in response to the growth of population, income, and changes in tastes both nationally and internationally.

The prospects of growth in grain production and productivity in the IDB member countries will be influenced by several factors, which can be grouped into four analytically convenient categories.

1. Land and water resources
2. Technology
3. Domestic institutions and policies
4. International environment: institutions and policies

2.1 Land and water resources

Land and water are interconnected resources and should not be seen in isolation for crop production. Their use depends on a host of factors, including technology, rights of ownership and access, management practices, prices, institutional environment, and policies. While there is room for expansion of arable land in some countries in Sub-Saharan Africa, the gains are likely to be far more significant there, and in other regions, by putting resources and efforts to arrest the growing menace of land degradation, whatever its source (Bruinsma 2003). The potential for expansion should not be overestimated because of

[47] Byerlee, Heisey and Pingali (2000) suggest that an analysis of the future prospects for yield gains should take into account three contrasting situations: (i) areas with high yield levels and a low yield gap (mainly in South and South East Asia); (ii) favoured areas with a significant yield gap (rainfed areas of South Asia and Sub-Saharan Africa); and (iii) low potential areas with low yield gaps with current technology (the African Sahel). They argue that significant growth in the yield levels is possible in all three situations, but with different strategies.

requirements of investment, incidence of diseases, deforestation, and environmental fragility. The emphasis in reasonably productive areas, both rainfed and irrigated, should be on improving soil texture and fertility and conserving water. Studies and projects under way in all of these areas have shown encouraging results.[48]

The large desert areas and drylands (including the uphill drylands) that are either rainfed or depend on expensive irrigation have little potential for efficient and profitable production of grains. The major concern for these areas should be to arrest the spread of deserts and, where, economically viable, to improve the quality of drylands. In fact, in many areas, especially in North Africa and some parts of West Asia and Sub-Saharan Africa, the alternatives may be far more attractive and economical. The evidence on labour migration and the rising cost of labour reinforces this argument. The potential for growth of cereal output on marginal lands—as in large areas of Central Asia and West Asia—is low without significant investment in land improvement and farming practices, hence it may be necessary to reallocate resources. Investment in the low-potential and low-yield areas for cereal production on a large-scale makes little sense, especially as borders become more open and there are better economic alternatives.

Land productivity is also closely associated with the rights to own and cultivate land, the size of farm and its subdivision. Numerous studies have shown that ill-defined property rights, high concentration of land, and excessive fragmentation of farms are harmful to both productivity and social cohesion.[49] It should be added that land tenure reform could contribute significantly to rural poverty reduction by its direct effect on agricultural growth and contribution to human capital. In many IDB member countries, the issue of land tenure reform has remained either unresolved or poorly addressed. The efforts to establish land and tenancy rights in several countries in Sub-Saharan Africa should be hastened to reduce the pressure on land and create incentives to make long-term investment. Similarly, in some member countries in West Asia, North Africa, South Asia, and all countries of Central Asia land tenure reform should receive greater attention than the governments have been willing to give.

There is general agreement that water is a far more serious constraint on agricultural production than land in almost all countries and likely to be even more critical in the future (FAO 2003b).[50] In rainfed areas, the major problem is the high variability of water between years and during the crop season. There are large rainfed areas, in both subhumid and arid zones, where water harvesting can reduce the variability of water supply and raise the productivity of land. In West Africa, this is of particular importance in the Sahel countries and in several countries of Asia as well. In the subhumid zone of West Africa, water harvesting projects, with direct participation by the water users, show clearly (e.g., in Burkina Faso) that they can have a significant impact on land and crop productivity by increased intensification. Similar water harvesting projects can be developed in many rainfed areas of Asia that will help stabilise the supply of water and reduce the incidence of land degradation by erosion. There is enormous irrigation potential for increased rice

[48] Several IDB member countries in Sub-Saharan Africa, in collaboration with FAO and the World Bank, have incorporated the Soil Fertility Initiative (SFI) into National Action Plans (FAO 2001a).

[49] See World Bank (2003b) for a comprehensive analysis of land rights, including their impact on agricultural productivity, income distribution, and conflicts.

[50] IDB (2002) has published a good summary account of the importance of water and the likely effects of its future scarcity on the well being of people in many developing countries.

production in the Sahel region from of the Senegal, Niger, Black Volta, Chari, and Logone rivers (FAO 2003b). However, in this region, water stress may become a serious problem for grain production because of global warming.

The problem in the large-scale irrigated areas, as in Pakistan, Turkmenistan, Kazakhstan, Syria, Iraq, Turkey, and Sudan, is the harmful effects of extensive salt concentration, high water tables, and depletion of nutrients.[51] In addition, in several countries of North Africa and Asia, water resources are scarce and water withdrawals are high due to losses in its use from both the surface and ground sources. In some countries, especially in North Africa and West Asia, groundwater mining has been depleting the renewable water resources on a large scale (FAO, 2003b). The irrigation systems need rehabilitation including adequate drainage, decentralisation of administration, demand-based pricing of water, and irrigation practices that enhance water productivity at the farm level. Governments have been far too slow in accepting or implementing the idea that water users should hold most of the responsibility in maintaining the integrity of the irrigation system. Also, small-scale irrigation schemes based on traditional and new technologies should be supported with investment and services.

2.2 Technology

Technology encompasses many activities and products. Its development, adoption and diffusion should be regarded as the key to increase grain production and productivity in the future. The examples of technical progress and its beneficent impact on agriculture and farmers in many developing countries are far too numerous to count. They include new or improved quality of farm inputs and practices, better or more efficient use of resources and inputs in diverse agro-ecological and socio-economic environments. With regard to the effects of technology used in crop production, an important point is to integrate those farm inputs and practices—to benefit from their synergetic effect—that raise productivity, conserve scarce resources, and are profitable. Several examples can be given of technologies that, though profitable in the short run, can damage resources and reduce productivity in the long run: e.g., monoculture based on the intensive use of land and water resources with excessive dependence on tillage and chemicals.

As stated earlier, the challenge in most IDB member countries, particularly in Sub-Saharan Africa is to raise the average yield level of grains.[52] Consider two yield gaps of direct relevance to this challenge. First, there is a significant difference between the yield levels of the average and best farmer within a given agroclimatic environment. Second, there is a wide spread between the yield levels on the farm and experimental station. Of course, the yield level on experiment station may be lower than the genetic potential of the grain as recent research in biotechnology has clearly revealed. There is also the issue of annual and regional yield variability due to differences in weather, water and land conditions. The technology package required for raising the yield level could be divided into two interdependent components. The first component comprises the genetic material and the quality of seed. The second component comprises a number of complementary

[51] Egypt's investment in its drainage programme since the mid-1980s has produced impressive results in terms of its effect on salinity and land productivity (FAO 2003b).

[52] A large number of studies on yield gaps, especially for major grains like wheat, rice and maize, have been published by national and international agencies. See for example, Curtis, Rajaram, and Macpherson (2002) and FAO (2001c). Of course, intensification and yield growth have limits due to the environmental and resource stresses; in some settings maximising the yield level may not be economical.

farm inputs and practices, including tillage, water management, fertilisation, pest control, and post-harvest management. In the first component, the focus has to be on improving the yield potential of existing varieties or introducing new varieties and providing good quality seed to farmers. In the second component, the efforts have to concentrate on zero tillage, integrated plant nutrient systems (including changes in cropping patterns), and integrated pest management.

The breeding and transfer of new varieties of grains probably hold the key to raise the yield level provided these varieties can respond well to the environmental stresses, adapt to nutrient deficiency, demand less intensive use of chemical inputs and water, and are resistant to diseases caused by pathogens. The experience of HYVs of wheat and rice is that their yield levels are far higher than of the varieties they replace, but they depend on highly intensive use of inputs, not readily adaptable to environmental stresses, and are vulnerable to a variety of insects and pests. In the last two decades, the advances made in genetic engineering and related disciplines have produced genetically modified food and non-food products on a commercial basis with several unprecedented advantages. For example, genetically modified cereals can produce significant gains in productivity, improve the nutritional quality of food, save on resources, and adapt to biotic and abiotic stresses. The potential for increased production is regarded significant enough to provide plentiful food at reduced prices to the growing populations. Persley and MacIntyre (2002) give numerous examples of the on-going international and regional research programmes on grains and other crops in several developing countries. It is, however, important to note that the commercial use of genetically modified organisms for crop and animal production, notwithstanding their realisable potential and benefits, has raised serious concerns about its cost and risks. These concerns include uncertain or unanticipated effects on the environment, human health, and biodiversity, increased market concentration in seed industry, and exclusion due to intellectual property rights (Persley and MacIntyre 2002; Bruinsma 2003).[53]

An important implication of biotechnology for future grain production in the IDB member countries—Indonesia, Pakistan and Egypt have established apparently strong institutional capacity for biotechnology in crop production—is that the national and international agricultural research systems increase the level of investment and integrate their work on regional basis. The regional consortia of donors and recipients on rice and wheat are a good beginning for addressing the yield gap issue in both Africa and Asia. A related issue in the member countries is to improve the regulatory and institutional environment for seed multiplication and distribution to farmers. Turkey has probably made the most significant progress in this respect. Private sector in the seed market needs proper incentives, information, and infrastructure. In addition, farmer organisations can play an important role in seed production and multiplication, as has been the experience in some countries of West Africa, at least at the local level. Protectionist policies on breeding and multiplication of seed, with unregulated markets without integration with the end users, impede the growth of cereal production in many countries.

The productivity potential of seeds can be realised only if farm practices that affect crop growth are rationalised. The growth of grain production and productivity in the member countries can be sustained by practices that most farmers can profitably adopt with

[53] An international treaty on Plant Genetic Resources for Food and Agriculture (PGRFA) was adopted in 2001 and expected to be ratified by most countries before the end of 2004. The treaty addresses the issues of benefit sharing in research and breeding, conservation of plant genetic resources, and farmers' rights (Bruinsma 2003).

the support of research and extension services. There is now good evidence in several countries that the conventional tillage practice—in which land is ploughed, harrowed and hoed before the seed is thrown—has negative impact on land productivity, soil quality and the environmental processes. Also, there is equally good evidence that minimal soil disturbance, biomass cover, direct sowing, and mixing cereals with legumes are practices that can increase the yield level—by 20 to 50 per cent—and improve the quality of soil and the environment. The new practice is, however, not without cost or easy to adopt since it may require new tools, management skills, and weed control. In some countries with arid climates without irrigation, there may not be sufficient crop residues to shift from the conventional tillage practice. There is also evidence that the existing research and extension services are either ill equipped or sceptical of the advantages of conservation agriculture. The experience in the wheat-rice areas in South Asia and in some countries of West Africa is that the no-till practice can work effectively if the farmers are organised and participate directly in the adoption phase (Pieri *et al*. 2002).

The use of chemical fertilisers and pesticides has been promoted to increase crop productivity and the evidence is that these inputs can make a significant contribution to the growth of output. However, there is now widespread evidence that injudicious use of these chemicals can seriously damage soils, crops, human health, and the environment. The improper use of fertilisers—in quantity, nutrient mix and timing—can disturb the balance of soil nutrients leading to loss in productivity and even land degradation. These effects are evident on the irrigated and rainfed lands of arid and semiarid regions in Asia and North Africa. In many countries, farmers are not well informed or advised about good management of plant nutrients that includes organic matter and balanced fertilisers. The research-extension experiments using the farmer field schools (FFS) seem to hold significant potential for introducing and expanding the integrated plant nutrient management practices. They are of particular relevance to countries in Sub-Saharan Africa where land quality is poor and the level of fertilisation is low.

Pest control by chemicals has also been an important part of the strategy to increase crop production. The long-term and excessive use of pesticides has created hazardous effects on human and livestock health, non-pathogenic organisms, and the environment. In fact, it has contributed to the resurgence of pests and new outbreaks. Farmers should be informed about the advantages of alternative methods of pest management that can enhance crop productivity and protect human health the environment. They include biological, physical and cultural methods combined with practices of land management, irrigation and fertilisation that reduce pest problems. The on-going IPM experiments through the farmer field schools (FFS) in West and North Africa have produced encouraging results. In many countries, the major impediments to the adoption of IPM are (i) favourable regulatory and pricing policies for pesticides and (ii) weak extension services.

2.3 Domestic institutions and policies

Much has been learnt from the experience of many developing countries about the role of public and private sectors in facilitating the growth of the economy in general and the agriculture sector in particular. For decades, the public sector dominated the economy to induce rapid industrial growth with macroeconomic and investment policies that

generally discriminated against the agriculture sector and the rural economy. In addition, governments participated directly, often as a monopoly, in the production and distribution of industrial and agricultural products with little or no room for the private sector. The predominant role of the public sector in the economy often misdirected resources, distorted prices and did not necessarily help the poor and vulnerable in the society.

The governments had to review and change these policies when they were faced with economic and financial crises, generally starting in the mid-1980s, in which they had played a major role. They had to accept deep structural adjustment and economic reform programmes that include (i) shock treatment to contract demand in the short run and (ii) deep structural reforms emphasising deregulation and privatisation of the economy. While these programmes have been the focus of intense and divisive debate, in almost all countries there has been a paradigm shift in favour of the private sector. In this transition, reduced government spending, withdrawal of some of the important support services, reduced price and financial subsidies, and trade liberalisation have affected the economic well-being of people both positively and negatively according to their status and role in the economy. Governments are under pressure to decentralise their administration and create room for more direct participation of communities at the local level to reduce the cost and improve the quality of services and outcomes. This has opened the doors for the rapid growth of NGOs and community-based organisations as partners with governments to reach the small and poor farmers.

In the context of future growth of agriculture and grain production in the member countries of IDB, the roles of public and private sectors seem to be fairly well defined. Public sector should invest, in partnership with local communities, in building and improving the rural physical and social infrastructure to facilitate the development of human capital, reduce the cost of transport and communications, raise the level of land productivity, and reduce the waste of water resources. The current investment levels in many countries, particularly in Sub-Saharan Africa and South Asia, and the reduced levels of investment in other parts (e.g. Central Asia and Indonesia) have to be raised significantly to meet the requirements of agricultural growth and grain production.[54] Recent experience in several countries in Sub-Saharan Africa and Asia is that direct involvement of rural communities (farmer groups) in the infrastructure projects, like village-to-market roads, village schools, dispensaries, small-scale irrigation schemes, can reduce their cost, improve the quality of service and output, and make the infrastructure sustainable.

The low levels of spending on agricultural research—in several countries less than one percent of the value-added in agriculture—cannot support the multiple needs of technology transfer and its diffusion. This is particularly relevant to LDCs where a vast majority of farmers are greatly constrained by inadequate knowledge and access to profitable technology. It also means that the research-extension services should be rationalised—reduce overlap and waste—and integrated more closely with farmers. The on-going farmer field school (FFS) projects on integrated water, land and pest management practices in some countries of North Africa and Sub-Saharan Africa will need expansion and increasing support. In other parts, as in South Asia, community organisations and WUAs should be strengthened and used as conduits for the adaptation, transfer and

[54] According to FAO (2002c), the agricultural orientation index—ratio of the share of agriculture in total public expenditure to the share of agriculture in GDP—is low in countries with significant undernourishment (over 20 per cent) compared to those with lower incidence of undernourishment (less than 10 per cent). Further, in the 1990s, the index declined in the former group of countries and increased in the latter group.

diffusion of new technologies. It seems that in many countries private sector is likely to remain interested in research-extension activities associated mainly with products that are marketed on a large scale in domestic and export markets.

The government's role in the input and output markets should focus on three key areas:

1. In the seed market, they should protect the rights of breeders, regulate the quality of seed, and create incentives for the private sector to invest in the production and distribution of quality seed. In some areas, governments should provide support to farmers' organisations to produce and distribute quality seed at the local level in collaboration with the research-extension services. The evidence in West Africa is that it can work well to meet the needs of small farmers, particularly for grain production.

2. They should facilitate the integration of financial markets in rural areas and make credit accessible to small landholders. In several countries, the on-going group-lending programmes through community-based organisations should also be supported by changes in the rules and regulations governing the banking system. This approach seems to reduce the cost of credit and make it conveniently accessible to those groups in the community who are not regarded credit worthy by the commercial banks. The experience in countries like Indonesia, Bangladesh and Pakistan is that these programmes facilitate the use of productivity-enhancing inputs and are also financially sustainable without subsidy. The centrally administered rural or agricultural development banks are costly and do not reach the small farmers.

3. They have to find a balance between two apparently conflicting policies: provide food subsidy to consumers as a means to reduce food insecurity and give price support to farmers that maintains incentives for investment in productivity-enhancing technology. The food subsidy bill can be reduced significantly by (i) changing the administrative structure and mechanisms to reach the vulnerable groups and (ii) maintaining incentives for farmers to raise productivity so that the cost of food declines. Farmers everywhere tend to respond strongly to both price and non-price incentives. It makes little sense to provide price subsidy on inputs if it has little impact on productivity, distorts resource allocation between crops or enterprises, wastes scarce resources (e.g. water and fuel), and discriminates against small landholders. Similarly, governments have to find mechanisms, other than their intrusive involvement, to reduce price variability in the market. In the context of grain production in the future, with increased liberalisation of trade in agricultural products, governments should create conditions that allow farmers to develop and strengthen comparative advantage in producing grains. Food security cannot be increased by focusing on self-sufficiency without taking into account the level of productivity and production cost of grains. For example, investment in the marginal lands to produce more grains should not be an option because there are more economical and environmentally friendly alternatives. On the other hand, there are vast areas with high potential for growth, in several countries of Sub-Saharan Africa, where farmers need public investment and policies that help them establish competitive advantage in grain, especially wheat and rice, production.

2.4 International Environment: Institutions and Policies

The role of international institutions—bilateral and multilateral agencies—through concessional loans, grants, and technical assistance, foreign private capital flows, and foreign trade environment are important influences on the performance of economies and the well-being of people in developing countries. There are several important aspects of the international environment for agricultural growth, including grain production, in the member countries of IDB.

First, several multilateral development banks, including the World Bank, regional development banks, and IDB, and bilateral agencies of governments in developed countries transfer public capital on concessional terms for investment in the rural infrastructure and agriculture projects. In addition, three major agencies of the United Nations, FAO, IFAD, and WFP, give substantial technical assistance and food aid particularly to LDCs.[55]

Second, several international agricultural research centres under the umbrella of the Consultative Group on International Agricultural Research (CGIAR) give material and technical support on grains and other agricultural products to the National Agricultural Research Systems (NARS) in developing countries.

Third, the agreements on international trade in agricultural products under the World Trade Organisation (WTO) are expected to have significant impact on global, regional and national grain production, prices and trade.

Fourth, flow of private capital, loans and investment, into commercial agriculture has important implications for the structure of grain production and markets in many IDB member countries.

Finally, changes in the global climate due to human activity and natural phenomena can have serious effects on the patterns of agricultural growth, well being of farmers, and food security at the household and national levels.

1. Role of Foreign Aid: Foreign public capital is important for poor countries, particularly LDCs, with limited ability to mobilise domestic savings and investment. It is more important for agriculture since foreign private investors show limited interest in the production of grains. However, foreign public capital for agriculture has been concentrated on large-scale water and land development projects and not necessarily related to need as reflected by the low share of LDCs, especially in Sub-Saharan Africa. Also, it declined in real terms by nearly 50 per cent during the 1990s (FAO 2002c). In recent years a consensus has emerged that much more has to be done for agriculture in Sub-Saharan Africa and in some countries of Asia in terms of investment and food aid to meet the goal of food security. As is evident in recent documents of the World Bank and other multilateral development agencies, the focus of the investment strategy has shifted in favour of holistic and integrated programmes of rural development in which agriculture occupies a central place (World Bank 2001; FAO 2002d). Another important development that looks promising for the future in many countries is the emphasis on direct participation of rural communities and farmer groups in making decisions and sharing responsibility for the

[55] Given the economic predicament of many countries in Sub-Saharan Africa, several international initiatives are under way to provide long-term assistance for the development of agriculture, especially to reduce their dependence on imported cereals and food aid. FAO has recently helped the New Partnership for Africa's Development (NEPAD) prepare a comprehensive investment programme for agriculture in Sub-Saharan Africa (FAO 2002e).

operation and maintenance of small-scale village infrastructure. In many IDB member countries, especially LDMCs, government investment services can be more effective if the local communities become major partners. Evidence from many countries, including the LDMCs in Sub-Saharan Africa and Asia, is clear that farmer participation improves the effectiveness of investment and makes the outcomes more equitable and sustainable.

Food aid as a form of assistance to developing countries started in the 1950s when structural surpluses of cereals appeared in the United States. A large part of food aid continued to be associated with the disposal of surpluses throughout the 1980s and 1990s. However, gradually other forms of food aid—purchases from local and third party markets—have emerged because the pressures of surplus disposal have weakened and the aid programmes have become more responsive to the recipient needs. In fact, for many donors, food aid is now an integral part of the overall development assistance budget and competes with other forms of assistance. The element of additionality has almost disappeared. The largest multilateral agency involved in food aid now is the World Food Programme (WFP) which was established in 1961. The multilateral food aid programme has been guided by successive conventions—the last one was in 2002—which among other things set a minimum annual quota of food aid. The future role of food aid for developing countries, including several IDB member countries, will depend on the structure of changes in export credit and export subsidy programmes of developed countries under the Agreement on Agriculture (AoA) in the WTO. With tighter disciplines on export subsidies and export credits, food aid will become more important in quantitative terms but also more subject to variability. The counter-cyclical nature of food aid, observed in recent years, could be exacerbated in the future, hence affect the required assistance available to LDCs and LIFDCs. One idea is to establish a Revolving Fund to stabilise the flow of food aid to these countries (FAO 2002a).

2. Role of the Islamic Development Bank: Since its establishment in 1975 the Bank has been actively involved in providing financial and technical assistance to member countries through a variety of projects and programmes for the agriculture sector. These projects focus on the development of rural infrastructure, water for irrigation, and services that can directly contribute to the goals of food security and rural poverty reduction. The Bank has given, as shown in Table 6, over one billion US dollars for 254 projects—completed and under implementation—grouped into three major categories. They are: agriculture services projects (seed development, grain storage, agro-processing); agricultural and livestock projects (land development, livestock breeding and health, agro-pastoral, food security, production cooperatives, rural credit); and irrigation and rural development projects (small and large-scale irrigation and drainage, integrated rural and regional development). More than two-thirds of the value of these projects is in the form of concessional loans.

Table 6

Financial Assistance of IDB for Agriculture, 1975-2002 ($ million)

Region	Agriculture Service and Storage		Agricultural and Livestock Development		Irrigation and Rural Development		All Projects	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Sub-Saharan Africa	7	14.57	42	96.46	93	353.64	142	464.67
North Africa	3	49.78	3	2.86	24	200.17	30	252.81
West Asia	6	20.56	9	15.02	15	67.76	30	103.34
Transition Countries	0	0.00	3	-0.68	12	64.40	15	63.72
South Asia	1	0.34	2	29.84	9	58.19	12	
South East Asia	0	0.00	5	22.37	7	88.20	12	
All Member Countries	17	85.25	64	145.87	160	832.36	241	1,063.48
Regional Projects	3	5.06	5	3.93	1	0.26	9	9.25
AQF	1	4.00	1	4.43	2	11.00	4	19.43

Notes:

1. These numbers have been calculated from the data provided by the Islamic Development Bank.
2. The list here excludes projects for fisheries and forestry; projects labelled as "cancelled" or
3. "frozen".
4. Transition Countries include the IDB member countries in Central Asia, Albania, and Azerbaijan.

The Bank's portfolio of concessional loans and technical assistance is dominated by the irrigation and rural development projects: they account for nearly two-thirds in number and over three-quarters in value, followed by the agricultural and livestock production projects accounting for over one-quarter in number and 14 per cent in value. The member countries in Sub-Saharan Africa have received the largest share in both numbers (59 per cent) and value (44 per cent) of all projects. The members in West Asia and North Africa have one-quarter of the numbers and one-third of the value of projects. While the irrigation and rural development projects dominate the portfolio in Sub-Saharan Africa, the agriculture services projects are more prominent in West Asia and North Africa. In the other regions, the irrigation and rural development projects have by far the largest share of the IDB-funded projects.

The importance given to the conservation and development of water resources is reflected in the fact that, between 1976 and 2000, the Bank used one-fifth of its resources equivalent to $1.5 billion to finance water-related projects in the member countries (IDB, 2002). Irrigation projects were given nearly 40 per cent of the funds for water resources with 52 per cent used for water supply and sanitation and the rest to the hydroelectric

power supply projects. With regard to its involvement in the improvement of water supply for irrigation, the Bank has provided financial assistance worth $363.26 million to 20 member countries for 58 projects (Table 7). Most of the projects are in the form of concessional loans and technical assistance. Thirty-two projects worth $147.99 million are in 8 Sub-Saharan African countries, followed by 15 projects worth $147.41 million in 7 member countries in North Africa and West Asia. The loan projects dominate in number and value for the member countries in Sub-Saharan Africa and the Transition Countries (Albania, Azerbaijan, Tajikistan, and Turkmenistan). Nine projects worth 150.54 million have been financed in five countries (Algeria, Egypt, Indonesia, Iran, and Syria) on the basis of sale, lease and *istisna*.

Table 7

Irrigation Water Projects Financed by IDB, 1977-2003 ($ million)

Region	Loans		Technical Assistance		Others		All Projects	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Sub-Saharan Africa	23	144.86	9	3.13	--	--	32	147.99
North Africa	2	14.00	3	1.44	4	86.62	9	102.06
West Asia	2	9.05	1	0.10	3	36.20	6	45.35
Transition Countries	3	25.47	4	1.15	--	--	7	26.62
South East Asia	2	13.52	--	--	2	27.72	4	41.24
All Member Countries	32	206.90	17	5.82	9	150.54	58	363.26

Notes:

1. These numbers have been calculated from the data provided by the Islamic Development Bank.
2. Transition Countries include the IDB member countries in Central Asia, Albania, and Azerbaijan.
3. "Others" include sales, lease and *Istisna*.

In view of the twin problems of water shortage for irrigation and land degradation due to soil salinity—evidently serious and growing in several member countries—the Bank took the lead in establishing the International Center for Biosaline Agriculture (ICBA) in the United Arab Emirates in 1999. The mandate of ICBA is to "demonstrate the value of saline water resources" for crop production and transfer the research results to national and regional research services in the member countries and elsewhere. The Center plans to develop (i) salt-tolerant plants for food and forage and (ii) new or improved production systems for irrigated agriculture and provide support for dissemination of the new technologies. It has already established linkages with ICARDA and ICRISAT and is an active member of the Global Water Partnership.[56]

[56] Since its beginning the Bank has also participated actively in financing programmes of assistance that include the development of surface and groundwater for irrigation and drinking water for the people of eight Sahel countries in Sub-Saharan Africa (IDB 2002).

Besides its major involvement in the development of water resources, the Bank has given financial assistance, worth $521.09, to nine member countries for the import and export of grains, particularly wheat and rice, between 1988 and 2003 (Table 8). Most of the financing to the member countries in North Africa and West Asia, excluding Turkey, and South East Asia (Indonesia) has been used for importing wheat and rice. Nearly one-half of the financial assistance was provided for grain trade between the member countries.

Table 8

Financial Support of IDB to Member Countries for Grain Trade, 1988-2003

Country	Number of Trades	Type of Grain	Amount (US$ million)
Algeria	2	Wheat	48.25
Egypt	2	Wheat	140.00
Indonesia	1	Rice	155.00
Iran	1	Rice	15.00
Jordan	1	Wheat	155.00
Pakistan	1	Rice	10.00
Saudi Arabia	2	Wheat & Rice	5.97
Tunisia	1	Wheat & Barley	75.00
Turkey	3	Wheat	41.87

Note: These numbers have been calculated from the data provided by the Islamic Development Bank.

The Bank should continue to provide financial and technical support for the improvement and development of irrigation water supply, especially water harvesting and management, at the local, national and regional levels. In addition, it can make significant contribution to promote agricultural trade among member countries and support the existing regional institutions with assistance for information networking particularly in agricultural research.

3. Production and transfer of technology: The progress in agricultural research has been the basis for rapid growth of grain, especially wheat, rice and maize, production and productivity in many developing countries outside Sub-Saharan Africa. It was facilitated by several international agencies, particularly the CGIAR-funded research centres like CIMMYT, IRRI, ICARDA, ICRISAT, and CIAT, in collaboration with the national and regional agricultural research systems. In addition, agencies like FAO and IFAD and regional organisations (e.g. WARDA) are supporting projects that help transfer new technologies to farmers.[57] The problem is that, in spite of the compelling evidence that

[57] WARDA (2002) has been active in promoting the New Rice for Africa (NERICA)—based on indigenous varieties that are less susceptible to weed and pest attack and have high yield potential—to meet the rapidly growing demand for rice in West Africa.

investment in agricultural research, particularly in genetic improvement of crops, has high rates of return, national governments and international donor agencies have reduced their support in the last decade. It is particularly untimely since in many Asian countries there is concern about the declining or stagnant yield levels of rice and wheat and the desperate need for raising the yield levels of grains in Sub-Saharan Africa. For the IDB member countries, especially LDMCs, the challenge is to pool their meagre resources and attract outside support on a long-term basis so that they can increase their capacity to produce, adapt and transfer productivity-enhancing and sustainable technologies. The increasing involvement of the private sector poses both risks and opportunities. The private sector's bias for technologies with greatest impact on company growth and profits is not necessarily compatible with the needs of the agriculture sector, particularly of small and poor farmers, in developing countries. However, collaborative partnerships with mutually beneficial agreements can mobilise the required resources and contribute significantly to the agricultural research needs of some developing countries.

4. International trade environment: Two clear trends in agricultural trade of developing countries have emerged in the last 40 years. First, the share of agricultural products in the merchandise exports declined from 50-70 per cent in the early 1960s to 10-20 per cent at the end of the century. Second, LDCs were net exporters of agricultural products until the early 1980s, but have become major net importers in the last 20 years (Bruinsma 2003). This shift in the trade balance is reflected in the increasing net import bill for food including cereals.

In both developed and developing countries, governments have tightly regulated the agriculture sector to meet their complex (even contradictory) national policy goals of food security and food safety, transfer of resources and income, and protection of the environment. Generally, agriculture is heavily subsidised in developed countries and taxed in developing countries with adverse effects on the allocation of resources, distribution of income, the environment, and international trade. The consumers and taxpayers in developed and farmers in developing countries are the major losers. The Uruguay Round (1986-94) of multilateral trade negotiations has brought the agriculture sector under the rule-based discipline to which industrial products were subject for over four decades. Because of this lack of discipline, there were significant distortions in world markets for agricultural products. However, in spite of the AoA for eight years, the Doha Round of negotiations in the WTO seems to have made little progress in liberalising trade in major agricultural products (OECD 2002; Ingco 2003).

In developed countries, the barriers to trade include substantial subsidies on prices and export of agricultural products, high levels of duties (tariffs) on imports and other restrictions on market access. It is estimated that farm subsidies and support in OECD countries amounted to $235 billion, equivalent to 32 per cent of the gross value of farm output or nearly one per cent of GDP in 2002.[58] The aid from developed to developing countries amounted to only one-quarter of this support to farmers in developed countries. In the context of grain production in the future, one of the crucial issues is whether and to what extent developing countries would be able to expand their grain production and possibly exports if policy distortions, imposed mainly by OECD countries, were removed

[58] The European Union (EU), United States and Japan account for 80 per cent of the total amount. It should be added that the subsidy level in OECD countries was worth $298 billion or 38 per cent of the gross value of farm output in 1986/88 (OECD 2002). It should be added that the average level of support conceals differences in the levels for specific agricultural products.

under the WTO agreements.[59] The effects will depend on the nature and extent of reforms, extent of market access, change in prices, nature of agricultural products, structure of production, and dependence on trade. Recent changes in the Common Agricultural Policy (CAP) of European Union (EU) do not inspire much confidence since they have not adequately addressed the issues of export subsidies and barriers to market access. The only major change is that the EU has accepted in principle to decouple subsidies and production. However, the decoupling will take place in stages, beginning any time between 2005 and 2007. With regard to cereals, there will be partial decoupling but the intervention price—minimum guaranteed price—for farmers will not change any time soon.[60]

The developing countries want the Doha Round concluded in Cancun (Mexico) with dozens of policies granting them "special and differentiated" treatment and implementation of previous trade agreements to be friendlier. However, it should be added that interests, options and objectives diverge greatly across developing countries and within each country between different groups of producers and consumers. As an example, countries differ between the net food importers and net food exporters: export subsidies may benefit some countries directly through food aid or indirectly by lower world market prices. There are indications that trade liberalisation could worsen the terms of trade for LDCs, which are net importers of cereals and net exporters of tropical products. The expected increase in world prices for staples may have little effect on domestic production because of the severe supply constraints, hence food import bills may rise significantly. A major concern about changes in the world economy is that it may increase price fluctuations of cereals—as border protection is lowered and the WTO regime imposes discipline on subsidised exports—with major consequences for both (small) producers and (poor) consumers of grains in developing countries.

A major challenge for governments in the IDB member countries, especially LDMCs and LIFDC which are net importers of cereals, is to find institutional mechanisms with support from the donor community to reduce price variability and maintain strong non-price incentives for farmers to become more productive and internationally competitive. For example, rice farmers in West Africa find it hard to compete against imported rice from Asia because of the price difference. The challenge is to raise their productivity level significantly by investment in rural infrastructure and new technologies. There is reasonably good evidence that this challenge can be met provided certain conditions and policies are maintained or promoted (WARDA 2002). In the context of grain production in the future, with increased liberalisation of trade in agricultural products, governments in the member countries should create conditions that allow farmers to develop and strengthen comparative advantage in producing grains. Food security cannot be increased by focusing on self-sufficiency without taking into account the level of productivity and production cost of grains. For example, investment in the marginal lands to produce more grains should not be an option because there are more economical and environmentally friendly alternatives. On the other hand, there are vast areas with high potential for growth, in several countries of Sub-Saharan Africa, where farmers need public investment and policies that help them establish competitive advantage in grain, especially wheat and rice, production. The regional consortia for productivity enhancement and the

[59] These issues are explored in some detail by Bruinsma (2003) and FAO (2002b). The FAO study focuses on LDCs. Another recent study by FAO examines the state of grain production, prices and trade with reference to the WTO negotiating issues (FAO 2002a). Also, see OECD (2002) and Ingco (2003).

[60] See *The Economist*, issues of June 26 and July 5, 2003.

trade in grains between member countries should receive high priority in the strategic plans of the Bank and governments.

5. Global climate change: Grain production in the future may be affected by the long-term global warming trend and the variations around it. While there is consensus that climate is changing, partly if not largely by human activities, there is great uncertainty about its impact on agriculture and food security. The FAO study (Bruinsma 2003) on the future of world agriculture expects that climate change—which may be beneficent for temperate zones and injurious for tropical and subtropical zones—will not be significant enough to have a serious impact on any part of the world in the next 30 years. However, the chances of extreme events seem to be rising and will increase in frequency with disproportionately large impacts on the small and poor farmers because they are more vulnerable and have little capacity to absorb the shock of droughts and floods. Increased frequency of extreme events could have substantial impact on some countries both in terms of their economic performance and food security. Recent examples of droughts and floods in several IDB member countries in South East Asia, South Asia and North Africa lend substantial support to these observations. The challenge for governments, especially in LDMCs, and the international community is to develop policies and mechanisms by which the effects of these events on small producers and poor consumers can be mitigated.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

1. Major Conclusions

Several important lessons can be drawn from the review of literature and data on the experiences of grain production and productivity and their underlying factors, with tentative observations on the growth prospects for grains, in the member countries of IDB.

1. The 54 member countries of IDB represent great diversity with regard to their physical, natural, geographic, social, and economic conditions. Twenty-three of these countries are in the United Nations' list of the least-developed countries and 33 are on the list of the low-income food deficit countries. The economic structures of the member countries are quite diverse in terms of size, production, exports and imports. Some of them have large size economies with high level of production in industries outside agriculture and they export a large variety of processed and industrial goods with some raw material. Their imports are equally varied, dominated by manufactured and intermediate goods, although some of them import food as well. A majority of countries in Sub-Saharan Africa, and some in West Asia, still depend on the production of food and raw material and their exports consist mainly of one or two dominant raw material, fuel or minerals. Their imports include food and manufactured goods.

2. In the member countries, the agriculture sector functions in a range of farming systems with very diverse impact on the current state of agriculture and rural poverty and have equally different potential for growth and poverty reduction. These complex systems have evolved under the interactive influence of the forces of nature (geography and climate), demographic changes, economic growth, technology, markets, state policies, and traditions.

3. Agriculture is still an important sector of the economy of a majority of the member countries in terms of its contribution to GDP and employment of labour. For example, it contributes from 20 to over 60 per cent of GDP in Sub-Saharan African countries—exceptions are Djibouti, Gabon, and Senegal—around one-quarter in Bangladesh and Pakistan, 20 to 40 per cent in Central Asia—Kazakhstan being the exception—and nearly 50 per cent in Albania. Its contribution is relatively modest in most countries of West Asia, Azerbaijan and Syria being the exceptions. Labour in agriculture accounts for 50 to 80 per cent of the total labour force in Sub-Saharan African countries (the oil exporting Gabon being the exception) and between 45 and 60 per cent in some South Asian countries, Indonesia, Turkey, and Albania. Production of food, including grains, is particularly important for the farm systems of small landholders to provide food security and avoid hunger.

4. In the last decade, the overall performance of the agriculture sector was reasonably strong in most countries in Sub-Saharan Africa—following a disastrous decade of the 1980s—all countries in South Asia and North Africa, but in only a handful in West Asia. The Central Asian countries experienced substantial fall in both agricultural output and GDP. The level of agricultural productivity, as measured by output per unit of land and labour, is low in most

of the Sub-Saharan African countries and in Bangladesh, Pakistan and Yemen.

5. Grains contribute 55-70 per cent of the total calories—as high as 85 per cent in the poor rural households—to the diets in developing countries. The domestic output of cereals in many IDB member countries has not kept pace with the growth in demand, although in some countries the yield levels have increased quite significantly. The large import dependent countries—with high net import to domestic output ratio—are in North Africa and West Asia followed by Sub-Saharan Africa. During the period 1990/91 and 2000/01, the ratio rose from 73 to 96 per cent in North Africa, from 35 to 51 per cent in West Asia, and remained at 27 per cent in Sub-Saharan Africa. The South East Asian countries (Indonesia and Malaysia) experienced an increase in the deficit ratio from 10 15 per cent and in South Asian countries (Pakistan and Bangladesh) the ratio fell from 5 per cent to self-sufficiency. Kazakhstan is a major net exporter of cereals. An important implication for the high net importers of cereals is that they have to either increase their production and productivity and/or earn enough foreign exchange from exporting other commodities.

6. Wheat and rice are consumed in almost all the member countries. However, wheat consumption is concentrated in the countries of West Asia, North Africa, Central Asia, and in Afghanistan, Pakistan, and Albania. The major wheat producers are Kazakhstan, Turkey, Pakistan, and Egypt. Rice consumption is concentrated in South East Asia, Bangladesh, and in some countries of West Africa. There is significant consumption of rice in countries like Pakistan, Iran and Turkey. Rice production is dominant in Indonesia, Bangladesh, Pakistan, Egypt, Malaysia, Iran, and Turkey, followed by some countries in West Africa like Cote d'Ivoire, Mali, and Guinea. Sorghum is produced mainly in countries of Sub-Saharan Africa, particularly Sudan Niger, Burkina Faso, Mali, and Chad. Yemen is the only country outside Africa where it accounts for a significant proportion of the crop area. It is also an important part of human diet in these countries. In several other countries, it is used as animal feed.

7. Food insecurity for a substantial portion of the population, especially among the rural poor, is one of the most important issues in a majority of IDB member countries. The incidence of undernourishment in the IDB member countries declined only slightly from 24 to 22 per cent of the population in the 1990s compared to the average for all developing countries that fell from 20 to 17 per cent. The average for the LDMCs declined from 37 to 33 per cent in the same period. The highest incidence was in South Asia and did not change during the decade. The undernourished population in Sub-Saharan Africa decreased from one third to 28 per cent of the population. In West Asia and North Africa, ten per cent of the population remained undernourished. The lowest incidence of undernourishment was in South East Asia. The state of undernourishment is also reflected in the proportion of underweight children in the population under five years. One-fifth of the children under five in the IDB member countries, and 30 per cent in LDMCs, were underweight in

2002. Their proportion in Sub-Saharan Africa was 25 per cent and 45 per cent in South Asia.

8. In a majority of member countries the basic problem is the low productivity of resources (land in particular) in grain production. This is clearly reflected in the large yield gaps of wheat, rice and sorghum. The challenge for the member countries is to raise the average yield to significantly higher levels. They have to undergo the first Green Revolution in Sub-Saharan Africa and a second Green Revolution in Asia. The strikingly large yield gaps in Sub-Saharan African countries can be attributed to the slow process of technology adoption and deterioration of the natural resource base. In several countries outside Sub-Saharan Africa, the slow yield growth in recent years and the large yield gaps reflect the stresses on land and water resources caused by intensive crop production practices. In most of the IDB member countries, flawed public policies on investment in the infrastructure and support services, rights to the ownership and cultivation of land, and prices of inputs and outputs, combined with poor administrative capacity, seem to have played a major role in these processes.

9. In several IDB member countries, particularly in Sub-Saharan Africa, the high yield gaps reflect a large potential for significant growth in output. In fact, there are very few countries, in which the yield gap for the three grains is not significant. The contribution of yield to future grain production will also depend on the share of irrigated agriculture since it is more intensive (and reliable) than rainfed agriculture. Of course, intensification of agriculture with irrigation—increased cropping intensity—can be risky in terms of its harmful effects on soils and the environment as has become evident in several countries of Asia and North Africa. The important point is to find a balance between intensification and sustainable use of the natural resource base.

10. In many member countries in West Asia and North Africa, South East Asia, and South Asia, there is little additional arable land or it is too costly to expand. In fact, they have to grapple with the widespread problem of land degradation—acute in arid and semiarid areas—and reduce the use of marginal lands for grain production. In most of the member countries in Sub-Saharan Africa, there is seemingly high potential for expanding the arable area. However, it can be argued that the investment in arresting or reversing the incidence of land degradation even in these countries may be as if not more important for productivity gains and quality of the environment.

11. Cereals are grown in a variety of environments in which generally they compete against other crops (or enterprises) for land and other inputs. Admittedly they are, and likely to remain, an important source of food security for a vast majority of the poor farming and non-farming households. However, with increased integration into the market economy, farmers must consider prices and profits of other crops in making decisions about producing cereals. In many areas, particularly in North Africa and West Asia, high-value crops are replacing cereals with important implications for future changes in the production and productivity of cereals. Cereal profitability is being squeezed because of the fall in prices—a trend that is likely to continue as borders become more open for trade—and the rising cost of production in

many developing countries. The focus, therefore, has to be on raising productivity and reducing the cost of production.

12. The IDB member countries are net importers of grains and most of the imported grain comes from non-member (developed) countries. There are two important implications of the evidence on cereal export and import for the member countries. First, the high net importers of cereals have to either increase their production and productivity or earn enough foreign exchange from exporting other commodities. Second, member countries with the untapped potential for growth in cereal production and productivity should produce exportable surpluses for trade with other member countries, taking advantage of the new WTO trading framework for agricultural products. A major challenge for governments in the IDB member countries, especially LDMCs and LIFDC which are net importers of cereals, is to find institutional mechanisms with support from the donor community to reduce price variability and maintain strong non-price incentives for farmers to become more productive and internationally competitive.

2. Recommendations

The challenge for grain production in the future is to raise the productivity level since there is either little potential for expansion of arable land—most of it is in Sub-Saharan Africa—or it may imply high investment and environmental costs. It is of particular relevance to several member countries outside Sub-Saharan Africa. Dependence on imported grains, including food aid, has been rising in a majority of LIFDCs, including LDMCs, with serious implications for the household and national food security. It is important, however, to differentiate between member countries in terms of their potential capacity to increase grain production and ability to pay the (rising) import bill.

There are some countries, especially in West Asia and North Africa, with moderate levels of undernourishment and food insecurity that can generate resources to meet the import bill for grains by expansion of other competitive exports. This will alleviate the stresses on their natural resource base by reducing dependence on grain production. Their strategy should focus on crop diversification and provision of safety nets to the vulnerable groups in urban and rural areas. In many other countries, particularly in Sub-Saharan Africa, where the levels of food insecurity and undernourishment are high and a large proportion of the population depends on agriculture, the focus should be on exploiting the potential for expansion of arable land and substantial productivity gains. These countries are not likely to generate adequate resources by which they could import grains since a large part of the future demand and requirements for grains will also be in this group of countries.

The results of this study, summarised in the preceding section, lead to several recommendations on a number of key issues for sustainable growth of grain production and productivity in the member countries of IDB.

1. In a majority of the member countries, land degradation and inadequate management of water are the most serious problems affecting the crop productivity. To alleviate the twin menace, a number of policy changes are needed at the national and regional levels.

- Co-ordinated management of water at the regional level for the cross-boundary river systems, in which international agencies should participate with investment and technical assistance.
- Increased level of investment in small-scale irrigation and water harvesting projects.
- Devolution of water management responsibility to water users and cost recovery of the operations and maintenance of irrigation system or removal of subsidy on irrigation water.
- Rapid dissemination of practices of zero-tillage and integrated soil, water and pest management on the farm.
- Increased financial and technical support by international aid agencies to conserve land and water resources and increase the institutional capacity of national governments and regional organisations to raise the level of grain productivity especially of small and poor farmers. Given the role played by IDB in the development of land and water resources in the member countries, it should consider raising the level of assistance (financial and technical) for both the country and regional projects, emphasising the direct participation of farmers in these projects.

2. In several countries in Sub-Saharan Africa, West Asia, North Africa, Central Asia, and South Asia, the issues of land titles, rights to land through ownership and tenancy, land concentration, and land fragmentation should be addressed with urgency to increase productivity, enhance food security, reduce rural poverty, and promote social harmony. International agencies should raise the level of assistance and institutional support to national governments.

3. National governments, supported by international agencies, should provide increasing technical and financial support to improve and build the rural infrastructure, including rural education, health care and roads, since they can make a significant contribution to productivity enhancement and rural poverty reduction.

4. Given the importance of technology in raising grain productivity, the emphasis should be on the development and transfer of technologies that can be adopted by farmers with reduced dependence on natural resources and inputs. Regional consortia for new technologies to reduce the yields gaps should be adequately funded and their work well coordinated with the NARS. IDB should provide financial and technical assistance, directly or through the regional consortia to organisations like WARDA for the development of rice in West African countries.

5. An important implication of biotechnology for future grain production in the IDB member countries—Indonesia, Pakistan and Egypt have established apparently strong institutional capacity for biotechnology in crop production—is that the national and international agricultural research systems increase the level of investment and integrate their work on regional basis. The regional consortia of donors and recipients on rice and wheat are a

good beginning for addressing the yield gap issue in both Africa and Asia. However, it is important that the breeding programmes, using biotechnology to enhance productivity, should provide adequate protection to the indigenous strains of grains.

6. The on-going projects on integrated management practices, combining soil and water and pest control, with direct participation of farmers in several countries should be expanded.

7. National governments should not waste scarce financial and economic resources for general subsidies on farm inputs and credit since they distort resource allocation and have perverse distributive effects. Similarly, they should remove all forms of implicit taxes on farm produce and create a competitive environment for farm inputs and outputs. To maintain output and price stability, governments should provide institutional support to the private sector with minimum direct intervention in the production and distribution of inputs and products. The government's role in the input and output markets should focus on the following:

   - In the seed market, they should protect the rights of breeders, regulate the quality of seed, and create incentives for the private sector to invest in the production and distribution of quality seed. They should improve the regulatory and institutional environment for seed multiplication and distribution to farmers. Turkey has probably made the most significant progress in this respect. Private sector in the seed market needs proper incentives, information, and infrastructure. In addition, farmer organisations can play an important role in seed production and multiplication, as has been the experience in some countries of West Africa, at least at the local level.

   - They should facilitate the integration of financial markets in rural areas and make credit accessible to small landholders. In several countries, the on-going group-lending programmes through community-based organisations should also be supported by changes in the rules and regulations governing the banking system. This approach seems to reduce the cost of credit and make it conveniently accessible to those groups in the community who are not regarded credit worthy by the commercial banks. The experience in countries like Indonesia, Bangladesh and Pakistan is that these programmes facilitate the use of productivity-enhancing inputs and are also financially sustainable without subsidy. The centrally administered rural or agricultural development banks are costly and do not reach the small farmers.

   - They have to find a balance between two apparently conflicting policies: provide food subsidy to consumers as a means to reduce food insecurity and give price support to farmers that maintains incentives for investment in productivity-enhancing technology. The food subsidy bill can be reduced significantly by (i) changing the administrative structure and mechanisms to reach the vulnerable groups and (ii) maintaining incentives for farmers to raise productivity so that the cost of food declines. Farmers everywhere tend to respond strongly to both price and

non-price incentives. It makes little sense to provide price subsidy on inputs if it has little impact on productivity, distorts resource allocation between crops or enterprises, wastes scarce resources (e.g. water and fuel), and discriminates against small landholders. Similarly, governments have to find mechanisms, other than their intrusive involvement, to reduce price variability in the market.

- In the context of grain production in the future, with increased liberalisation of trade in agricultural products, governments should create conditions that allow farmers to develop and strengthen comparative advantage in producing grains. Food security cannot be increased by focusing on self-sufficiency without taking into account the level of productivity and production cost of grains. For example, investment in the marginal lands to produce more grains should not be an option because there are more economical and environmentally friendly alternatives. On the other hand, there are vast areas with high potential for growth, in several countries of Sub-Saharan Africa, where farmers need public investment and policies that help them establish competitive advantage in grain, especially wheat and rice, production. The regional consortia for productivity enhancement and the trade in grains between member countries should receive high priority in the strategic plans of the Bank and governments.

8. Since many member countries are dependent on imported grains, including food aid from bilateral and multilateral sources, it is imperative that they pursue policies on two fronts simultaneously both at the individual and regional levels.

   - First, in the member countries of Sub-Saharan Africa where there is demonstrable potential for growth of production and productivity of grains, the level of funding and support by individual governments and international agencies, including IDB, should increase and be channelled to programmes and projects that have shown to be effective. IDB should consider involvement in the NEPAD initiative on a regional basis. The aim is to produce an exportable surplus based on comparative advantage, given the potential for area and yield expansion.

   - Second, in the member countries of North Africa and West Asia, excluding Turkey, perhaps Iraq and Iran, it may well be prudent to reallocate resources from grains to other products with higher productivity and economic returns to farmers. IDB should help some of these countries in the transition with financial and technical assistance and provide support for imported grains from other member countries with exportable surpluses. The existing or new bilateral and multilateral (regional) trade agreements, within the WTO framework, should be used to promote the grain trade between member countries.

9. There are substantial uncertainties about the effects of changes in (i) the trade environment for agricultural products, including grains, resulting from the on-going WTO negotiations and (ii) the global climate, especially the frequency and severity of floods and droughts. Governments should persist in their

efforts, and seek support from the international community, to provide risk-mitigating mechanisms for the small grain producers and low-income consumers. These mechanisms, including financial assistance and food aid, should be well targeted and not distort incentives for resource allocation.

10. Given the challenges for future grain production, especially in the LDMCs, the Bank should make significant contribution to promote agricultural trade among member countries and support the existing regional institutions with assistance for information networking, and region-based development activities such as water conservation, building rural infrastructure, and improving agricultural research.

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APPENDIX TABLES

List of Tables

Data Sources

[**1**] Jelle Bruinsma (Editor): *World Agriculture: Towards 2015/2030*, 2003

[**2**] FAO database (FAOSTAT)

[**3**] FAO: *The State of Food Insecurity in the World 2002*

[**4**] FAO: *The Role of Agriculture in the Development of LDCs and Their Integration into the World Economy*, 2002 (Table 12)

[**5**] FAO: *FAO Papers on Selected Issues Relating to the WTO Negotiations on Agriculture*, 2002 (Table 1)

[**6**] FAO: *Assessment of the World Food Security Situation*, 29th Session, Committee on World Food Security, May 2003

[**7**] U.N.D.P.: *Human Development Report 2003*

[**8**] World Bank: *World Development Report 2003*

[**9**] World Food Programme: *Annual Report 2002*

Table A1. Key Economic Indicators in IDB Member Countries

Country	HDI Rank 2001	Total Pop'n-(Million) 2001	Annual Pop'n Growth (%) 1990-2001	GNI per person 2001	Annual Growth % of GDP 1990-2001	% Pop'n below $1 per day 1990-2001	% Rural Pop' 1990	% Rural Pop' 1990	Agr'l. V. Added % of GDP 2001	% Agr' Labour 1990	% Agr' Labour 2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
EAST & S. AFRICA		82.3									
Djibouti	153	0.6	2.9	890			19.15	16.0	4	82.8	79.0
Mozambique	170	18.1	2.2	210	7.5	37.9	78.99	67.9	22	82.7	80.5
Somalia		9.1	2.2				75.8	72.5		75.3	71.2
Sudan	138	31.7	2.2	330			73.4	63.9		69.5	61.1
Uganda	147	22.8	3	280	6.8	82.2	88.8	85.8	42	84.5	80.1
WEST AFRICA		114.2									
Benin	159	6.4	2.8	360	4.8		65.5	58	38	63.5	54.0
Burkina Faso	173	11.6	2.4	210	4.9	61.2	86.4	83	35	92.4	92.3
Cameroon	142	15.2	2.4	570	2.1	33.4	59.7	51	46	69.7	59.4
Chad	165	7.9	2.9	200	2.5		79.0	76	40	83.3	75.2
Comoros	134	0.6	2.6	380			72.1	66.7	39	77.6	73.7
Cote d'Ivoire	161	16.4	3	630	3.1	12.3	60.2	56.4	24	59.7	49.2
Gabon	118	1.3	2.7	3160			31.9	18.5	7	51.4	37.7
Gambia	151	1.3	3.3	330		59.3	75.1	69.3	27	81.8	79.0
Guinea	157	7.6	2.5	400	4.1		76.6	72.5	25	87.2	83.8
Guinea-Bissau	166	1.2	2.4	160			76.2	68.5	62	85.4	82.7
Mali	172	11.1	2.5	210	4.1	72.8	76.2	69.8	38	85.8	81.0
Mauritania	154	2.8	2.9	350	4.2	28.6	56.0	42.3	21	55.2	52.9
Niger	174	11.2	3.4	170	2.6	61.4	83.9	79.4	39	89.8	87.8
Senegal	156	9.8	2.6	480	3.9	26.3	60.0	52.6	18	76.7	73.7
Sierra Leone	175	5.1	2.3	140	-2.8	57	70.0	63.4	49	67.5	62.1
Togo	141	4.7	2.7	270	2.2		71.5	66.6	39	65.6	59.7

Table A1. Continued

Country	HDI Rank 2001	Total Pop'n- (Million) 2001	Annual Pop'n Growth (%) 1990-2001	GNI per person 2001	Annual Growth % of GDP 1990-2001	% Pop'n below $1 per day 1990-2001	% Rural Pop' 1990	% Rural Pop' 1990	Agr'l. V. Added % of GDP 2001	% Agr' Labour 1990	% Agr' Labour 2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
WEST ASIA		240.1									
Azerbaijan	89	8.1	1.1	650	2.7	<2		48.1	20		26.7
Bahrain	37	0.7	3.2	9370			12.5	7.8		1.8	1.0
Iran	106	64.7	1.6	1750	3.6		43.7	36.0	19	32.2	26.5
Iraq		23.8	2.5				30.4	32.5		16.1	10.1
Jordan	90	5	4.2	1750	4.8	<2	27.8	6.5	2	15.1	11.4
Kuwait	46	2	-0.4	18030	3.2		5.1	4.0		1.2	1.1
Lebanon	83	4.4	1.7	4010	5.4		15.8	10.3	12	7.3	3.7
Oman	79	2.5	3.7				37.9	24.0		44.7	35.8
Palestine	98	3.1	4.1	1350							
Qatar	44	0.6	1.9				10.2	7.3		2.8	1.3
Saudi Arabia	73	21.4	2.8	7230	1.5		21.8	13.8		19.1	9.8
Syria	110	16.6	2.9	1000	5.5		51.1	48.6	24	33.2	27.8
Turkey	96	66.2	1.5	2540	3.3	<2	38.8	34.2	15	53.6	46.2
United Arab Emirates	48	3	4.4				19.8	13.3		7.8	4.9
Yemen	148	18	3.8	460	5.6	15.7	77.2	75.3	15	61.0	50.9
NORTH AFRICA		140.4									
Algeria	107	30.9	1.9	1630	2	<2	48.6	42.9	12	26.1	24.3
Egypt	120	65.2	2	1530	4.6	3.1	56.4	57.3	18	40.3	33.3
Libya	61	5.4	2.1				18.2	12.4		11.0	6.0
Morocco	126	29.2	1.8	1180	2.5	<2	51.6	44.5	16	44.7	36.1
Tunisia	91	9.7	1.6	2070	4.7	<2	42.1	34.5	12	28.2	24.6

Table A1. Continued

Country	HDI Rank 2001	Total Pop'n- (Million) 2001	Annual Pop'n Growth (%) 1990-2001	GNI per person 2001	Annual Growth % of GDP 1990-2001	% Pop'n below $1 per day 1990-2001	% Rural Pop' 1990	% Rural Pop' 1990	Agr'l. V. Added % of GDP 2001	% Agr' Labour 1990	% Agr' Labour 2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CENTRAL ASIA		31.3									
Kazakhstan	76	14.8	-0.8	1360	-2.8	<2		73	9		17.7
Kyrgyz	102	5	1.1	280	-2.9			92	38		25.7
Tajikistan	113	6.2	1.5	170	-8.7			72.4	20		33.8
Turkmenistan	87	5.3	3.3	950	-2.8	12.1		55.2	28		33.4
SOUTH ASIA		302.5									
Afghanistan		27.3	3.9				81.8	78.1		70.3	67.0
Bangladesh	139	133.4	1.8	370	4.9	36	80.2	75.0	23	65.2	55.6
Maldives	86	0.3	2.6	2040			74.1	72.5		32.6	22.8
Pakistan	144	141.5	2.5	420	3.7	13.4	69.4	66.9	25	51.7	47.1
SOUTH EAST ASIA		237.7									
Brunei DS	31	0.3	2.7	15380			34.2	27.7		1.8	0.7
Indonesia	112	213.6	1.6	680	3.8	7.2	69.4	59.0	16	55.2	48.4
Malaysia	58	23.8	2.4	3640	6.5	<2	50.2	42.6	8	27.4	18.7
EASTERN EUROPE		3.4									
Albania	95	3.4	0.4	1230	3.7		63.9	57.7	49	54.6	48.2
SOUTH AMERICA		0.4									
Suriname	77	0.4	0.4	1690			34.6	25.9		21.2	18.9

Table A2. Agricultural Growth and Indices for Food and Cereals in IDB Member Countries

Country	% Growth of Agr'l Output Index (1989/91-2001/02)	Agr'l. V. Added per Worker 1988-90 (1995 $)	Agr'l. V. Added per Worker 1998-2000 (1995 $)	Agr'l-Prod. Index (1989-91=100) Average Av. 2000-02	Agr'l- Prod Per capita Index (1989-91=100) Av. 2000-02	Food Output Index (1989-91=100) Average 2000-2002	Food Output-Per capita Index (1989-91=100) Av. 2000-02	Cereal Output Index (1989-91=100) Av. 2000-02	Cereal Output Per capita Index (1989-91=100) Av. 2000-02
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EAST & S. AFRICA									
Djibouti	-1.01			76.7	59.4	76.7	59.4	157.4	124
Mozambique	3.83	123	134	128.5	94.4	126.8	93.1	259.5	190.3
Somalia				104.9	81.9	104.8	81.8	61	47.6
Sudan	4.61			167.3	130.7	171.3	133.8	151.2	118.7
Uganda	2.96	298	353	137.4	98.6	135.4	97.2	137.9	98.8
WEST AFRICA									
Benin	5.66	397	586	182.9	132.3	173.1	125.1	172.6	124.8
Burkina Faso	3.81	148	180	149.3	113.3	147.8	112.1	144.7	109.8
Cameroon	2.54	842	1104	130.1	99.4	130.1	99.4	161.5	123.5
Chad	4.09	173	227	145	103.9	151.2	108.3	166.6	119.4
Comoros	1.8			120.2	87.1	121.8	88.3	110.9	80.4
Cote d'Ivoire	3.04	937	1097	132.4	101.9	134.5	103.6	158.9	122.5
Gabon	1.81			119.6	88.7	116.6	118.1	117.2	87
Gambia	5			143.9	99.5	145.8	100.7	180.3	125.3
Guinea	4.01	249	292	160	119.1	158.8	118.1	183.2	136.5
Guinea-Bissau				142.9	110.2	143.1	110.4	96.5	74.5
Mali	3.22	252	285	135.9	102	129.9	97.6	134.4	100.8
Mauritania	1.2	391	480	110.4	80.1	110.4	80.1	130.8	94.6
Niger	3.45	204	214	143.4	98.4	142.4	97.8	133.2	91.3
Senegal	2.07	344	304	121.5	92.3	122.5	93	99.8	75.6
Sierra Leone	-2.15	612	336	76.8	67.7	78.7	69.3	38.5	33.9
Togo	2.95	451	538	132.3	98.1	128.7	95.4	142.7	105.6

Table A2. Continued

Country	% Growth of Agr'l Output Index (1989/91-2001/02)	Agr'l. V. Added per Worker 1988-90 (1995 $)	Agr'l. V. Added per Worker 1998-2000 (1995 $)	Agr'l- Prod. Index (1989-91=100) Average Av. 2000-02	Agr'l- Prod Per capita Index (1989-91=100) Av. 2000-02	Food Output Index (1989-91=100) Average 2000-2002	Food Output- Per capita Index (1989-91=100) Av. 2000-02	Cereal Output Index (1989-91=100) Av. 2000-02	Cereal Output Per capita Index (1989-91=100) Av. 2000-02
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WEST ASIA									
Azerbaijan	0.74		708	70.8	62.8	80.9	71.9	176.4	156.5
Bahrain	0.07			89.9	67.6	89.9	67.6		
Iran	3.1	2838	3756	149.9	122.8	150	122.9	113.2	92.8
Iraq	-2.34			75.3	55	75.7	55.3	50.2	36.7
Jordan	1.95			145.2	94	148.7	96.2	76.2	48.8
Kuwait	14.91			185.2	200.4	186.2	201.5	248.4	268
Lebanon	3.61		29241	151.9	116.5	149.4	114.6	122	93.5
Oman	4.84			159.8	108.6	161.1	109.5	118	80.4
Palestine	-0.24			102		102		104.2	
Qatar	3.76			161.2	127.5	161.2	127.5	172.8	136.3
Saudi Arabia	-1.22			91.9	67.3	91.1	66.7	50.6	37
Syria	3.58	2056	2890	157.2	117.4	157.9	117.8	233.5	174.8
Turkey	1.2	1847	1878	114.2	94.7	114.4	94.9	109.2	90.8
U. A. Emirates	16.61			525.2	399.7	528.8	402.5	10.4	8
Yemen		333	377	139.2	84.4	137.2	83.1	101.2	60.9
NORTH AFRICA									
Algeria	2.57	1776	1962	136.4	110	137.6	110.9	88.7	71.5
Egypt	3.51	997	1240	146.5	119.3	150.2	122.3	159.9	130.3
Libya	3.9			145.4	115.9	147	117.2	70.8	56.3
Morocco	1.27	1847	1785	102.4	82.8	102.4	82.8	51.6	41.6
Tunisia	1.22	2228	3083	115.5	98.9	116.7	99.9	62.3	53.7

Table A2. Continued

Country	% Growth of Agr'l Output Index (1989/91-2001/02)	Agr'l. V. Added per Worker 1988-90 (1995 $)	Agr'l. V. Added per Worker 1998-2000 (1995 $)	Agr'l-Prod. Index (1989-91=100) Average Av. 2000-02	Agr'l- Prod Per capita Index (1989-91=100) Av. 2000-02	Food Output Index (1989-91=100) Average 2000-2002	Food Output-Per capita Index (1989-91=100) Av. 2000-02	Cereal Output Index (1989-91=100) Av. 2000-02	Cereal Output Per capita Index (1989-91=100) Av. 2000-02
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CENTRAL ASIA									
Kazakhstan	-3.32		1421	71	73.7	72.6	75.4	77.1	80.1
Kyrgyz	2.4		1583	112	98.6	126.5	111.3	130.7	114.9
Tajikistan	-4.12		1236	51.9	44.7	55.4	47.8	167.5	144.8
Turkmenistan	-0.42		1229	91.9	69.8	129	98	433	328.2
SOUTH ASIA									
Afghanistan									
Bangladesh	3.05	251	296	136.8	107.2	138.6	108.7	143.7	112.6
Maldives	3.26			148	106.5	148	106.5	70.9	50.3
Pakistan	3.98	513	630	149.3	113.2	159	120.5	132.3	100.3
SOUTH EAST ASIA									
Brunei DS	10.24			299.5	229.4	301.6	231	34.9	26.7
Indonesia	1.34	674	734	120.4	102.3	120.7	102.5	115	97.7
Malaysia	2.17	5680	6519	129.8	102.3	148.1	116.8	122.9	96.9
EASTERN EUROPE Albania									
SOUTH AMERICA Suriname	-2.58			78.1	74.9	78.2	74.9	79.2	75.8

Table A3. Use of Land, Irrigation, Fertilizer and Machinery in IDB member Countries

Country	Total Land Area (000 ha) 2000	Arable and Permanent Crops Area (000 ha) 2000	Arable Land Area (000 ha) 2000	Arable Land per Capita (ha) 2000	% Arable Area in Total Land Area 2000	% Agr'l Area in Total Land Area 2000	% Irrigated Area in Arable Land Area 2000	Fertilizer Consumption (Kg per Arable ha) 2000	Arable Land per Tractor (ha) 2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EAST & S. AFRICA									
Djibouti	2,318					56.1			
Mozambique	78,409	4,160	3,925	0.22	5.0	61.4	2.7	2.90	683
Somalia	62,734	1,067	1,043	0.11	1.7	70.2	19.2	0.48	567
Sudan	237,600	16,506	16,306	0.51	6.9	56.3	12.0	2.34	1476
Uganda	19,710	6,910	5,060	0.22	25.7	44.2	0.2	0.92	1077
WEST AFRICA									
Benin	11,062	2,188	1,925	0.3	17.4	24.8	0.6	23.87	10405
Burkina Faso	27,360	3,825	3,775	0.33	13.8	35.9	0.7	10.24	1892
Cameroon	46,540	7,160	5,960	0.39	12.8	19.7	0.6	8.06	11920
Chad	125,920	3,550	3,520	0.45	2.8	38.6	0.6	4.97	20465
Comoros	223	128	78		35.0	64.1		3.85	
Cote d'Ivoire	31,800	7,350	2950	0.18	9.3	64.0	2.5	24.32	
Gabon	25,767	496	325	0.25	1.3	20.0	4.6	0.92	217
Gambia	1,000	230	225	0.17	22.5	68.9	0.9	4.44	5000
Guinea	24,572	1,485	885	0.12	3.6	49.6	10.7	3.61	1633
Guinea-Bissau	2,812	350	300	0.25	10.7	50.9	5.7	5.00	15789
Mali	122,019	4,662	4,618	0.42	3.8	28.4	3.0	11.02	1776
Mauritania	102,522	500	488	0.17	0.5	38.8	10.0	2.46	1284
Niger	126,670	4,500	4,490	0.4	3.5	13.0	1.5	0.97	35078
Senegal	19,253	2,375	2,338	0.24	12.1	41.7	3.0	18.41	3597
Sierra Leone	7,162	545	487	0.1	6.8	38.3	6.2	0.25	5939
Togo	5,439	2,630	2,510	0.53	46.2	66.7	0.3	7.32	31375

Table A3. Continued

Country	Total Land Area (000 ha) 2000	Arable and Permanent Crops Area (000 ha) 2000	Arable Land Area (000 ha) 2000	Arable Land per Capita (ha) 2000	% Arable Area in Total Land Area 2000	% Agr'l Area in Total Land Area 2000	% Irrigated Area in Arable Land Area 2000	Fertilizer Consumption (Kg per Arable ha) 2000	Arable Land per Tractor (ha) 2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WEST ASIA									
Azerbaijan	8,660	1,950	1,688	0.21	19.5	51.6	86.2%	4.71	55
Bahrain	71	6	2		2.8	14.1	200.0	195.00	167
Iran	163,620	17,296	15,312	0.24	9.4	37.5	49.2%	87.00	65
Iraq	43,737	5,540	5,200	0.22	11.9	21.8	67.8	73.02	105
Jordan	8,893	398	244	0.05	2.7	13.4%	30.7	84.26	44
Kuwait	1,782	9	8		0.5	8.1	87.5	108.00	
Lebanon	1,023	331	190	0.04	18.6	33.9	54.7	342.02	23
Oman	30,950	80	20		0.1	3.5	310.0	316.35	133
Palestine	38	222	10	0.03	26.3	47.4	120.0		14
Qatar	1,100	21	18		1.6	6.5	72.2	36.11	225
Saudi Arabia	214,969	3,785	3,594	0.17	1.7	80.8	45.1	104.90	378
Syria	18,378	5,427	4,622	0.28	25.2	74.8	25.9	79.68	48
Turkey	76,963	26,672	24,138	0.36	31.4	50.7	18.6	88.93	27
U. A. Emirates	8,360	232	52	0.02	0.6	6.4	146.2	685.58	159
Yemen	52,797	1,668	1,546	0.09	2.9	33.6	32.0	10.96	267
NORTH AFRICA									
Algeria	238,174	8,194	7,674	0.25	3.2	16.7	7.3	12.07	82
Egypt	99,545	3,296	2,830	0.04	2.8	3.3	116.5	435.82	33
Libya	175,954	2,150	1,815	0.34	1.0	8.8	25.9	39.53	53
Morocco	44,630	9,751	8,792	0.3	19.7	68.9	14.8	40.98	203
Tunisia	15,536	5,014	2,909	0.3	18.7	58.4	13.1	38.42	83

Table A3. Continued

Country	Total Land Area (000 ha) 2000	Arable and Permanent Crops Area (000 ha) 2000	Arable Land Area (000 ha) 2000	Arable Land per Capita (ha) 2000	% Arable Area in Total Land Area 2000	% Agr'l Area in Total Land Area 2000	% Irrigated Area in Arable Land Area 2000	Fertilizer Consumption (Kg per Arable ha) 2000	Arable Land per Tractor (ha) 2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CENTRAL ASIA									
Kazakhstan	269,970	21,862	21,724	1.47	8.1%	76.3	10.8	1.50	415
Kyrgyz	19,180	1,435	1,368	0.27	7.1	55.9	78.4	20.80	53
Tajikistan	14,060	860	730	0.11	5.2	31.0	98.5	13.49	24
Turkmenistan	46,993	1,695	1,630	0.31	3.5	68.9	110.4	60.34	33
SOUTH ASIA									
Afghanistan	65,209	8,054	7,910	0.29	12.1	58.4	30.2	0.63	9417
Bangladesh	13,017	8,462	8,117	0.06	62.4	69.6	50.3	165.76	1479
Maldives	30	3	1		3.3	13.3			
Pakistan	77,088	21,920	21,268	0.15	27.6	34.9	84.7	136.34	66
SOUTH EAST ASIA									
Brunei DS	527	7	3		0.6	2.5	33.3		
Indonesia	181,157	33,146	20,100	0.09	11.1	24.5	23.9	125.85	287
Malaysia	32,855	7,605	1,820	0.08	5.5	24.0	20.1	790.25	42
EASTERN EUROPE									
Albania	2,740	699	578	0.17	21.1%	41.8%	58.8	17.47	71
SOUTH AMERICA									
Suriname	15,600	67	57	0.1	0.4	0.6	89.5%	97.37	43

Table A4. Cereals: Production, Trade and Supply in IDB Member Countries

Country	Area hectare 1989-91	Area hectare 2000-02	Output (met. ton) 1989-91	Output (met. ton) 2000-02	Yield (Hg/ha) 1989-91	Yield (Hg/ha) 2000-02	Exports (met. ton) 1990-91	Exports (met. ton) 2000-01	Imports (met. ton) 1990-91	Imports (met. ton) 2000-2001	Self-Suff. Ratio (%) 1997-99	Output per Capita (kg) 2000-01
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
E. & S. AFRICA												
Djibouti	5	8	8	13	15,238	16,250	645		46,892	48,018		
Mozambique	1,560,919	1,893,625	629,216	1,609,154	4,037	8,562			522,891	467,016	80	89
Somalia	671,200	671,433	496,753	327,567	7,153	4,868			204,150	118,089	56	35
Sudan	5,376,189	7,467,934	2,771,200	4,193,583	4,968	5,567	50,000	54,064	961,153	875,006	83	106
Uganda	1,077,677	1,395,000	1,597,242	2,247,667	14,825	16,106	31	17,543	23,375	117,562	88	98
WEST AFRICA												
Benin	658,061	921,102	566,080	954,214	8,601	10,388	22	1,098	247,052	105,826	87	138
Burkina Faso	2,743,343	3,060,871	1,974,824	2,838,135	7,166	9,232	42	51,946	138,086	221,144	91	225
Cameroon	754,869	747,489	889,549	1,320,306	11,812	17,662	99	837	334,482	482,718	77	95
Chad	1,170,467	1,899,595	676,744	1,139,111	5,756	5,970			50,987	58,021	92	144
Comoros	14,659	15,700	18,897	20,867	12,889	13,291		3	33,419	22,969		29
Cote d'Ivoire	1,401,333	1,381,333	1,224,710	1,829,583	8,739	13,245	30,000	4,282	510,368	1,957,013	66	113
Gabon	14,393	16,500	23,012	26,967	15,987	16,343			58,643	117,228	21	22
Gambia	92,063	137,392	99,317	171,512	10,778	12,455		246	97,710	128,259	45	132
Guinea	603,328	742,031	631,969	1,030,700	10,522	13,883		7,625	288,435	325,008	72	134
Guinea-Bissau	105,791	153,557	164,707	162,143	15,553	10,546			55,546	80,076		141
Mali	2,340,175	2,768,888	2,114,113	2,712,781	9,072	9,800	20,000	10,292	80,067	107,570	94	235
Mauritania	156,137	184,971	130,767	149,328	8,311	8,520			269,531	261,378	21	72
Niger	6,231,559	7,693,062	2,120,259	2,678,405	3,415	3,468	1	215	128,127	281,851	91	238
Senegal	1,211,080	1,174,281	996,460	940,877	8,227	8,025	56	334	658,111	905,272	48	106
Sierra Leone	461,990	213,045	565,633	251,024	12,245	11,765			171,349	193,923	43	49
Togo	624,635	702,846	504,881	722,102	8,092	10,275	39,000	48,205	104,313	140,844	79	160

Table A4. Cereals (continued)

Country	Area hectare 1989-91	Area hectare 2000-02	Output (met. ton) 1989-91	Output (met. ton) 2000-02	Yield (Hg/ha) 1989-91	Yield (Hg/ha) 2000-02	Exports (met. ton) 1990-91	Exports (met. ton) 2000-01	Imports (met. ton) 1990-91	Imports (met. ton) 2000-2001	Self-Suff. Ratio (%) 1997-99	Output per Capita (kg) 2000-01
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
WEST ASIA												
Azerbaijan		1,770,154		1,861,774		25,199		2,989		710,834	61	225
Bahrain		735,264						4,666	73,287	121,448		
Iran	9,502,673	7,740,318	12,972,594	15,047,354	13,645	19,374		13,244	5,595,794	9,890,154	69	192
Iraq	2,741,383	2,525,567	2,541,384	1,217,467	9,271	4,802	275	6,842	2,451,665	4,269,597	40	51
Jordan	100,563	52,157	105,312	58,614	10,400	12,958	55,058	6,306	1,377,223	1,535,594	4	12
Kuwait	498	1,544	1,443	3,587	24,387	23,181	2,898	16,501	172,418	747,163		2
Lebanon	40,918	53,457	79,977	143,607	19,547	26,826	7,023	1,813	578,617	822,559	10	25
Oman	2,343	2,487	4,980	5,774	21,243	23,215		212,255	341,485	531,987		2
Palestine	1,700	1,700	867	900	5,098	5,294			140,984	12,779		
Qatar	1,170	1,562	3,394	5,736	29,095	36,830		620	113,602	162,415		10
Saudi Arabia	1,008,543	615,035	4,214,336	2,184,155	41,774	35,502	1,112,856	5,863	4,977,322	6,356,243	23	98
Syria	3,967,635	3,027,687	2,597,203	5,452,854	6,683	18,027	10,228	100,058	1,916,049	1,336,654	77	245
Turkey	13,679,107	13,945,548	28,282,540	31,253,145	20,652	22,409	2,089,232	2,025,266	1,907,463	1,916,767	99	435
U. A. Emirates	1,156	485	2,181	241	19,117	4,845	201,372	498,023	471,931	2,241,100		
Yemen	781,481	654,194	692,860	682,803	8,708	10,453		9,359	1,557,426	1,993,458	24	36
N. AFRICA												
Algeria	2,807,482	1,770,000	2,481,007	1,897,650	8,542	10,416	1,786		4,797,277	7,095,617	21	55
Egypt	2,279,585	2,699,811	12,672,365	19,626,457	55,512	72,711	113,547	563,805	7,980,115	9,694,231	69	305
Libya	418,492	342,020	284,038	216,283	6,802	6,324		660	2,375,598	2,015,963	10	39
Morocco	5,544,500	5,180,900	7,456,488	3,965,948	13,463	7,768	1,942	136,480	1,781,100	5,187,825	55	112
Tunisia	1,372,077	781,857	1,623,867	1,004,467	11,120	13,202	25,518	222,632	1,181,881	2,679,160	45	150

Table A4. Cereals (continued)

Country	Area hectare 1989-91	Area hectare 2000-02	Output (met. ton) 1989-91	Output (met. ton) 2000-02	Yield (Hg/ha) 1989-91	Yield (Hg/ha) 2000-02	Exports (met. ton) 1990-91	Exports (met. ton) 2000-01	Imports (met. ton) 1990-91	Imports (met. ton) 2000-2001	Self-Suff. Ratio (%) 1997-99	Output per Capita (kg) 2000-01
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
C. ASIA												
Kazakhstan		13,081,777		14,471,001		11,019		4,820,196		20,770	167	938
Kyrgyz		617,760		1,755,533		28,361		18,147		162,419	93	340
Tajikistan		376,340		490,635		13,033		36		438,631	44	45
Turkmenistan		819,167		1,715,233		20,942				174,247	87	260
SOUTH ASIA												
Afghanistan	2,296,667	2,240,000	2,754,333	3,739,000	11,996	16,692			232,686		94	94
Bangladesh	11,082,944	11,711,927	28,031,691	39,121,167	25,297	33,400		835	1,580,187	1,980,361	87	290
Maldives	6	5	7	5	11,250	9,333			25,453	35,382	0	
Pakistan	11,793,967	12,299,600	21,037,567	28,092,200	17,838	22,822	974,278	2,716,884	1,510,030	610,634	99	206
S.-E. ASIA												
Brunei DS	617	257	1,123	403	17,929	15,628			40,301	51,799		3
Indonesia	13,442,158	15,003,927	51,258,341	60,754,669	38,137	40,494	89,658	64,503	2,311,273	5,819,383	88	282
Malaysia	695,808	704,933	1,886,261	2,175,933	27,099	30,876	84,052	146,739	2,923,832	3,925,497	25	96
E. EUROPE												
Albania	295,080	183,433	792,167	543,733	26,093	29,647		48	207,518	400,515	61	184
S. AMERICA												
Suriname	60,756	47,957	228,937	182,417	37,700	38,092	59,652	58,860	53,435	40,681	115	382

Table A5. Area, Output and Yield of Wheat, Rice and Sorghum in IDB Member Countries

Country	Wheat Area (000 ha) 2000-02	Annual Change in Wheat Area (%)	Wheat Output (000 MT) 2000-02	Wheat Yield (Hg/ha) 2000-02	Annual Change in Wheat Yield (%)	Rice Area (000 ha) 2000-02	Annual Change in Rice Area (%)	Rice Output (000 MT) 2000-02	Rice Yield (Hg/ha) 2000-02	Annual Change in Rice Yield (%)	Sorghum Area (000 ha) 2000-02	Annual Change in Sorghum Area (%)	Sorghum Output (000 MT) 2000-02	Sorghum Yield (Hg/ha) 2000-02	Annual Change in Sorghum Yield (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
E.& S. AFRICA															
Djibouti															
Mozambique	1	-6	1	8,333	-4	169		162	9,583		420		293	7,489	9.1
Somalia	3	1.8	0.9	3,462	0.7	2	-6	3	15,111	-6.2	417	0.7	113	2,685	-4.4
Sudan	109	-11	255	23,292	3	5	20	10	19,539	-4	4,913	1	3,312	6,657	1
Uganda	8	7	13	17,381	-1	75	5	112	15,046	1	281	1	405	14,417	0
WEST AFRICA															
Benin						27	13.3	57	21,354	4.9	184	2.6	172	9,316	2
Burkina Faso						48	8.2	101	21,160	0.1	1,396	0.8	1,254	8,941	0.9
Cameroon	0.3	0	0.4	13,333	0	20	6	62	30,701	-2	357	-3	440	12,333	5
Chad	2	3	3	16,423	0	89	8	107	11,996	-3	702	4	439	6,251	0
Comoros						14	0.3	17	12,143	0.3					
Cote d'Ivoire						510	-2	1,087	21,314	8	58	2	31	5,376	-1
Gabon						1	1.9	1	20,000	0					
Gambia						13	0.5	30	21,960	3.3	19	4.5	25	12,920	3.3
Guinea						499	3	790	15,835	3	7	-8	5	7,381	-2
Guinea-Bissau						71	1	92	12,961	-5	22	4	17	7,494	-2
Mali	3	14	8	25,021	2	424	6	867	20,511	3	800	-1	678	8,345	1
Mauritania	0.4	-2	0.4	10,000	-1	18	3	70	39,905	1	146	1	68	4,454	-2
Niger	6	7	8	13,081	-6	26	-1	71	27,536	1	2,455	1	561	2,252	4
Senegal						83	1	208	24,940	1	180	4	143	7,977	-2
Sierra Leone						189	-6	226	11,934	-1	7	-14	9	12,905	7
Togo						31	5	63	19,631	4	183	0	145	7,900	1

Table A5. Continued

Country	Wheat Area (000 ha) 2000-02	Annual Change in Wheat Area (%)	Wheat Output (000 MT) 2000-02	Wheat Yield (Hg/ha) 2000-02	Annual Change in Wheat Yield (%)	Rice Area (000 ha) 2000-02	Annual Change in Rice Area (%)	Rice Output (000 MT) 2000-02	Rice Yield (Hg/ha) 2000-02	Annual Change in Rice Yield (%)	Sorghum Area (000 ha) 2000-02	Annual Change in Sorghum Area (%)	Sorghum Output (000 MT) 2000-02	Sorghum Yield (Hg/ha) 2000-02	Annual Change in Sorghum Yield (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
WEST ASIA															
Azerbaijan	572	2.8	1,446	25,135	4	4	16.9	19	49,176	23.5	0	-59.5			10.2
Bahrain															
Iran	5,651		9,849	17,312		533	-0.3	2,026	38,004	0					
Iraq	1,207		611	5,065		87	0	80	9,333	-7.8	3	1.5	1	2,402	-8
Jordan	21	-11	17	10,101	-6						17	-9	0	188,409	4
Kuwait	0.2	47.9	0.5	23,290	-3										
Lebanon	42	6	129	30,339	2						1		2	16,667	
Oman	0.4	-2.7	1	31,850	3.1						1	1	3	29,798	-0.4
Palestine	1	0	0.5	7,143	0										
Qatar	0	-12.5		23,082	0										
Saudi Arabia	422	-7	1,862	44,123	0						163	2	204	11,864	1
Syria	1,681	2	4,209	25,038	2						4	-7	3	7,174	0
Turkey	9,383	0	20,339	21,673	0	67	2.9	370	56,140	-12.4					
U. A. Emirates	0	-10	0	4,845	-14										
Yemen	94	0	148	15,810	0						380	-2	373	9,837	1
N. AFRICA															
Algeria	1,354	0	1,434	10,347	2	0.2	-11	0.3	15,000	-7	173	0	1	41,583	3
Egypt	1,016	2	6,334	62,352	2	612	3	5,609	91,756	2	157	1	851	54,241	1
Libya	165	4	128	7,778	-3.4										
Morocco	2,743	1	2,685	9,941	-2	6	6	26	42,314	0	17	-5	10	6,276	3
Tunisia	525	-5	794	15,290	0						3	-7	1	3,333	0

Table A5. Continued

Country	Wheat Area (000 ha) 2000-02	Annual Change in Wheat Area (%)	Wheat Output (000 MT) 2000-02	Wheat Yield (Hg/ha) 2000-02	Annual Change in Wheat Yield (%)	Rice Area (000 ha) 2000-02	Annual Change in Rice Area (%)	Rice Output (000 MT) 2000-02	Rice Yield (Hg/ha) 2000-02	Annual Change in Rice Yield (%)	Sorghum Area (000 ha) 2000-02	Annual Change in Sorghum Area (%)	Sorghum Output (000 MT) 2000-02	Sorghum Yield (Hg/ha) 2000-02	Annual Change in Sorghum Yield (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
C. ASIA															
Kazakhstan	10,824	6	11,493	10,575	1	69	-6	204	29,575	-1					
Kyrgyz	475	6	1,178	24,777	1	6	11	18	30,673	10					
Tajikistan	320	7	385	12,064	3	15	3	50	32,706	7					
Turkmenistan	710	14	1,644	23,096	3	49	3	37	8,595	-12					
S. ASIA															
Afghanistan	1,742	1.3	2,686	15,419	1.3	135	-2.8	388	28,741	0.4					
Bangladesh	782	3	1,706	21,797		10,840		37,344	34,114	0	1	8.2	1	12,397	0
Maldives															
Pakistan	8,234	0	19,443	23,594	2	2,231	1	6,457	28,891	2	370	-8	223	6,042	0
S.- E. ASIA															
Brunei DS		0.6			2.6	0.3	-7.7	0.4	15,628	-0.1					
Indonesia						11,645	1	51,321	44,072	0.1					
Malaysia						681	0	2,109	30,972	0.6					
E. EUROPE															
Albania	102	-4	306	30,143	1						16	-1	15	9,304	0
S. AMERICA															
Suriname						48	-2	182	38,103	-0.1					

Table A6. Food Insecurity and Undernourishment in IDB Member Countries

Country	% Share of Food in Imports 1997-1999	% Share of Cereals in Food Imports 1996-98	Food Aid Av. annual Supply (000 met. T) 1999-2001	% Pop'n tUnder-nourished 1990-1992	% Pop'n tUnder-nourished 1998-2000	% Under-weight Under-fives 2002	Dietary energy supply per capita kcal/day 1998-2000	Cereal Supply (kg) per capita per year 1999-2000	Calories from cereals per capita per day 1999-2000	Wheat Supply (kg) per capita per year 1999-2000	Rice Supply (kg) per capita per year 1999-2000	Sorghum Supply (kg) per capita per year 1999-2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
E. & S. AFRICA												
Djibouti	30	43	11					130	1118	84	41.7	1.9
Mozambique	18	57	138	69	55	26	1910	99.4	813	18.5	9.2	14.3
Somalia	50	41	29	67	71	26	1600					
Sudan	12	61	131	31	21	17	2360	143	1230	22.7	1.2	96.4
Uganda	11	70		23	21	26	2330	62.7	517	4.3	5	5.4
WEST AFRICA												
Benin	16	43	12	19	13	29	2570	111	916	8.7	9.7	17.8
Burkina Faso	14	66		23	23	34	2320	222.2	1833	7.7	22.5	80.2
Cameroon	9		4	32	25	21	2270	101.1	872	15.5	13.4	18.3
Chad	9	59	18	58	32	28	2180	128.2	1039	6.5	8.9	50.1
Comoros	40	48						78.1	749	10.9	63	
Cote d'Ivoire	10		11	18	15	21	2590	118	1051	17.9	66.2	1.2
Gabon	9			11	8	12	2550	86.8	686	55.2	21	
Gambia	37	49	5	21	21	17	2400	135.3	1173	6	53.2	13.6
Guinea	15	50	27	40	32	23	2240	110.8	1011	14.5	72.8	0.5
Guinea-Bissau	22	77	6					155.1	1458	8.8	102.2	12.2
Mali	10	32	5	25	20	43	2400	191	1647	6.8	46.7	45.7
Mauritania	78	63	25	14	12	23	2660	165.6	1430	88.6	49.7	21.1
Niger	24	37	14	42	36	40	2100	209.1	1456	5.4	11.6	28.7
Senegal	30		29	23	25	18	2260	159.6	1348	25.9	75	12.5
Sierra Leone	86	73	34	46	47	27	1980	114.1	1078	12.2	94.3	3.3
Togo	14	54	7	28	23	25	2370	132.2	1113	8.3	27	23

Table A6. Continued

Country	% Share of Food in Imports 1997-1999	% Share of Cereals in Food Imports 1996-98	Food Aid Av. annual Supply (000 met. T) 1999-2001	% Pop'n tUnder-nourished 1990-1992	% Pop'n tUnder-nourished 1998-2000	% Under-weight Under-fives 2002	Dietary energy supply per capita kcal/day 1998-2000	Cereal Supply (kg) per capita per year 1999-2000	Calories from cereals per capita per day 1999-2000	Wheat Supply (kg) per capita per year 1999-2000	Rice Supply (kg) per capita per year 1999-2000	Sorghum Supply (kg) per capita per year 1999-2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
WEST ASIA												
Azerbaijan	23		24		23	17	2330	195.9	1511	179.5	3.5	
Bahrain	8											
Iran	18		6	4	5	11	2910	191.8	1702	162	28.5	
Iraq			6	7	27	16	2150					
Jordan	19		208	4	6	5	2720	163.6	1394	142.9	19.3	
Kuwait	13			22	4	10	3130	132.4	1158	83.4	47.5	
Lebanon	12		96	0	3	3	3160	131.9	1090	123.4	7.8	
Oman	11											
Palestine			54									
Qatar	8											
Saudi Arabia	13			4	3	14	2840	150.8	1350	98.6	38.6	9.7
Syria	16			5	3	13	3050	176.4	1407	164.8	8.9	
Turkey	4			0	0	8	3390	215.3	1645	189.4	7.9	
U. A. Emirates	5			3	0	14	3180	135	1172	86.3	48.3	
Yemen	30	46	149	36	33	46	2040	165.6	1366	124.8	11.9	19.3
N. AFRICA												
Algeria	25		27	5	6	6	2960	225.4	1731	198.1	1.6	
Egypt			40	5	4	12	3320	236.6	2135	130.3	39	5.9
Libya	13					5	3300	192	1486	160.8	16.9	
Morocco	11		102	6	7	9	3010	243.3	1846	164.6	0.8	1.3
Tunisia	7		4			4	3360	211.4	1688	204	1.8	0.1

Table A6. Continued

Country	% Share of Food in Imports 1997-1999	% Share of Cereals in Food Imports 1996-98	Food Aid Av. annual Supply (000 met. T) 1999-2001	% Pop'n tUnder-nourished 1990-1992	% Pop'n tUnder-nourished 1998-2000	% Under-weight Under-fives 2002	Dietary energy supply per capita kcal/day 1998-2000	Cereal Supply (kg) per capita per year 1999-2000	Calories from cereals per capita per day 1999-2000	Wheat Supply (kg) per capita per year 1999-2000	Rice Supply (kg) per capita per year 1999-2000	Sorghum Supply (kg) per capita per year 1999-2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
C. ASIA												
Kazakhstan	9				8	4	2720	134.8	1024	119.5	5.3	
Kyrgyz	12		75		8	14	2830	214.2	1672	210.6	3	
Tajikistan	27		142		64		1790	141.5	1108	133	5.3	
Turkmenistan	16		9		8	12	2720	218.2	1705	211.5	4.1	
S. ASIA												
Afghanistan	18	28	233	63	70	48	1630					
Bangladesh	18	61	650	35	35	48	2100	177.7	1741	20.4	155.5	
Maldives	11	28	5					123.7	1023	72.3	50.8	
Pakistan	15		93	25	19	38	2460	150.2	1230	128.2	12.7	
S.-E. ASIA												
Brunei DS	8							156.8	1352	41.8	82	
Indonesia	9		321	9	6	26	2900	200.6	1830	17.1	149.3	
Malaysia	4			3		18	2930	149.7	1271	29.4	88	
E. EUROPE												
Albania	21				8	14	2750	185.3	1433	174	6.1	
S. AMERICA												
Suriname	20			12	11		2630	128.5	1092	55.6	70.5	