The Agricultural Development Experience of Algeria, Morocco, and Tunisia

A Comparison of Strategies for Growth

Kevin M. Cleaver

WORLD BANK STAFF WORKING PAPERS
Number 552
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The World Bank
Washington, D.C., U.S.A.
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Kevin M. Cleaver, currently deputy chief of agriculture at The World Bank Resident Mission in Nairobi, Kenya, was with the Europe, Middle East, and North Africa Regional Office of the Bank when he wrote this paper.
**ABSTRACT**

This paper undertakes a comparison of the agricultural experience of Algeria, Morocco, and Tunisia in order to provide insights into (i) the importance of food and agriculture for development and poverty reduction, and (ii) determinants of agricultural growth. The three countries provide special interest because they have very similar agricultural resource endowments, similar cultural and colonial heritages, and similar agricultural potentials, but different policies and development strategies. A major difference is the importance of oil exports to each. The report provides recommendations with respect to appropriate Government investment and policy strategies in the agricultural sectors of the three countries. It finds that there is considerable agricultural potential in the three countries, but agricultural development strategy needs reform, particularly with respect to prices, subsidies, land tenure, credit, marketing, extension and research.

**ACKNOWLEDGMENTS**

Criticism and comment made by Messrs David Turnham, Baelhadj Merghoub, Robert Picciotto, and staff in the EMENA Region during a seminar organized by Mr Vinod Dubey contributed greatly to this paper. Bank staff participating in the three agricultural sector surveys completed for the three countries contributed indirectly.
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B. Policy with Respect to Marketing and Processing

C. Agricultural Credit and Financial Markets

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I. INTRODUCTION AND SUMMARY

1.01 The objective of this working paper is to undertake a comparison of the agricultural experience of Algeria, Morocco, and Tunisia in order to provide insights into (i) the importance of food and agriculture for development and poverty reduction, and (ii) policy determinants of agricultural growth. The paper was prepared for use as background material for the Bank's Fifth World Development Report. The three countries provide special interest because they have very similar resource endowments, similar cultural and historical heritages, similar agricultural potentials, but greatly different policies and development strategies. All three are middle income countries, although Morocco's per capita GNP of US$740 (1979) is one half of Algeria's US$1,590 (boosted by considerable oil income). Tunisia's per capita GNP of US$1,120 lies between the two. The case study is thus oriented to identifying the impact of differing development strategies in order to make recommendations with respect to appropriate Government investment and policy strategies in the agricultural sectors of the three countries. Chapter 2 describes the role and performance of agriculture. The remaining chapters provide explanations for the performance observed and recommendations for the future.

1.02 The three countries have pursued a mineral and industry-led growth strategy in which Government participation and direction are dominant. Algeria has been most radical in this strategy allocating the greatest percentage of its investment and human resources to the mining (mostly petroleum) and industrial sectors. Algeria also maintains Government control over most economic activity through Government ownership of nearly all medium and large enterprises in all sectors, control of most prices, imports, exports, and financial markets. Participation by the Tunisian Government in productive activity is much less substantial. It is exercised through price controls, import controls, control of agricultural and mining sector exports, public enterprises, and substantial public investment and services. Participation by the Moroccan Government is similar to that of Tunisia. All three Governments have devoted increasing public resources to social services and consumption subsidies for basic foodstuffs. In Algeria and Tunisia, rising social expenditures are financed primarily by oil revenues. In Morocco, phosphate revenues, and increasingly foreign borrowing are major sources of finance. All three countries suffer high un- and underemployment (15-25% of the labor force). Tunisia is faced with the requirement of using its policy instruments more effectively to restrain final consumption and to stimulate savings as oil and gas production declines.
Morocco is even more constrained since it has no significant hydrocarbon production. All three countries are attempting to maintain wage policies which keep labor cost increases in line with productivity increases in order to maintain a competitive industry. All three are slowly moving toward greater promotion of, and emphasis on, labor-intensive industry rather than large scale capital-intensive industry, in order to attack the unemployment problem.

1.03 Objectives assigned by the Governments of all three countries to the agricultural sector include the pursuit of food self-sufficiency to reduce dependence on food imports, increased rural incomes, greater food availability, employment generation, foreign exchange earnings and savings, and economic growth. These objectives often conflict. For example, the pursuit of food self-sufficiency is not totally consistent with export promotion, nor with the maximization of agricultural incomes. However, all of these objectives are achieved by growth in agricultural production and by improved marketing and processing of agricultural products. Despite similarities in objectives, there are differences of emphasis which are important in interpreting the information provided in this report. Partly because of Algeria's more difficult colonial experience and its devastating war for independence, greater emphasis is put in Algeria on economic independence, national control over local resources, and self-sufficiency. In order to achieve these goals, greater Government control over resource use in agriculture has been necessary. This report evaluates agricultural performance primarily against the objectives of growth, efficiency, and poverty reduction. Algerian agriculture, it will be shown, has done less well according to these criteria, hence sacrificing in order to pursue its objectives of economic independence and self-sufficiency.

1.04 The role of agriculture in each of the three countries is declining as other sectors grow more rapidly. Agriculture's share in GDP declined in Algeria from 21% in 1960 to 7% in 1979. In Morocco, the decline was from 23 to 19% and Tunisia 24 to 16% in the same period. Despite this decline, agriculture is important in all three countries as a source of employment, food, foreign exchange, and potentially of growth. It still employs more than 30% of the labor force in each country. It has been neglected, particularly in Algeria. Investments in agriculture are productive: on average as much or more so than in industry.

1.05 Only Tunisia is now maintaining a rapid enough agricultural growth (in the long term) to avoid increasing dependency on foreign food. Continuation of present trends would make Algeria and Morocco increasingly dependent on imports. With this poor performance comes low income in agriculture, increasing rural-urban inequality and rapid migration off the land.

1.06 Tunisia's good agricultural performance, Morocco's good performance in the 1960s and scrutiny of agricultural potential suggest room for agricultural growth in all three countries. Because of natural resource constraints, much of this growth must come from energy and foreign exchange saving innovations, more intensive use of the land, and continued shift in cropping patterns to high-value crops in line with changing demand. Several of the appropriate technologies and investments are identified in this report. These include the green revolution seed/chemical input/farm machinery technologies; new farm implements; numerous irrigation technologies; greenhouses; improved cultivation practices; new soil conservation and reforestation strategies; several livestock development activities including
improved stock, animal shelters, and health facilities; marketing facilities; fruit tree investment, and rural infrastructure.

1.07 To successfully introduce the above technologies, this report develops the following recommendations which are found in most cases to be appropriate to all three countries of the Maghreb:

(a) investigate the possibility of partially re-allocating investments (i) out of large-scale irrigation, mechanization and infrastructure; (ii) into research, extension, credit (for on-farm investment), forestry, soil conservation, small-scale irrigation, irrigation rehabilitation, marketing, processing. More stringent economic criteria should be used in evaluating investments in order to exclude those that are not viable;

(b) introduce reform of price policy so as to drastically reduce price discrimination against agriculture and, in so doing, (i) encourage farmers to remain in agricultural occupations, and (ii) permit the accumulation by farmers of financial surplus for investment in agriculture;

(c) promote private and cooperative sector participation in agricultural marketing and processing through technical assistance, credit, identification of promoters, and legislation with respect to cooperatives. At the same time undertake improvements to the operation and management of public marketing and processing enterprises, in part by providing incentives for improved performance by management and staff;

(d) drastically reform agricultural credit systems (in Algeria and Tunisia) so as to serve more farmers, recover more credit, and channel a greater proportion of credit into viable investments;

(e) improve land tenure conditions (land consolidation, distribution of collective land to private farmers, security of tenure to tenant farmers);

(f) improve management of production cooperatives by providing financial incentives for work and performance;

(g) improve the content (as well as quantity) of agricultural research, extension, and training;

(h) provide more resources for input supply facilities and make less use of input subsidies. The private sector should be permitted to participate in the supply of farm inputs, while the management of public input supply enterprises is improved by providing incentives similar to those suggested for public food marketing enterprises;

(i) concentrate effort on institution-building for long-term development rather than on short-term (5-year) projects. This will involve the development of national institutions and private enterprises, with less focus on autonomous project authorities which circumvent national institutions and, in so doing, retard their development;
(j) develop projects oriented to exploiting readily available resources (pasture-land, fisheries, people), and to introducing energy and foreign exchange saving agricultural technologies such as those identified in Chapter V;

(k) concentrate more resources on project preparation: the number of poor projects suggests inadequate attention to preparation;

(l) encourage local community development of rural infrastructure;

(m) generally improve project operation and maintenance in part by devoting more financial and human resources to it, even at the cost of reduced investment. In particular, improved management of irrigation perimeters and public enterprises will be required;

(n) a new strategy of soil conservation and reforestation is required in which incentives are provided to affected populations to modify their grazing, land use and tree-cutting practices. The strategy should increase livestock and agricultural production using agricultural techniques which conserve the soil, reduce water run-off and reduce erosion. This can be done by introducing cropping patterns which assure permanent vegetative cover, better use of agricultural machinery (plowing in contours), better range management practices, etc. This would be combined with soil conservation works, reforestation and introduction of permanent pasture.

1.08 A contribution expected from comparative analysis of agriculture in three countries with similar natural resource endowments is the ability to identify important factors in explaining agricultural growth. The above summary of the recommendations suggests the factors which this report finds to be critical motors of agricultural growth. The contribution of most of these factors to growth cannot be quantified. They are matters of judgment. Judgments are drawn mostly from work by numerous Government and Bank staff in the three countries, including agricultural sector surveys for each done by the Bank (jointly with Government in the case of Algeria and Tunisia).

1.09 A table has been included at the end of this report which summarizes for each factor affecting agricultural development, the judgment made about the relative performance of each country. The table suggests that performance by each country with respect to these causal variables is remarkably similar. Tunisia ranks slightly better than Morocco, which ranks slightly better than Algeria. This is also the order of performance in terms of long-term agricultural growth. However, performance is judged against the criteria of growth, efficiency, and poverty reduction. Had Algeria's greater emphasis on national control over local resources and economic independence been considered, Algeria's ranking would have been better.
II. THE ROLE AND PERFORMANCE OF AGRICULTURE IN DEVELOPMENT
AND POVERTY REDUCTION IN THE MAGHREB

A. The Agricultural Environment

2.01 Broadly speaking, the three Magreb countries can be divided into three large ecological zones. Each has a high rainfall area (400-1,000 mm) along the coast stretching at most 100 miles inland. In Morocco, this includes the Atlantic as well as the Mediterranean coast. These areas, along with irrigated areas, are responsible for most agricultural production. This high rainfall region is divided from a drier steppe region in Tunisia and Algeria by low lying mountains. The steppe regions receive about 200-400 mm of rainfall and are used mainly as pasture-land for grazing. Some cereals and olive trees are also grown. Morocco also has a large steppe region found in the South Central part of the country. The Southern parts of each country are pre-desert and desert zones receiving less than 200 mm of rainfall per year. Vegetation is sparse consisting primarily of low growing shrubs. There is some extensive grazing, and some irrigated agriculture mostly based on the use of groundwater obtained from wells. Mountainous regions, particularly in Morocco, contain pasture and forest used for grazing and forestry material. The availability of natural resources is discussed in Chapter III as a factor explaining variations in agricultural performance between the three countries.

2.02 Algeria and Morocco each have populations of nearly 19 million. Tunisia's is approaching 7 million. Cultivable area equals about 7.5 million ha in both Morocco and Algeria. It equals about 5 million ha in Tunisia. The cropping pattern applied in each country is similar, although more of Morocco's arable area is under cereals, Tunisia has a high proportion under fruit trees (mainly olives), and Algeria has considerable fallow land.

<table>
<thead>
<tr>
<th></th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>39</td>
<td>56</td>
<td>34</td>
</tr>
<tr>
<td>Fruit Trees and Vineyards</td>
<td>9</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>Forage Crops</td>
<td>5</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Pulses</td>
<td>2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Vegetables</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fallow</td>
<td>42</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>Industrial Crops</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
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</table>

2.03 Structural Change in Agriculture Since Independence. The most important structural changes in the agricultural sectors of the three countries since independence have been Government-induced. The three Governments responded to decolonization with policies, differing largely in the degree to which Government took over farming, marketing, and processing activities. Public agricultural marketing enterprises were created in Algeria and given an official monopoly. Prices were fixed from the farmgate through the retail level, and the public enterprises implemented official policy. Enterprises providing farm inputs were nationalized and prices fixed by Government. The banking system was nationalized, and agricultural credit
provided through one of the banks according to Government directives. Farms owned by foreign colonists before independence were converted into collective farms, in effect managed by Government. An Agrarian Revolution was later undertaken in which land held by the largest Algerian farms was expropriated and converted into production cooperatives. Cooperative members were drawn from landless labor and small farmers. Algerian Government action in agriculture has consisted primarily (a) of distributing credit for investment and farm inputs to farms according to a Government Development Plan, (b) establishing prices of inputs and of agricultural commodities, (c) defining investment and action programs for agricultural marketing, input supply, and processing enterprises, (d) undertaking public investment in irrigation infrastructure, agricultural services (research and extension), and (e) providing other agricultural services such as livestock health. The private sector, now holding about 50% of Algeria's arable land, has received little credit, few farm inputs and investment goods, and virtually no Government services. The private sector sells most of its produce on an unofficial market. These policies are analyzed in Chapter VI. As indicated in the summary, Algeria has attached considerable weight to the objectives of economic independence and self-sufficiency. The pursuit of this objective has required substantial Government control of agriculture.

2.04 The Moroccan and Tunisian Governments participated less directly in agriculture than did Algeria. Both attached greater weight than did Algeria to agricultural growth compared to economic independence. In Tunisia, most land previously owned by colonists was organized into state farms and production cooperatives, although some was distributed to private farmers. Only about 10% of farm land is farmed by the "public" sector in Tunisia compared to the 50% in Algeria. Morocco distributed some colonists land to state enterprises managed on business principles independent from direct Government supervision. The remainder was distributed to private farmers organized into service cooperatives (land belongs to individuals but most farm assets such as machinery are owned in common). Public institutions were also created for marketing farm produce and supplying many farm inputs in both Tunisia and Morocco. However, these enterprises were largely restricted to the marketing of export crops and cereals. Domestic marketing of meat, milk, fruits, vegetables, and pulses, were left largely to the private sector. Official Government prices have been applied to a much smaller percentage of production than in Algeria due to the greater importance of the private market. Price policy has had greatest impact on cereals, milk, sugar beet, and vegetable oils because these commodities are marketed either through the public marketing enterprises (cereals) or generally require processing hence providing a point of control at the factory. Considerably greater autonomy is permitted to the Moroccan agricultural credit bank in distributing credit than is the case in Algeria. Tunisia's credit system has some elements of bank autonomy and Government control. The Tunisian and Moroccan Governments also invest heavily in agricultural infrastructure, particularly irrigation, and in research/extension services. The evaluation of the effectiveness of these policies and services constitutes the subject of Chapter VI.
B. The Role and Performance of Agriculture

2.05 The role of agriculture in the economy and its evolution is represented by the following:

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<tbody>
<tr>
<td>Agricultural Value Added in GDP/a</td>
<td>(%)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural Employment in</td>
<td>(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment /a</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural Exports in Exports/b</td>
<td>(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural Imports in Imports/a</td>
<td>(%)</td>
<td></td>
<td></td>
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</tbody>
</table>

n.a.: not available

/a Source: World Development Indicators; IBRD.
/b Sources: Morocco: No. 5; Tunisia No. 10 (exports for 1965 rather than 1960); Algeria No. 22 (exports for 1965 rather than 1960), and World Bank estimates. Numbered sources are identified in the bibliography at the end of the report.

2.06 For all three countries, agriculture's role in generating value added, employment and exports was about average for middle income countries in the 1960s. Already, however, each of the countries was more dependent on imported food than was the average middle income country (middle-income countries had per capita GDP's ranging from US$380 to US$4,380 in 1979). By all indicators, agriculture is more important in Morocco, followed by Tunisia, and last Algeria. The decline in the role of agriculture from 1960 to 1979 was unusually great in Algeria as the hydrocarbon and industrial sectors grew rapidly. It followed the normal middle-income country patterns more closely in Morocco and Tunisia.

2.07 The performance of agriculture and its contribution to growth varied considerably between the three countries.

<table>
<thead>
<tr>
<th>Growth Rates (% p.a.)</th>
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<tbody>
<tr>
<td>Contribution of Agriculture to Growth in GDP</td>
</tr>
<tr>
<td>Real Rate of Growth of GDP /a</td>
</tr>
<tr>
<td>Real Rate of Growth of Agriculture /b</td>
</tr>
<tr>
<td>Percent of GDP Growth directly caused by Agricultural Growth /c</td>
</tr>
</tbody>
</table>

Sources:/a World Development Indicators, IBRD.
/b World Development Indicators for middle-income countries. FAO Production Yearbook for Algeria, Morocco, Tunisia.
/c Computed as (rate of growth of agriculture) x (percent of GDP contributed by agriculture) divided by rate of growth of GDP. Agriculture also contributed indirectly to growth by permitting other sectors to grow, notably agro-industry.
2.08 Growth of GDP has been rapid in each of the three countries during the approximate twenty years since independence. In the ten-year period (1960-70), agricultural growth was responsible for one-quarter of Morocco's total growth of GDP. It was responsible for only 8% of Tunisia's overall growth, and 4.5% of Algeria's. In the last decade, the rate of agricultural growth declined drastically in Morocco, contributing about 3% of the expansion of Morocco's economy. Agricultural growth continued to be slow in Algeria. In Tunisia, however, agriculture boomed during the early 1970s, contributing 9% of rapid Tunisian economic growth. Compared to middle-income countries on average, agriculture grew more rapidly in the Maghreb only in 1960-70 in Morocco, and 1969/71-78/80 in Tunisia. Algeria, and Morocco during 1969/71-1978/80, had among the slowest-growing agricultural sectors of middle income countries.

2.09 Rapid growth in Algeria's GDP and to a lesser extent Tunisia's has been primarily the result of increased income from oil and gas, and to a lesser extent rapid growth in services, industry and in Tunisia phosphate production. Morocco's growth in the 1960s was more agriculturally based, but since then phosphates, industry, and services have grown most rapidly. Rapid growth in sectors other than agriculture draws human and financial resources out of agriculture, reducing its growth. However, non-agricultural growth also stimulates demand for agricultural products, which stimulates production if the increased demand is permitted to manifest itself initially in higher prices. Thus, human and financial resources have been drawn out of Algerian agriculture into more rapidly growing sectors. Increased Algerian demand for food caused by rapidly rising per capita incomes and population growth did not cause agricultural producer prices to increase which would have stimulated production. Instead, producer prices were kept artificially low by Government, and demand satisfied by imports. Government's objective was social rather than economic: to subsidize food consumption, without excessively burdening the Government budget by combining low retail food prices with low agricultural producer prices. In addition, management and other institutional constraints hindered the ability of Algerian production cooperatives, controlled largely by Government, from responding to increased demand for food (Chapter VI). These are among the most important explanations for the low agricultural growth in Algeria. Only in the last two years has the Algerian Government permitted significant increases in agricultural prices. Human and financial resource transfers out of agriculture have occurred in Morocco and Tunisia, though not to the same extent as in Algeria. In Morocco and Tunisia, the stimulative effect of increased per capita income and population on demand for food has been transmitted more efficiently through the market place to farmers. This has occurred somewhat through more responsive marketing enterprises and price increases. Farmers have responded with greater output.

2.10 Food Supply. Performance of agriculture is closely related to nutrition in low income countries. It is less so in middle-income countries which have the ability to import food. Nevertheless, most middle-income countries are constrained in the amount of foreign exchange which can be used to import food. There remains therefore a relationship between agricultural performance and the ability of a nation to feed its population. The data below suggest that despite its higher per capita income, Algeria's poor agricultural performance has resulted in less satisfaction of its population's food needs. Morocco and particularly Tunisia have done better, consistent with their better agricultural performance.
Calorie Intake Per Capita Per Day

<table>
<thead>
<tr>
<th>Calorie Intake Per Capita Per Day</th>
<th>Middle-Income Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>Morocco</td>
</tr>
<tr>
<td>1,826 2,363</td>
<td>2,309 2,640</td>
</tr>
</tbody>
</table>

Source: FAO Production Yearbook, Vol. 34, 1980 for Algeria, Morocco, Tunisia. IBRD World Development Indicators for Middle-Income Country Average.

2.11 Food Self-Sufficiency. Countries with sluggish agricultural sectors tend to become more dependent on food imports. This is acceptable if they have the resources to generate foreign exchange and employment by developing other sectors. However, none of the three countries can afford to become excessively dependent on food imports. The following table shows that Algeria was able to restrict growth of food imports despite a poorly performing agriculture in the 1960s. However, in the 1970s there was an extremely rapid increase in food imports. Growth of agricultural imports was less rapid in Tunisia, and considerably less rapid in Morocco. Agricultural exports have grown more slowly in each country than agricultural imports.

<table>
<thead>
<tr>
<th>Growth Rates (% p.a.)</th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of Agricultural Exports (in current prices)</td>
<td>-5.5</td>
<td>-5.1</td>
<td>5.4</td>
</tr>
<tr>
<td>Growth of Agricultural Imports</td>
<td>-.7</td>
<td>23.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Source: Morocco, No. 6; Tunisia, No. 10; Algeria No. 22, and World Bank estimates for each country.

2.12 As a result of the above import trends, Morocco's dependency on imports declined in the 1960s and early 1970s due to rapid agricultural growth, as shown in the figures below. However, in more recent years growth in Morocco's agricultural imports has exceeded agricultural growth signifying increasing dependency. In Tunisia, rapid agricultural growth in the 1970s has permitted a decline in dependency on imports. By contrast, Algerian dependency on agricultural imports has increased greatly throughout the 1960s and 1970s. In this sense Algeria's pursuit of economic independence did not succeed.
Value of Food Imports to Value Added in Agriculture (%)

<table>
<thead>
<tr>
<th></th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>34</td>
<td>63</td>
<td>27</td>
</tr>
</tbody>
</table>

Sources: Algeria No. 22; Morocco: No. 7, 8; Tunisia: 10, 11.

2.13 Efficiency of Investment in Agriculture. The relative efficiency of investment in agriculture is crudely indicated by the following incremental capital output ratios (the ratio of investment to incremental value added).

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Agriculture</td>
<td>2.4</td>
<td>1.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Industry</td>
<td>7.8</td>
<td>2.4</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Sources: Algeria: No. 22; Morocco: No. 4; Tunisia: No. 12, 13; and World Bank estimates. These ratios were computed in current prices which biases them downward compared to constant price calculations.

The above ratios are imperfect measurements of investment efficiency. Comparison between countries using this indicator is not valid due to differences in relative price inflation, differences in annual variations in output, and different basis of measurement. Within country comparisons between sectors are more meaningful. Even these suffer due to distortions caused by relative price changes. However, there is no substitute for this commonly used indicator. It suggests that agriculture made more efficient use of investment resources in each country than did industry. Theoretically, agricultural investments should have been increased in each country and industrial investment reduced (para. 5.02 discusses investment effort). This would have driven up the average incremental capital output ratio in agriculture, and driven down that for industry. This would result because the marginal investment is likely to be less productive than the average investment undertaken. That there were investment opportunities is indicated in chapter V. Crop yields (production per hectare) are low in the Maghreb compared to other developing countries, indicating opportunity for expansion. Because the incremental capital output ratio is a crude indicator of investment efficiency, more evidence would be needed to recommend a relative shift of investment to agriculture from industry. Ex-ante economic rate of return calculations on both agricultural and industrial projects financed under World Bank Projects show no pattern for agriculture to have higher returns. Rates of return vary considerably from one project to the next in both sectors. Nevertheless, the incremental capital output ratios are suggestive enough to justify serious consideration of increasing the share of agriculture in total investment (see also paras. 5.01 and 5.02).
2.14 **Agricultural Income and Poverty**. Agriculture's contribution to poverty reduction is partly represented by its contribution to growth. The following data shows agricultural income per capita to have declined in Algeria, while it increased slightly in Morocco and greatly in Tunisia. The income data are striking not only in the country comparisons, but by the low levels for each country. Per capita GNP was reported in para. 1.02 as US$740 in Morocco, US$1,120 in Tunisia, and US$1,590 in Algeria. Household budget surveys undertaken in Morocco and Tunisia confirm that income in rural areas is less than half that in urban areas. There are other sources of income in rural areas, but these do not make up for the low level of agricultural income. Although no poverty data for Algeria exist, it is apparent from the low level of agricultural income that poverty in rural areas is high. However, rural poverty appears to be slowly declining in each of the three countries.

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<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Value Added Per Capita, (1979 US$) /a</td>
<td>277</td>
<td>275</td>
<td>187</td>
<td>60 to 2,510</td>
</tr>
<tr>
<td>Percent of Rural Population Living Below Absolute Poverty /b</td>
<td>n.a.</td>
<td>n.a.</td>
<td>49</td>
<td>14.6</td>
</tr>
<tr>
<td>Rural Population per Hospital Bed in Rural Areas /b</td>
<td>n.a.</td>
<td>n.a.</td>
<td>2,980</td>
<td>n.a.</td>
</tr>
<tr>
<td>Rural Population with Access to Safe Water /b</td>
<td>n.a.</td>
<td>n.a.</td>
<td>28</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

/a Computed as agricultural value added in 1979 prices divided by the agricultural population and converted to dollars at the 1979 exchange rate. This approximates per capita agricultural income.

/b The threshold of absolute poverty is a level of living which permits survival (just adequate caloric consumption, housing, etc.). These estimates are subject to considerable error.

Sources: World Development Indicators for inflation rates and agricultural value added per capita in middle income countries; IBRD country economic reports for rural population, agricultural value added, poverty estimation, and social infrastructure data.

2.15 In addition to agricultural income and employment, well-being in rural areas is affected by health facilities (roughly indicated by hospital beds), education, employment in non-agricultural occupations, access to water and transportation. Although reliable indicators are scarce, urban areas in all three countries have benefitted more than have rural areas from investment in social infrastructure and education. Algeria's land reform which distributed land to some of the landless had an equalizing effect (Chapter VI for discussion of land tenure). All three countries have rural non-agricultural sectors which provide rural income. This sector includes mining and construction, Government services, textiles, clothing, rug-making, food industry, wood-working, leather goods, and others. However, statistics are not available on this little researched subject. Non-agricultural income causes the inequality between rural and urban income to be less than that between agricultural and non-agricultural income. Remittances from the cities to the countryside also reduce inequality. However, continued rapid rural-urban migration suggests over all rural-urban inequality in income and well-being.

2.16 **Rural-Urban Migration**. The low incomes available in agriculture, the higher incomes and the generally higher level of living in urban areas, and the better educational facilities in urban areas are stimulating rapid rural-urban migration, and migration abroad. This trend is characteristic of middle income countries. The more rapid rural exodus in Algeria and Tunisia than in Morocco suggests more rapid expansion in employment opportunities and income outside of agriculture compared to agriculture than in the average middle-income country.
### Percent of Population in Rural Areas

<table>
<thead>
<tr>
<th></th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
<th>Middle-Income Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>70</td>
<td>71</td>
<td>64</td>
<td>63</td>
</tr>
<tr>
<td>1980</td>
<td>39</td>
<td>59</td>
<td>48</td>
<td>49</td>
</tr>
</tbody>
</table>


2.17 The few employment surveys available suggest that employment in agriculture is stagnating in each of the three countries (it may be decreasing in Algeria). Employment is created by investment in irrigation, livestock, fruit trees, forestry, and soil conservation. It is reduced by labor-saving mechanical innovations such as tractors, mechanical milkers, mechanical olive harvesters, combine harvesters, etc. The two tendencies appear to have offset each other. The growing rural non-agricultural sector is a source of future labor force absorption, particularly if conscious effort is made to promote it. Another phenomenon is the increasing frequency of farm owners working part time in rural towns or on other farms. One result is that the percentage of farm work done by women has increased. This phenomenon should be accounted for in designing extension and credit systems, which are usually directed toward men.

C. Conclusions

2.18 The performance of agriculture in all three countries must be viewed in the context of the important land and climate constraints discussed in Chapter IV and the need to transform a colonial agricultural structure inherited at independence. Each country successfully undertook the transition from the colonial agricultural structure. During the colonial period, the best land, marketing and processing facilities were owned by colonists. The rapid transition, at independence, without an important fall in output, was an important achievement. Government's interventionist policy in each of the three countries was important in explaining the success. Government quickly took over marketing and processing operations left by departing colonists, and began farming operations on land previously belonging to colonists. The land continued to be productive, and the Government enterprises assured continued food supply to consumers, collection of food from farmers, and exports. The three Governments also took over and strengthened research, extension, credit, and project planning systems. These functioned with varying efficiency, but in the worst case kept agriculture from declining, and in the best (Morocco during the 1960s, Tunisia during the 1970s) facilitated substantial agricultural growth.

2.19 The agricultural sectors of the three countries continue to be important as sources of employment and growth, but less so as other sectors develop more rapidly. This same evolution characterized the growth of presently developed countries in Europe and North America. The statistics presented above and information presented in Chapter IV also suggest that none of the three country's agricultural sector grew at its potential. The result
of inability to develop agriculture rapidly in Morocco and Algeria during the 1970s (and in the 1960s for Algeria) has been reduced economic growth, reduced food supply, and greater dependence on imported food. With the exception of Tunisia, agricultural incomes have been stagnant. Even in Tunisia, agricultural incomes are far below average national income, contributing, with other urban advantages, to rapid rural-urban migration. Causal factors for differences in performance are scrutinized in the following chapters.

III. SUPPLY AND DEMAND: TRENDS AND CAUSES

3.01 Sources of Demand. As a country moves out of poverty into the middle-income levels, the "pull" of other sectors on agriculture becomes more important. Farmers produce less for subsistence and more for the market. With urbanization, the market increasingly means the urban consumer. As urban incomes increase, demand for agricultural products diversifies from low value cereals and pulses to higher value products such as fruit, vegetables, dairy products, and meat. This stimulates growth in the production of these products. Each of the three countries has experienced relatively rapid development of its non-agricultural sectors and of agro-industry, as shown below. Population growth has also been rapid in each country. Demand "pull" has therefore been increasing in all three countries.

Sources of Demand "Pull"

<table>
<thead>
<tr>
<th>Sources of Demand &quot;Pull&quot;</th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
<th>Middle-Income Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per-capita GDP (1979 US$)</td>
<td>n.a.</td>
<td>1,590.0</td>
<td>n.a.</td>
<td>740.0</td>
</tr>
<tr>
<td>Growth of per capita GDP (% p.a.)</td>
<td>1.8</td>
<td>2.5</td>
<td>1.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Growth in agro-industry (% p.a. in constant prices)</td>
<td>3.7</td>
<td>8.4</td>
<td>9.0</td>
<td>7.2</td>
</tr>
<tr>
<td>Population Growth (% p.a.)</td>
<td>2.8</td>
<td>3.3</td>
<td>2.5</td>
<td>2.9</td>
</tr>
</tbody>
</table>

/a IBRD World Development Indicators: for 1979 only.
/b IBRD World Development Indicators.
/c Algeria No. 22; Tunisia No. 11, 13; and World Bank estimates. Years 1965-70; 1970-79.
/d World Bank Estimates.

3.02 The above factors are largely responsible for the extremely rapid growth in food consumption in each country. Production has not kept up with consumption growth for most commodities, resulting in rapid import growth in all three countries. As shown in para. 2.11, food import growth has been most rapid in Algeria, followed by Tunisia and last by Morocco.
3.03 The most important result of the above supply and demand performance in each country has been the increase in imports and general decline in agricultural exports necessary to satisfy the growth of domestic consumption. Secondly, the significant variation in the growth of demand and production between commodities has caused an important structural change in the agricultural sector of each country. In general, both consumption and production of high value irrigated crops and livestock products have increased most rapidly (vegetables, fruit, milk, meat). Higher per capita incomes and urbanization have increased demand for these high-value foodstuffs more rapidly than for traditional foodstuff (cereal, olive oil, sugar). This has stimulated a switch in production to higher-value crops, a switch which creates additional agricultural value added. Technological change has also been particularly rapid for high-value commodities (irrigation of fruits and vegetables, genetically superior livestock, industrial poultry production, greenhouses: Chapter V). As a result, an increasing percentage of agricultural value added is generated by the production of high value commodities, and less by the traditional commodities (cereals, olive oil, wine grapes).

### Percent Contribution to Total Agricultural Value Added (In World Prices)

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<th></th>
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</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>6.3</td>
<td>10.4</td>
<td>4.7</td>
<td>12.8</td>
<td>16.2</td>
<td>18.6</td>
</tr>
<tr>
<td>Fruit</td>
<td>21.0</td>
<td>20.3</td>
<td>15.3</td>
<td>22.4</td>
<td>15.1</td>
<td>11.4</td>
</tr>
<tr>
<td>Livestock</td>
<td>26.8</td>
<td>39.7</td>
<td>29.0</td>
<td>22.7</td>
<td>25.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Cereals</td>
<td>25.4</td>
<td>18.5</td>
<td>39.7</td>
<td>26.8</td>
<td>21.1</td>
<td>14.1</td>
</tr>
<tr>
<td>Pulses</td>
<td>0.5</td>
<td>0.8</td>
<td>2.1</td>
<td>1.6</td>
<td>1.4</td>
<td>5.3</td>
</tr>
<tr>
<td>Wine</td>
<td>12.2</td>
<td>4.2</td>
<td>5.4</td>
<td>1.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Olives, Oil seeds</td>
<td>8.1</td>
<td>5.8</td>
<td>2.2</td>
<td>4.1</td>
<td>13.4</td>
<td>10.5</td>
</tr>
<tr>
<td>Industrial Crops</td>
<td>0.6</td>
<td>0.3</td>
<td>1.6</td>
<td>8.2</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Other (fish, forestry)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.4</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Sources: Algeria, 20; Morocco, 7; Tunisia, No. 11, 13; and World Bank estimates. Prices used are IBRD-reported World Prices for 1980.
3.04 Food imports equal 15% of total Algerian merchandise exports (in 1979), 17% in Tunisia, and 32% in Morocco. The percentages are now growing in each country. The lower percentage for Algeria is due to Algeria's better overall export performance, caused by petroleum exports. If the 20-year historical production trends are not improved upon, present rates of agricultural import growth and agricultural export stagnation will continue. World food supply trends may be less favorable than in the 1970s, and it will be increasingly costly for these countries to pursue policies which inhibit agricultural development and necessitate increased food imports.

3.05 In the future, for agricultural potential to be achieved, the natural constraints to agricultural growth, and the following problems must be overcome. These are discussed in the remaining chapters.

(a) Generally, inefficient systems (research, extension and credit) for discovering, adapting, introducing and financing new agricultural technology (although with notable exceptions such as credit in Morocco);

(b) price policy which for many commodities is not presently oriented to providing incentives to producers, but rather is directed to restraining producer prices in order to maintain consumer food prices at low levels while minimizing the financial burden on Government;

(c) inadequately developed private input supply, marketing, processing activity; and inefficient public marketing and processing enterprises, combined with increasingly difficult export markets for the agricultural products of the region (wine, olive oil, vegetables, fruit);

(d) scarcity of land and a land tenure situation not conducive to efficient farming, including inefficient producer cooperatives and state farms (Algeria and Tunisia);

(e) inadequate development of community organizations able to manage their own resources;

(f) rapid soil erosion and desertification, combined with scarcity of water;

(g) inadequate allocation of human and financial resources to agriculture leading to neglect of operation and maintenance of investments, particularly of irrigation infrastructure;

IV. NATURAL CONSTRAINTS TO AGRICULTURAL GROWTH

A. Data Indicating the Natural Constraints

4.01 The natural constraints to agricultural growth relate to a country's natural resource endowment, including its human resources. Government policy and investment, as well as private efforts can, and do, overcome these constraints. The physical constraints are represented below, and consist of quantities of arable land, water, and people. Important natural resources are not shown due to lack of data. These include potentially irrigable land and average rainfall on arable land. Potentially irrigable land is greatest in Morocco followed by Algeria.
### Table: Agricultural Data

<table>
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<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>6,856.0</td>
<td>7,497.0</td>
<td>.7</td>
<td>.7</td>
<td>.9</td>
<td>.7</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>10.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Morocco</td>
<td>7,479.0</td>
<td>7,719.0</td>
<td>.9</td>
<td>.7</td>
<td>2.0</td>
<td>1.7</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>4.02</td>
<td>3.3</td>
</tr>
<tr>
<td>Tunisia</td>
<td>4,483.0</td>
<td>4,970.0</td>
<td>2.0</td>
<td>1.7</td>
<td>2.0</td>
<td>1.7</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>10.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1969/71</td>
<td></td>
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<td></td>
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<tr>
<td>1978/80</td>
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</tr>
</tbody>
</table>

/a FAO Production Yearbooks.
/b Source: FAO Production Yearbook for arable land, Population; and World Bank estimates.
/c Sources: Algeria No. 14; Morocco No. 8; Tunisia No. 13, 15, and World Bank estimates.
/d Growth rate is 1960-70, and 1970-80.

### B. Water and Climate

4.02 Rainfall is sparse and erratic over most of the Maghreb. Only 33% of arable land in Tunisia receives more than 400 mm of rain p.a. The figure is probably similar in Algeria. About 59% of Morocco's arable land receives more than 400 mm of rainfall. Although the impact of this cannot be quantified, the lower the rainfall and the greater its variability, the greater the risk to the farmer. It is now known that farmers account for risk in their decisions about cropping patterns and input use. The greater the variability of revenue (due to crop yield and price variability), the greater the tendency for farmers to avoid cost-increasing technologies despite the likelihood of increased net income in an average year. The more intensive use of farm inputs in a low rainfall year could cause considerable revenue loss. The importance attached by the average farmer to loss is far greater than that attached to gain. This is certainly one of the principal factors inhibiting many farmers, particularly small farmers, from introducing new farm technology (Chapter V). It should work more forcefully to inhibit farmers from introducing new technology in Tunisia and Algeria than in Morocco. Generally, higher rainfall, and a higher percentage of land under irrigation in Morocco (para. 5.12 for data on irrigated area) explains in part the higher average crop yields in Morocco (para. 5.04 for crop yield statistics). However, the impact on crop yields of greater water availability in Morocco compared to the impact of other factors is impossible to quantify. It is also notable that, despite a less hospitable agricultural environment in terms of water availability, Tunisia's agriculture grew more rapidly in the 1970s than did Morocco's. Other factors were therefore influencing growth.

/1 In economic terms the amount of water available is a "stock" variable, which influences the level of crop yields (higher in Morocco), but not necessarily the growth of those yields (a "flow" variable).
C. Scarcity of Land

4.03 A second major natural constraint facing agriculture in the Maghreb is the scarcity of agricultural land relative to the rural population (1.7 ha of cultivable land per rural person in Tunisia, .7 ha in Morocco, and .7 ha in Algeria). Other countries are more severely constrained, however (China has .13 ha of arable land per rural person, and India has about .3 ha). The average developing country has .42 ha of arable land per rural person. Nevertheless, this constraint is one cause for problems of erosion and desertification discussed in Chapter V. With a low land/man relationship, most farms are small, often too small for viable farming under rainfed conditions. As the rural population expands, marginal land is brought under cultivation and expanded livestock herds increasingly overgraze pasture-land. Marginal land in sloping areas is likely to erode when cultivated, particularly when cultivated mechanically. Overgrazing destroys vegetative cover, accelerating soil erosion and desertification. The table above shows that all three countries opened up land to cultivation between 1969/71 and 1978/80, mostly in semi-arid and hilly areas. Most of this expansion was used for the cultivation of barley and wheat. This land was previously used for grazing and its cultivation reduced meat production somewhat. The annual increase in cereal production permitted would approximate the rate of increase in arable land: 1% p.a. in Algeria, .3% p.a. in Morocco, 1% p.a. in Tunisia. Cereals account for about 20% of agricultural value added in each country. The maximum growth in agricultural value added caused by the expansion in arable land during the 1969/71-1978/80 period, assuming no decline in meat production, was .2% p.a. in Algeria, .06% p.a. in Morocco, and .2% p.a. in Tunisia. For Algeria this growth nearly equaled the entire growth in agriculture during this period. For Morocco and Tunisia it was a relatively insignificant source of growth.

4.04 Tunisia has the highest land/man ratio and the largest average farm size, which explains in part its higher average farm income. This has also probably contributed to Tunisia's more rapid agricultural growth. Tunisia's advantage is mitigated somewhat by the fact that a greater percentage of Tunisian arable land is found in low rainfall areas (less than 400 mm of rain per year). Less rainfall (and irrigation water) causes the need for larger farms to generate the same income. Areas receiving less rainfall support fewer people. Therefore, the carrying capacity of the average Tunisian hectare of arable land is probably somewhat less than in Algeria, and considerably lower than in Morocco. Before the introduction of modern farm techniques, the average family farm in all three countries probably produced about the same quantity of food. Due to different climatic conditions, the average farm was largest in Tunisia, and smallest in Morocco. This equilibrium was changed first with European colonization of the best land, then with the creation of large state farms and production cooperatives (particularly in Algeria), and more recently with the introduction of more modern technology. Modern technology can overcome water (and probably soil) deficits to some extent, but it still takes somewhat more land in Tunisia to produce the same income on average than in Morocco.

D. Human Resources

4.05 The development of human resources is associated with education, literacy, and health. Although unquantifiable, greater education and better health leads to a greater ability to understand and apply new agricultural knowledge, and better ability to work. These factors will stimulate
agricultural development. The data below reflect human resource development in each of the three countries, but not for the rural population specifically. However, development of human resources in rural areas is strongly correlated to overall human resource development. Literacy rates were very low in each of the countries in 1960, and remain considerably lower in each country than the average for middle income countries. Morocco has performed least well, Tunisia best. Efforts to overcome this problem in all three countries are reflected in the large increase in primary school enrollment. Tunisia is now performing well in this respect. Algeria and Morocco are progressing. Health care appears somewhat less good in the three countries than the average for middle income countries (lower life expectancy, greater population per physician), although Algeria and Tunisia have provided greater access to potable water.

<table>
<thead>
<tr>
<th></th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
<th>Middle-Income Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adult Literacy Rate (1960) (%)</td>
<td>10.0</td>
<td>14.0</td>
<td>16.0</td>
<td>54.0</td>
</tr>
<tr>
<td>2. Adult Literacy Rate (1975) (%)</td>
<td>37.0</td>
<td>28.0</td>
<td>55.0</td>
<td>71.0</td>
</tr>
<tr>
<td>3. Percentage Change in Crude Death Rate (1960-1978)</td>
<td>-39.1</td>
<td>-43.5</td>
<td>-42.9</td>
<td>-29.9</td>
</tr>
<tr>
<td>4. Life Expectancy at Birth (1978) (years)</td>
<td>56.0</td>
<td>55.0</td>
<td>57.0</td>
<td>61.0</td>
</tr>
<tr>
<td>5. Percentage of Population With Access to Water (1975)</td>
<td>77.0</td>
<td>55.0</td>
<td>70.0</td>
<td>60.0</td>
</tr>
<tr>
<td>6. Population per Physician (1977)</td>
<td>5,360.0</td>
<td>10,140.0</td>
<td>4,800.0</td>
<td>4,310.0</td>
</tr>
<tr>
<td>7. Number Enrolled in Primary School as Percentage of Age Group (1960)</td>
<td>46.0</td>
<td>47.0</td>
<td>66.0</td>
<td>81.0</td>
</tr>
<tr>
<td>8. Number Enrolled in Primary School as Percentage of Age Group (1977)</td>
<td>90.0</td>
<td>68.0</td>
<td>100.0</td>
<td>97.0</td>
</tr>
</tbody>
</table>

Source: IBRD World Development Indicators, 1981.

4.06 It can be concluded that the three countries are making efforts to overcome educational deficiencies. Health care is improving rapidly (decline in death rate), even more rapidly than in the average middle income country. This effort has certainly contributed to agricultural growth, but does not explain the variations in agricultural performance between the three countries. Considerably more can be done to develop human resources.

E. Summary

4.07 In summary, Tunisia's more rapid agricultural growth and higher per capita income is explained in part by a higher land/man ratio and larger farm size. Morocco has an advantage in rainfall (and irrigation) potential (irrigation is discussed in Chapter V). Algeria has no natural advantage over its neighbors. All three countries' agricultural sectors are benefitting from human resource development. Quantification of the importance of these factors as distinct from other factors is impossible, and must rest on judgment, although a rank ordering was given in the summary.
V. INVESTMENT AND TECHNOLOGICAL CHANGE IN AGRICULTURE

A. Investment Effort in Agriculture

5.01 Most agricultural growth in the Maghreb has resulted from a combination of the shift in production to high value crops and livestock products stimulated by demand changes, and the introduction of several technological changes embodied in new types of inputs and investments. The critical technological changes are identified in this Chapter. These technological changes were introduced by farms through investment in the inputs, material, equipment, and construction which embody the new technology. The effort made by each country in investing in agriculture is represented by the following:

<table>
<thead>
<tr>
<th></th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Investment effort</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment/GDP /b</td>
<td>42.0</td>
<td>44.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Investment in Agriculture to Total Investment /c</td>
<td>11.7/d</td>
<td>4.4</td>
<td>22.0/d</td>
</tr>
<tr>
<td>% of Operating Budget to Agriculture /c</td>
<td>4.3/d</td>
<td>3.4</td>
<td>7.7</td>
</tr>
<tr>
<td>B. Government Investment in Agriculture per ha per annum (US$/ha)/c</td>
<td>-</td>
<td>45.0</td>
<td>-</td>
</tr>
<tr>
<td>C. Compared to the Importance of Agriculture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture's share of GDP /b</td>
<td>21.0</td>
<td>7.0</td>
<td>23.0</td>
</tr>
</tbody>
</table>

Sources: /a Middle-income countries are defined in the IBRD World Development Indicators as having per capita incomes of from US$380 to US$4,380 in 1979 dollars.
/b World Development Indicators, IBRD (1981).
c Tunisia No. 12; and World Bank estimates. Arable land taken from FAO Production Yearbook 1980.
d For 1969-71.
e For 1976-79.

5.02 The investment effort in Algeria has been exceptionally high. Although the percentage of Algerian investment going to agriculture has been small relative to agriculture's share in GDP and relative to agriculture's efficiency (para. 2.13) because it invests more, the amount invested per ha of arable land has been high. Investment allocations in Morocco and Tunisia are at the level suggested by agriculture's share in value added, although as para. 2.13 shows more probably could have been efficiently allocated to agriculture. Since investment per hectare is highest in Algeria which has the lowest agricultural growth, variations in the investment effort of the three countries does not explain variations in agricultural performance. Operating budgets allocated to agriculture are extremely low in all three countries,
explaining in part the poor operation and maintenance of public agricultural and water investments in each country, but again not explaining variation in agricultural performance.1

B. Distribution of Agricultural Investment

5.03 Investment in agriculture in all three countries is skewed heavily and increasingly to large-scale irrigation infrastructure, mechanization, and other public infrastructure. The table below shows the shifting structure of agricultural investment. The analytical tools available do not permit precise quantification of the production impact of each investment taken individually. For example, increased agricultural production in a newly irrigated area will result from irrigation, increased fertilizer application, use of higher yielding seed varieties, improved cultivation techniques, etc. The separate impact of each of these interventions is a matter of judgment.

<table>
<thead>
<tr>
<th></th>
<th>% Total Agricultural Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Algeria 1970/73</td>
</tr>
<tr>
<td>Irrigation</td>
<td>26.6</td>
</tr>
<tr>
<td>Extension, research,</td>
<td>2.4</td>
</tr>
<tr>
<td>studies, training</td>
<td>11.6</td>
</tr>
<tr>
<td>Livestock</td>
<td>10.9</td>
</tr>
<tr>
<td>Fruit trees</td>
<td>13.2</td>
</tr>
<tr>
<td>Forestry, soil conservation</td>
<td>9.8</td>
</tr>
<tr>
<td>Machinery</td>
<td>18.9</td>
</tr>
<tr>
<td>Rural infrastructure</td>
<td>15.1</td>
</tr>
<tr>
<td>Fisheries</td>
<td>3.1</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

/a Morocco: excludes private investment (private investment is included in Algeria and Tunisia percentages).

Source: Algeria No. 19; Ministry of Plan; Morocco and Tunisia: Ministry of Agriculture in each country.

C. Research, Extension, and Farm Machinery Investment to Introduce the New Seed/Chemical Input Technologies

5.04 The most important technological innovation in the agriculture of the Maghreb during the past twenty years was the introduction of high yielding wheat varieties in the late 1960s and early 1970s, combined with intensified use of fertilizer, chemical plant protection and mechanization. Fertilizer, chemical plant protection, and expanded use of farm machinery also permitted increased yields of other crops. It was primarily this technology, along with irrigation, that permitted the supply response to changes in demand, through an intensification of agriculture. This is reflected in crop yields.

/1 As with the natural resource constraint, statistical analysis would be desirable, but could not be undertaken due to the inadequate number of empirical observations.
Crop Yields
(tons/ha)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>.6</td>
<td>.61</td>
<td>.56</td>
<td>.85</td>
<td>.93</td>
<td>1.07</td>
<td>.68</td>
<td>.81</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>n.a.</td>
<td>9.3</td>
<td>8.2</td>
<td>n.a.</td>
<td>19.8</td>
<td>26.5</td>
<td>12.6</td>
<td>16.6</td>
</tr>
<tr>
<td>Potatoes</td>
<td>n.a.</td>
<td>5.9</td>
<td>6.4</td>
<td>n.a.</td>
<td>10.1</td>
<td>13.7</td>
<td>7.7</td>
<td>11.5</td>
</tr>
<tr>
<td>Wine Grapes</td>
<td>n.a.</td>
<td>4.2</td>
<td>1.8</td>
<td>n.a.</td>
<td>3.5</td>
<td>3.8</td>
<td>3.3</td>
<td>3.6</td>
</tr>
<tr>
<td>Sugar Beet</td>
<td>n.a.</td>
<td>25.9</td>
<td>21.0</td>
<td>20.0</td>
<td>32.7</td>
<td>36.8</td>
<td>19.0</td>
<td>30.3</td>
</tr>
<tr>
<td>Broad Beans</td>
<td>n.a.</td>
<td>.7</td>
<td>.7</td>
<td>.7</td>
<td>1.1</td>
<td>.7</td>
<td>.4</td>
<td>.7</td>
</tr>
</tbody>
</table>

For 1961/65:
- Algeria (65/67) Statistiques Agricoles; Ministry of Agriculture;
- Morocco Ministry of Agriculture.

5.05 The introduction of this technology was permitted by investment in research, extension, farm mechanization and increased use of high-yielding seed, fertilizer and other chemical inputs. Increased use of farm inputs is not shown as an investment item in the classification used by the three countries (para. 5.03). In Tunisia, which had the highest increase in crop yields, investment in research, extension, studies, and farm mechanization amounted to about 24% of total agricultural investment in the 1960s, increasing to 34% during 1972-76, and falling to 22% in 1977-81. In Algeria, the percentage was 21% in the early 1970s and 19% in 1980. The data do not permit comparison with Morocco since the Moroccan private sector is excluded in para. 5.03. However, the percentage in Morocco is probably close to that in Tunisia. The increased intensity of input use which resulted is represented in part by increased fertilizer and tractor use:

Input Use

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ha/Tc</td>
<td></td>
<td>145.0</td>
<td>140.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fert/ha</td>
<td>3.5</td>
<td>12.1</td>
<td>22.0</td>
<td>7.0</td>
<td>12.4</td>
<td>22.0</td>
<td>11.2</td>
<td>23.3</td>
<td>35.0</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Source: /a Morocco No. 7; Tunisia No. 15.
/b Algeria No. 14, 18; Tunisia No. 15, and World Bank estimates.
/c FAO Production Yearbook 1980.

5.06 Despite similar allocations of investments to research, extension, and mechanization, and the increases in input use in each country which resulted, crop yields responded only in Tunisia and Morocco. In Algeria, the introduction of the new technology was not enough to compensate a deteriorating performance by production cooperatives due to the management problems discussed in Chapter VI. In addition, the new wheat varieties were not successfully introduced to Algeria's private sector. As a result, average wheat yields in Algeria have not increased (declined at 1% p.a. from 1970 to 1979). Yields to other crops have stagnated in Algeria for the same reasons.
5.07 The impact on crop yield of expanded use of fertilizer, chemical plant protection, and high yielding seed varieties is well known. The benefits of mechanization have been questioned. In most non-irrigated farming areas of the Maghreb, weather and soil conditions are such that rainfall is necessary before the land can be prepared for planting by animal-powered implements. On larger farms (60 ha and above), preparation by animal power requires considerable time. Since the period of rainfall is short, much of the benefit is lost by the time animal-powered land preparation on such farms is completed. Tractors can prepare the land before the rain, thus permitting increased use of scarce rain water by the plant. Tractors also permit better quality land preparation, can work for a longer period of time without stopping than can animal-drawn implements, and since the land can be prepared at the proper moment, tractors permit fertilizer and high yielding seed to have a more beneficial impact on yields. Research in Morocco indicates an average 0.3 ton/ha increase in cereal yields as a result of early sowing permitted by tractors, compared to yields obtained when sowing is undertaken by animal-powered implements. Use of tractors rather than draft animals reduces the amount of land which must be used to produce feed for draft animals, and reduces the drudgery of agricultural labor (one ha of land preparation by animal power requires the farmer to walk 60 kilometers). The introduction of the tractor is largely responsible for the increase in cultivated land reported in Chapter IV.

5.08 Despite the above benefits of mechanization, it has caused the replacement of labor, and when used in semi-arid areas, it has accelerated erosion and desertification. An experimental methodology for estimating economic and social benefits and costs was used to evaluate investments in tractors and combine harvesters in Morocco. It found that the average tractor and combine harvester investment is economically desirable, though economic returns (to the country) are lower than the financial returns to the farmer. However, the social cost of labor displacement is high enough in the case of the average investment in combine harvesters to reduce the "social rate of return" of such investments below an acceptable level. The average tractor investment was just acceptable according to the social rate of return analysis. These results suggest that restrictions/taxes be put on the import and sale of combine harvesters so that the cost of such investments is increased to reflect the social cost of labor displacement.

5.09 A rough quantification of the economic benefit of the new seed/chemical/machinery technology in Tunisia was obtained using the investment to incremental output ratio referred to in Chapter II. This ratio indicates the efficiency of investment: the investment required to generate one dollar of additional annual output. For comparison the ratio estimated for Tunisia's entire agricultural sector during 1965 to 1980 is 4.0 (4 US$ total investment to generate an increase in agricultural value added equal to US$1 per annum). The ratio for the manufacturing sector is 4.8. The


2/ This calculation is sensitive to the base years chosen, the price deflator used, etc. The ratios are different from those reported in Chapter II because the latter are based on current rather than constant prices and were calculated for different years.
estimate for the seed/fertilizer/mechanization investment is 3.6. This indicates that these investments are more efficient than the average in agriculture and in industry. This result is consistent with ex-ante economic rate of return calculations made for Project appraisals in all three countries (there have been no ex-post calculations made for projects involving this technology). Rural development and rainfed agriculture projects typically concentrate on research, extension, farm machinery and increased modern input use, although infrastructure is often financed as well. Economic rates of return are high (15-30%).

5.10 The major issues involved in this technology all relate to its considerable underutilized potential. Improved farm input use and hence higher crop yields are possible. The strategy would be for the agricultural research, extension, and input supply institutions to continue introducing the high-yield cereal seed/fertilizer/herbicide technology; application of new fruit, vegetable, and industrial crop varieties along with increased application of fertilizer and pesticides to these crops; and mechanization. The data below suggest that there is substantial untapped potential for continuation of these programs. The programs would also benefit from the introduction of improved cultivation techniques, emphasizing better timing and quality of operations (such as seed bed preparation).

\[\text{In making this computation only that part of these investments which affected the production of cereals and pulses is included. About one-half of Tunisia's total investment (private and public) in farm machinery, extension, research, studies, and modern farm inputs benefitted irrigated crops and fruit trees, while one-half benefitted cereal and pulses production. The part of these investments directed to crops other than cereals and pulses and their benefits were excluded since the benefit cannot be separated from that of irrigation and fruit tree investment. Had the benefits of higher vegetable and fruit yields obtained using this technology been included, an even better efficiency indicator would have been obtained. The data are as follows:}\]

<table>
<thead>
<tr>
<th>Analysis of Seed/Fertilizer/Farm Machinery Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Cereals</td>
</tr>
<tr>
<td>Pulses</td>
</tr>
<tr>
<td>Input Costs (Cereal, Pulses)</td>
</tr>
<tr>
<td>1/2 Investment in Machinery</td>
</tr>
<tr>
<td>1/2 Investment in Extension, Research, Studies</td>
</tr>
</tbody>
</table>

n.a.: not applicable.
Crop Yields (tons/ha)

<table>
<thead>
<tr>
<th>Crop Yields</th>
<th>Actual 1978-80</th>
<th>Potential Reflected by Yields in Other Countries 1978-80</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Algeria</td>
<td>Morocco</td>
</tr>
<tr>
<td>Wheat yields</td>
<td>.56</td>
<td>1.07</td>
</tr>
<tr>
<td>Potato yields</td>
<td>6.4</td>
<td>13.7</td>
</tr>
<tr>
<td>Tomato yields</td>
<td>8.2</td>
<td>26.5</td>
</tr>
<tr>
<td>Sugar beet yields</td>
<td>21.0</td>
<td>36.8</td>
</tr>
<tr>
<td>Wine grape yields</td>
<td>1.8</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Source: FAO Production Year Book, 1980.

5.11 A second issue is that these "green revolution" technologies have been introduced by a combination of several relatively inefficient extension systems operated by Provincial Agricultural staff, parastatal organizations ("Offices"), research institutes, public input supply enterprises, Irrigation Command Area authorities and project authorities responsible for agricultural development in a particular region. There has been a tendency in Morocco and Tunisia for new regional and irrigation projects to establish separate extension, research, input supply and credit systems, directed to the introduction of this same technology. These bypass the national institutions, weakening them in the process. Some of the regional project authorities (though not the irrigation authorities) tend to appear with new investment projects, and disappear when the project investment period ends. These Project-oriented services are rarely replicated outside project areas and do not contribute to building viable institutions which serve the entire country. This has frequently resulted from the type of Project approach followed by foreign aid and financing institutions. This has happened less in Algeria mostly because Algeria has many fewer foreign aid-financed agricultural projects which tend to be regionalized. Algeria provides its agricultural services much more in the form of national programs.

**D. Irrigation**

5.12 The second major technological innovation has been irrigation, which receives nearly half of agricultural investment in each country. Small-scale irrigation based on water from wells, small-scale river water diversion systems, and flood water spreading have been practiced in the Maghreb for centuries. Large-scale irrigation works based primarily on dam construction and large water conveyance structures were introduced by the French in each of the countries, and greatly expanded by independent Morocco and Tunisia. Expanded irrigable area permitted increased production of high value crops including vegetables, fruit, industrial crops (sugar beet, sunflower), and forage (alfalfa). Morocco, having greater water resources than Algeria and Tunisia invested heavily in irrigation beginning in the 1960s. Many of the large-scale schemes were already operating before 1970, contributing to Morocco's rapid agricultural growth during the 1960s. Tunisia began investing heavily in irrigation later, and the impact on its agriculture has been more apparent on the 1970s. Algeria invested less in irrigation. Greater resources have been allocated to irrigation in Algeria in the 1980s. The percentage of arable land which is irrigated in the Maghreb remains far below the average in developing countries according to the following data:
5.13 Greenhouses. A related innovation which is introduced in irrigated areas has been the greenhouse. Usually consisting of a wood or metal frame and transparent plastic or glass, greenhouses have permitted the production of early vegetables bringing a high price on the domestic market, and on the export market. It is the greenhouse which permits Morocco, and to a lesser extent Tunisia, to export vegetables to an increasingly restrictive European market. The EEC is relatively liberal with respect to vegetable imports between December and May. The in-season vegetables produced after May cannot be successfully exported to the EEC. Greenhouse production is bringing with it more complex and sophisticated farming involving carefully supervised and more intensive doses of pesticides and fertilizer. Drip irrigation systems are being introduced. Greenhouses cover about 1,000 ha in each of the three countries, and are spreading rapidly.

5.14 Large-scale irrigation systems are difficult to manage, and as a result are often poorly managed. In Tunisia and Algeria, irrigation works are underutilized with irrigation intensities approximating 75% (probably lower in Algeria). In Morocco, utilization is closer to the potential due to enforcement in most irrigation command areas (but not all) of a legal obligation for farmers benefitting from public irrigation to irrigate, and to adhere to the cropping pattern specified by the management of each public irrigation command area. Morocco has combined incentives to irrigate (high incomes obtainable by farmers) with discipline (land remaining unirrigated is subject to expropriation). Tunisia and Algeria provide only the incentives which are less effective. Morocco's technical approach to irrigation has also been important. Moroccan irrigation systems increasingly provide metered water to farmers on demand, and regulate water distribution mechanically. This works better than requiring farmers to group together to distribute water constantly available at an outlet serving a large area. The latter system wastes water, creates conflict between farmers, and often results in larger farmers appropriating most of the benefits. Moroccan crop yields are higher in irrigated areas than are Algeria's and Tunisia's as a result (see tomato, potato, sugar beet yields in para. 5.04).

---

Irrigable Area/Arable Land (%)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>4.5</td>
<td>4.5</td>
<td>6.5</td>
<td>2.7</td>
<td>3.3</td>
<td>17.0</td>
<td>19.5</td>
<td></td>
</tr>
</tbody>
</table>

---

/a FAO Production Yearbook for Algeria and Morocco. All figures for 1969/71 and 1980. For Tunisia, source is Ministry of Agriculture.

/b May exclude some expenditure on dams allocated to urban water supply; World Bank estimates.

/c Source No. 19, and World Bank estimates.

/d World Bank estimates. The figures are approximate. Irrigation has obtained about 57% of Government's investment budget since the 1968-1977 Plan.

/e Ministry of Agriculture, Tunisia.

n.a.: not available.

\[1\] Irrigation intensity equals irrigated area divided by irrigable area.
5.15 The investment to incremental output ratio for Tunisian irrigation investment is 5.0 (US$5 in investment per US$1 in increased annual agricultural output). This is less efficient than the average investment in agriculture and industry. Ex-ante and ex-post rate of return calculations in each country are consistent with this result, ranging from 5 to 15% for irrigation projects. A few having special problems have rates of return below 0 (due to a combination of absence of farmer interest, high cost per hectare, large cost overruns, delays, and inappropriate cropping patterns).

5.16 Another issue is the low level of recovery charges. Water charges typically cover only 30-75% of the operation and maintenance costs of the public irrigation perimeters. Contributions to investment costs by farmers are often uncollected. This cannot be justified on the basis of equity, since farmers in irrigated perimeters obtain numerous advantages such as a relatively dense research and extension system, better input supply, marketing and credit services. Prices of most irrigated crops (fruits, vegetables, milk) are not fixed artificially low as are prices of some other agricultural commodities (Chapter VI). Low water charges are sometimes considered necessary to stimulate water use, given the lack of use in some irrigation perimeters. However, causes for inadequate water use are rarely found to include high water charges. Usually, the causes are land tenure problems, absentee owners who own land for speculative purposes rather than to generate farm income, poor water distribution services and conflicts over water rights. Lower water charges do not stimulate much more water use of an efficient nature. It may encourage waste by a few farmers. The other problem, which involves an inadequate effort by Irrigation authorities to collect water charges, may be caused by the fact that these institutions are at the same time responsible for obtaining farmer cooperation in using irrigation water. The irrigation authorities do not want to negatively affect farmer cooperation by imposing penalties on farmers who refuse to pay. In addition, there is no positive incentive for the Irrigation authorities to collect recovery charges, since such collections merely reduce their budgetary allocation by Government. To the extent that charges are not collected the transfer from the Government budget is higher.

<table>
<thead>
<tr>
<th></th>
<th>Average Value of Production (1981 Prices)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Investment 1965-1979 (1981 Prices)</td>
</tr>
<tr>
<td></td>
<td>1963/67</td>
</tr>
<tr>
<td>Value of Vegetable Production</td>
<td>62.4</td>
</tr>
<tr>
<td>Irrigated Fruit</td>
<td>62.7</td>
</tr>
<tr>
<td>Sugar Beet, Tobacco</td>
<td>2.3</td>
</tr>
<tr>
<td>Input Use</td>
<td>19.3</td>
</tr>
<tr>
<td>Investment in Irrigation</td>
<td>n.a.</td>
</tr>
<tr>
<td>One-quarter of Mechanization</td>
<td>n.a.</td>
</tr>
<tr>
<td>One-quarter Extension, Research</td>
<td>n.a.</td>
</tr>
<tr>
<td>One-half Fruit Tree Investment</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture of Tunisia.
Total Tunisian investment (private and public) in irrigation from 1965 to 1979 was US$644 million (in 1981 prices). Increased agricultural production in the irrigation perimeters did not result from water alone, however. About 25% of the investment in research, extension, studies and farm machinery were directed to the irrigation perimeters. About 50% of the investments in fruit trees were directed to the irrigation perimeters. The benefits were to increased fruit, vegetable and industrial crop production. The investment to incremental output ratio is 5.0 (US$915 million/US$184.3 million).

5.17 Management is provided in public irrigation perimeters by semi-autonomous Government institutions. These institutions operate and maintain the facilities and provide agricultural services. Some also supervise construction. The agricultural services typically include extension, input supply, credit, marketing, and research. Agricultural services are provided by irrigation authorities because the national institutions and enterprises which normally provide these services are not considered to provide them in the quality and quantity desired. However, the act of circumventing the normal line agencies and diverting resources to parallel structures weakens the national line agencies. Although the irrigation authorities sometimes provide better service in the short-run to the small minority of farmers who live in the perimeters, agriculture in the Maghreb suffers due to the lack of development of the national institutions. In addition, the attention of the Irrigation authorities is diverted by these side-activities from their central function which is the construction, operation and maintenance of irrigation structures (in Tunisia, the Irrigation authorities only operate and maintain structures, they do not construct). This central function is often performed poorly as a result. The problem is most serious in Tunisia and Morocco, and less so in Algeria, as discussed in para. 5.11. Operation and maintenance also suffer in each country due to inadequate operating budgets allocated to irrigation authorities. This has been particularly damaging in Algeria, although there have been increases in the past two years.

E. Livestock Development

5.18 The table in para. 5.04 shows that Tunisia is now allocating the greatest percentage of agricultural investment to livestock (nearly 14%), with Algeria allocating one-half that percentage. The figures for Morocco underestimate the share of livestock in agricultural investment because private sector investment is excluded. Morocco probably approaches the percentage allocated by Tunisia.

5.19 Livestock development has taken a remarkably similar form in each country. It has been based on cattle and a poultry production. Sheep and goats have been largely ignored. For cattle the technology involves the introduction of genetically superior stock, as well as the animal health services, animal shelters, and better feed necessary to maintain this stock. Cows were imported from Europe for this purpose. Veterinary services, vaccination campaigns, and anti-parasitic baths were established. Animal feed manufacturing plants have been developed in each country. Extension services have promoted forage cultivation in both irrigated and non-irrigated areas. This technological package increases milk and meat yields per head of cattle as the data in the table below show. It has also stimulated an increase in the number of head of cattle. The package has worked best in irrigated or high rainfall areas where forage is available, on farms which are able to implement relatively modern livestock management techniques, and in areas where Government support services are concentrated. Growth in milk and meat
production has occurred almost entirely as the result of this new technology. Algeria and Morocco invested heavily in it in the 1960s and had good results (see meat and milk production growth rates para. 3.02). Tunisia began later, and had good results in the 1970s. Morocco had difficulty in the 1970s extending the technology into rainfed areas where animal feed deficits and poor animal health facilities have not permitted genetically superior animals to perform as expected. Mortality rates have been high. The inability of Morocco to extend the new technology over the entire farm sector (to smaller less technically competent farmers) suggests that continued gains from this technology will come from adaptation to small farmers. This lesson is appropriate to Tunisia and Algeria which are following Morocco in introducing this technology to smaller farmers and in more difficult agricultural environments. However, the higher meat and milk yields per animal in many other countries in the Mediterranean Basin suggest considerable potential for improvement in the Maghreb:

<table>
<thead>
<tr>
<th></th>
<th>Algeria</th>
<th>Morocco</th>
<th>Tunisia</th>
<th>Mediterranean Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cattle ('000 head)</td>
<td>872</td>
<td>1,325</td>
<td>3,617</td>
<td>3,650</td>
</tr>
<tr>
<td>Kg of Meat per Head</td>
<td>112</td>
<td>116</td>
<td>116</td>
<td>117</td>
</tr>
<tr>
<td>Kg of Milk per Cow</td>
<td>792</td>
<td>978</td>
<td>760</td>
<td>782</td>
</tr>
</tbody>
</table>

Mediterranean Basin Countries include IBRD Borrowers located in the EMENA Region.

5.20 Algeria has introduced large-scale industrial poultry production managed by large Government enterprises. Industrial hens were purchased from abroad and chicken houses constructed on the European model. Production of chicken and eggs expanded rapidly as a result. Tunisia and Morocco promoted private industrial poultry production through extension services and agricultural credit.

<table>
<thead>
<tr>
<th></th>
<th>Algeria</th>
<th>Tunisia</th>
<th>Morocco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth in poultry production (% p.a.)</td>
<td>9.5</td>
<td>12.5</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Source: Tunisia No. 11, 13; Algeria No. 20; Morocco Ministry of Agriculture.

5.21 The investment to incremental value of output ratio for livestock investments in Tunisia is the lowest (i.e., most efficient) for all agricultural technologies, equal to 1.1. This is consistent with estimated economic rate of return computations for livestock components of rural development projects, typically in the 15-30% range. Despite the efficiency of livestock investments, the table in para. 5.19 suggests that potential has not been reached. Constraints to higher yields include: (a) inadequate feed quality and quantity, (b) a frequent lack of water, (c) local breeds of livestock which, though hardy and able to survive under harsh conditions, are poor meat and milk producers, (d) frequent incidence of poor livestock shelters, poor sanitary conditions, inadequate livestock health facilities, (e) general absence of milk marketing outlets.
F. Soil Conservation and Forestry

5.22 In mountainous and hilly areas of the Maghreb there has been a rapid rate of soil erosion and deforestation. This degradation is causing agricultural production to decline. Similarly, in the Central and Southern areas of each country which are arid or semi-arid, desertification is rapidly converting grazing-land into waste-land. The causes of these phenomena include the following:

(a) A larger number of livestock exist in both mountainous and arid areas than can be supported by feed production from natural pastures and from annual crop residues. Natural pastures and forest areas are overgrazed as a result, causing destruction of the natural vegetative cover and preventing the natural regeneration of forests and pastures. As the natural vegetative cover is lost, water run-off and wind erode the soil. In mountainous areas, soil is carried by water into the river systems, and either into the sea or into reservoirs created by dams. A constraint to each country's plans for development of water supply and irrigation based on dam construction and river water storage is the rate of sedimentation of reservoirs. In arid areas erosion of soil leaves sand or rock behind, which is inhospitable for plants, resulting in desertification.

(b) Soil erosion also results from abusive cultivation practices including the ploughing of hillsides from top to bottom rather than in contours, thereby accelerating the transport of soil by water down the hillside; the cultivation of steep slopes where even contour farming will not prevent water run-off from carrying away soils; the mechanical cultivation of land in semi-arid areas which accelerates desertification; the predominance throughout the Maghreb of a cereal/fallow rotation which leaves soil bare for considerable periods of time and, therefore, susceptible to water and wind erosion; and overutilization of forests by local populations for firewood and charcoal. Destruction of forests has been so rapid that in some areas dried animal manure is substituted for fuelwood. Since manure is a major source of fertilizer for small-scale vegetable gardening in mountainous areas, vegetable yields are declining in these areas.

5.23 The table in para. 5.03 shows that there has been a significant reduction in the percentage of agricultural investment allocated to soil conservation and forestry in each country. This percentage has dropped from high levels (ranging from 10% in Algeria to 24% in Tunisia) to 5-8% in each country. Most of this investment has gone to reforestation and the creation of earth and vegetative barriers to water run-off. Reforestation has not been greatly successful due to continued cutting by local populations. This is uncontrollable. The forestry services' police cannot cover the large territory involved. Net forest area has increased very little as a result. Production from forests has stagnated in each country since the 1960s. The creation of earth and vegetative barriers on farm land has not usually been successful due to disinterest and hence poor maintenance by farmers. Control of gullies with rock barriers and planting of grass and trees has also been undermined by the overgrazing of sheep and goats. The investment in soil conservation and forestry has therefore not been very effective. This is the major reason for the decline in its budgetary allocation.
G. Fruit Trees

5.24 The table in para. 5.03 shows that the share of fruit tree investment in total agricultural investment has declined considerably in each country of the Maghreb. The Government of each country has planted olive and other fruit trees in areas subject to erosion both as an erosion control measure and to increase fruit production. Some of this investment has been unproductive. Fruit trees are not effective as a soil conservation measure, and tend to be unproductive in the harsh environment typical of areas requiring soil conservation. Much private investment in citrus, olive, almond, apricot, peach and apple trees has been highly productive. In Tunisia, the net effect has been that the average fruit tree investment is relatively productive with a ratio of investment to incremental value added of production equal to 3.6 for the period 1963/67 to 1977/80. This is better than average efficiency for Tunisian agricultural investments. Fruit tree investment components of agricultural projects are generally considered highly productive. However, such investments should be left to farm level decision-makers (private, cooperative and state farms), rather than to the Government administration.

H. Fishing

5.25 The share of fishing investments (in boats, equipment, shore facilities) in total agricultural investment varies greatly between countries and within each country in the Maghreb (para. 5.03). Tunisia is giving it increasing emphasis. Fisheries projects are now under consideration in all three countries. The investment to incremental output ratio for Tunisian fishery investment was 6 during the period 1963/67 to 1971/81. This indicates a combination of inefficiency, the limited fish resource in the Mediterranean, and the long delay before benefits are realized. Ex-post analysis of fishery projects also shows low returns. This suggests that less investment should be made in fishing and that the design of fishery projects be reconsidered. The fishery subsector faces major constraints with respect to the system of providing credit to fishermen (recovery rates are poor in each country), inadequate shore facilities, and the need to improve performance by the public institutions responsible. Only Morocco is likely to have large fish resources in the Atlantic.

I. Rural Infrastructure

5.26 Agricultural growth can be expected to occur not only as a result of the introduction of new farm technologies, but also of investments in rural infrastructure. Modern inputs, investment goods, and knowledge are transported with greater regularity to the farmer when there is a relatively dense road network. Development of marketing assembly points, dependent on roads, have the same effect. Demand is communicated from the cities to farmers through these markets as are inputs, knowledge, and the consumer goods which induce greater farmer participation in the market. Communication facilities (radio, newspapers) provide information to increasingly sophisticated and market-oriented farmers. Investments in rural infrastructure operate to: (i) facilitate the transmission of knowledge to farmers with respect to farm production techniques, consumer demand, etc.; (ii) facilitate the acquisition by farmers of inputs; or (iii) facilitate the continuous sales of products to buyers. Most investment in rural infrastructure is not included in agricultural investment budgets (para. 5.03). Data is not available to indicate the development of rural infrastructure, although it has probably occurred at the same rate as agriculture has grown.
J. Recommendations

5.27 Agricultural growth in the future can occur as a result of continued introduction of the technologies described above. Investment programs in all three countries emphasize these technologies. Greater emphasis appears justified for agricultural research and extension, projects which introduce the new seed/chemical input technologies, investments in livestock-related activities, and fruit trees. Some of this investment must be directed to the development of line agencies providing the relevant services. Most should go to farmers and enterprises who make the investments (credit programs). Some will go to public enterprises. Rural infrastructure should continue to be developed at about the rate of agricultural growth: not more rapidly to avoid wasteful over-capacity, nor too slowly to avoid the situation in which infrastructure constitutes a bottleneck. Less investment should generally be considered for fisheries (except perhaps in Morocco), large-scale irrigation, and industrial production of livestock. Small-scale irrigation appears to have considerable potential. Mechanization should not be subsidized so as to avoid encouraging excessive mechanization which accelerates soil erosion, and which displaces agricultural labor more rapidly than it can be absorbed in other agricultural and non-agricultural occupations. Soil conservation and reforestation strategies must be altered since they are presently unproductive. These conclusions are not exceptional, since variations have appeared in some Government and Bank sector work in the past. Bank lending strategy has generally moved in similar directions, although fisheries and mechanization have not yet been de-emphasized. The critical issue is how to implement these broad recommendations.

5.28 Research, Extension, and Farm Technology. To improve research and extension, it is recommended that a single national research and extension program, with regional and local representation and using existing organizations be created in each country. This issue is of such great importance that a section of Chapter VI (critical issues) is devoted to it. The national program would develop appropriate research themes and extension messages, organize research stations and extension centers, provide for staffing and management systems, and provide an investment and operating budget. Extension techniques should be borrowed from successful projects undertaken in other countries, particularly the training and visit system successfully established in India. In successful research and extension programs the institutional issues are overcome by consolidating authority under one institution having a research department and an extension department. Research is organized from "support" stations where applied research is undertaken, and from which contact with extension agents is maintained. Work centers house extension agents who are supported by more specialized subject matter specialists operating out of the "support" stations. The linkage between research and extension is maintained by these subject matter specialists. This recommendation is developed further in Chapter VI. An essential point is that national programs will permit the building of national institutions in a cumulative manner, avoiding the loss of services which occurs when regional project investment periods end. Only in poor backward areas, which line agencies consider as last priority, is there justification for multi-purpose autonomous project authorities to provide research and extension services. Even here, however, the services should be provided in the context of national programs. When the services are developed, the line agencies should take them over. Project authorities would therefore have the role of starting up development services, not of managing them in perpetuity.
5.29 The green revolution technologies must be carried further, and new methods introduced by research and extension services. A potentially productive new orientation is to introduce through extension, research, input supply, and credit, technologies which conserve energy, capital and soil. Up to the present, the emphasis has been on the introduction of technologies making intensive use of energy and capital, and causing soil depletion (mechanization, farm crop specialization, heavy doses of chemical inputs). Resource-conserving technologies will generally involve better adaptation of known technology, often traditional technology. In addition, in moving from low income traditional agriculture to a somewhat more sophisticated market-oriented agriculture, many farmers have already become familiar with the high-yielding seed/fertilizer/weed control technology. Gains are to be found in fine tuning: increasing efficiency of application, better seed bed preparation, timely cultivation, etc. Each farmer will, and should, have his own strategy which is likely to be somewhat different from that of other farmers with respect to fertilizer use, weed control, livestock handling, cropping pattern, mechanization, and storage. Extension messages should be tailored to fit individual agricultural zones and farmers rather than the same package covering all farmers in a large area.

5.30 Several technologies, not yet seriously considered in any of the Maghreb countries, which can be immediately efficient, consist of improvements to traditional technology, including:

i) better animal-drawn implements (slowing down the rate of increase in tractor use);

ii) improved animal-powered pumps, or eventually solar energy powered pumps (sunlight is abundant in the Maghreb);

iii) structures to channel and collect rain water run-off, combined with inexpensive gravity irrigation systems;

iv) use of animal manure and cultivation of nitrogen fixing legumes, as partial substitutes for chemical fertilizer. This will require diversification of crop and livestock production on each farm rather than specialization. Diversification also facilitates the maintenance of soil fertility.

v) reduction of tendency to use blanket applications of herbicides and pesticides in favor of combinations of manual weeding, cultivation practices which minimize pest and weed problems, other biological pest control measures and more limited chemical applications;

vi) techniques to conserve forage and maintain its nutritive value (silage); and

vii) community maintenance of permanent pastures in areas subject to soil erosion; for livestock production (Tunisia is beginning to experiment with this approach). Extensive areas in all 3 countries could be put under permanent pasture. Considerable quantities of milk and meat could be produced using local and cross-bred cattle; sheep and goats, based on pasture rather than imported feed.
5.31 **Irrigation.** The agricultural development of existing irrigation perimeters is of the highest priority in each of the three countries. The most important actions to be taken are to introduce improved management systems for the public irrigation perimeters, improve maintenance programs, apply existing land reform legislation (in Morocco and Tunisia), increase water charges to more nearly cover operation and maintenance costs, and reduce the activities of the irrigation authorities which are not directly related to the supply and use of irrigation water. The most important investments are in surface wells to exploit groundwater, maintenance equipment, rehabilitation of existing irrigation perimeters, and rural water supply. It is recommended that a national program of management reform and maintenance of irrigation perimeters be prepared in each country, with the highest priority in Algeria and Tunisia.

5.32 In order to encourage fuller use of irrigated land in Tunisia and Morocco, a land tax should be imposed so as to create a financial burden on absentee landowners who hold irrigable land for speculative purposes, but do not cultivate it. This would induce either sale of the land or its cultivation. It would also encourage cultivation of higher-value crops making more economic use of irrigation water. In addition, the full use of irrigation facilities in Morocco and Tunisia should be promoted by more intensive application of existing land reform legislation, discussed in Chapter VI. Farmers who refuse to irrigate land served by public irrigation works should be required to sell their land to farmers willing to irrigate. If this law is unworkable in practice, an alternative is to set the land tax proposed above high enough to induce either use of the land to pay the tax, or the sale of the land.

5.33 Some of the new large-scale irrigation Projects now being prepared in all three countries are costly (per ha) reflecting the tendency to develop irrigation potential to its maximum even in cases where it may not be economically justified. A stricter application of economic analysis is required in order to identify the poor projects, which should be excluded.

5.34 To induce more efficient collection of recovery charges, the irrigation authorities could be given financial independence, with their income based on collection of recovery charges. Recovery charges should be increased progressively. This should be supported by penalties on farmers for non-payment of recovery charges, including expropriation of land as a last resort. If recovery is poor, the budget allocation should be reduced, penalizing both the irrigation authority and the farmers from whom recovery charges could not be collected.

**Livestock Development**

5.35 Despite the high average efficiency of livestock investments, the issues listed in para. 5.21 need to be addressed. Existing programs of each Government should be continued, and expanded, but with management, institutional and policy changes to increase efficiency. More emphasis must be given to promotion by the extension services of forage production from permanent pasture in areas where crop production is not possible, and from cultivated forage production under dry farming conditions. Cultivation of cereal/forage rotations combined with livestock production under dry farming conditions has been found to have a secondary benefit of increasing soil fertility compared to the common cereal/fallow rotation without livestock.
The strategy would require the progressive removal of subsidies on animal feed (particularly in Tunisia and Algeria) in order that livestock production now dependent on such subsidies not have a financial advantage that dependent on unsubsidized permanent pastures and cultivated forage. This reduction of subsidies on animal feed would also reduce the profitability of industrial chicken production. The objective should be to make poultry production financially self-sufficient. Reduction of subsidies would tend to switch poultry production back to family farmers. Additional research and extension effort is required to improve sheep and goat production, which has been neglected in all three countries.

Soil Conservation and Forestry

5.36 Because of the lack of productivity of past soil conservation and reforestation programs, resources allocated to this activity have declined in each of the three countries in favor of more productive investment. The magnitude of the problem has increased, however, and a new strategy is required to permit effective treatment.

5.37 Large-scale pilot projects (at Sedjenane and Beja in Tunisia, in the Aurès of Algeria, and in the regions of Loukkos and the Middle Atlas in Morocco) suggest that, since the cause of soil erosion and desertification is human destruction of the environment, the solution is to provide incentives to the population involved to modify their behavior. This can only be done by providing an alternative to abusive cultivation practices and overgrazing, which improves the well-being of the population. The strategy which has been developed aims to increase livestock and crop production, using agricultural techniques which conserve the soil, reduce water run-off and hence reduce erosion. Projects would organize the provision of services by established national institutions. Services would include extension, credit, farm input supply, milk marketing, assistance with land consolidation where necessary, installation and management of permanent pastures, provision of farm machinery services, construction of water supply and livestock health facilities. The major technical innovation would be the planting of vast areas under permanent pasture. Pasture would serve as the major source of animal feed (which is scarce hence causing overgrazing). Pasture also efficiently retains water, reducing water run-off and hence erosion. The forestry service of each country could be made responsible for this activity, assisted by national livestock services. The extension service would introduce forage crops to supplement pasture as an animal feed and to increase vegetative cover of soils as a soil conservation technique. The extension service would also introduce intensive agricultural cropping to maintain a nearly permanent vegetative cover. Infrastructure (schools, roads, health facilities) would be provided by the national institutions responsible to improve the well-being of the local populations. The population of the areas subject to erosion and desertification is the poorest in each of the three countries so these actions also have a poverty alleviation function. To receive these services local communities will have to agree to respect and maintain the permanent pastures and introduce the new farming methods designed to reduce erosion and water run-off. They would have to agree to management by the forestry service of not only forest land, but of collectively used permanent pastures created by the Projects. They would agree to pay user charges for use of pastures, and to reimburse credit. On the basis of this new approach, an increase in the proportion of investments allocated to soil conservation and forestry is justified.
Fruit tree investments should be continued, but Government should reduce its direct intervention in favor of credit distribution for fruit tree plantations by private, cooperative, and state farms. Investment in fisheries should be de-emphasized in Tunisia and Algeria until a strategy can be developed which permits such investments to be more productive.

**K. Issues**

The recommendations with respect to investment and organizational strategy face general policy and structural obstacles, as well as the constraints specific to each investment type discussed above. The obvious obstacles of a general nature are administrative. These involve the inertia inherent in all administrative organizations: old ideas and methods are repeated out of habit. New approaches take hold slowly. The second is absorptive capacity. Because of historical Government investment orientations, Ministries of Agriculture (and Hydraulics in the case of Algeria) have large competent staffs in the areas of large-scale irrigation and energy-intensive agricultural techniques. Each country has impressive capacity to prepare irrigation projects, and much less to prepare research and extension activities, livestock investments, etc. Inevitably, resources will go to irrigation in these circumstances. A third problem is a tendency to underfinance operation and maintenance in order to allocate more to new investment. Existing projects therefore depreciate too quickly. Projects need to be prepared, staff and resource re-allocations undertaken, and Government directives issued in order to introduce the modest re-direction suggested above, and to overcome these obvious constraints.

In addition to the above constraints to the re-direction of investment and other productive activity in agriculture, there are several which involve complicated policy decisions and structural problems (natural resource constraints were discussed in Chapter III). The most important are discussed in the next chapter, including:

(a) price policy;
(b) marketing and processing;
(c) agricultural credit;
(d) land tenure;
(e) research and extension.

The selection of these five issues from among the large numbers facing agriculture in the Maghreb is a matter of judgment. Other important general issues not discussed are agricultural education and manpower requirements, capacity of Government agricultural services, inter-industry linkages, and foreign demand for the agricultural exports of the Maghreb.
VI. GENERAL CONSTRAINTS TO RE-ALLOCATION OF AGRICULTURAL RESOURCES AND AGRICULTURAL DEVELOPMENT

A. Price Policy

6.01 The objectives of agricultural price and marketing policy in each of the three countries are several, and often require contradictory policy. Objectives in each country include (i) providing food at affordable prices to low income groups, (ii) establishing prices which provide a sufficient incentive for farmers to produce, (iii) maintaining farm income levels, (iv) improving farm productivity and hence output by subsidizing key inputs such as fertilizer and animal feed, (v) insulating the economy from short-term international price fluctuations, and (vi) developing the marketing system to respond to changing consumer demand. For most commodities, Government intervention has been presumed necessary to attain all of these objectives simultaneously. For example, the wheat price consistent with maintaining low retail prices for bread is not consistent with that necessary to induce efficient cereal production, nor is it necessarily consistent with a free market price. Therefore, to attain objectives simultaneously, Governments in each country have tended to fix the retail price at a low level, fix the producer price of wheat at a level judged sufficient to induce efficient production, and the difference is met by Government financial transfers to processors and wholesalers. The Algerian Government is the most interventionist of the three, setting most agricultural producer, wholesale and retail prices. As stated in the summary of this report, this Government control is believed necessary in Algeria not only to efficiently manage the economy, but to achieve social objectives and to achieve the objective of economic independence. The Tunisian Government fixes the producer prices of the most important products (cereals, olives, wine grapes, sugar beet, milk, dates, beef, poultry). However, many prices are free (pulses, sheep meat, most fruits and vegetables, forage and fish). Private markets are tolerated even for commodities having fixed prices. A similar situation exists in Morocco to that of Tunisia. All three countries fix most prices of agricultural products sold by processors and wholesalers, including flour, bread, vegetable oils, olive oil, sugar, butter, milk, eggs, poultry, beef, canned tomatoes, wine, tobacco, and, periodically, potatoes. Fixing of prices at several marketing levels (producer, wholesaler, processor, retailer) is not only complicated, but has necessitated in each country a complex system of Government financial transfers to compensate some participants (but not all) for losses incurred as a result of price policy.

6.02 Modern farm inputs and some equipment are subsidized in each country. This is done firstly by fixing artificially low prices for fertilizer, animal feed concentrate, irrigation water, and credit (low interest rates). Subsidies are available in each country financed through credit for genetically superior livestock, and fruit trees. In Algeria, socialist sector farms obtain subsidies for all inputs. In Morocco, farm machinery has been subsidized for cooperatives. Some agricultural inputs are not subsidized. In Tunisia and Morocco farm machine services, equipment investments not financed through credit, draft animals and their implements, and livestock other than high-yielding cows are not subsidized. Labor use is effectively taxed in each country by a minimum wage set by law considerably above the opportunity cost of labor (except in irrigated areas where labor's opportunity cost is high).
6.03 The issue is that agricultural producer prices fixed by the three Governments have been in most cases below both world prices and prices which would be determined by a free market. All tradable (exportable or importable) agricultural products have also been penalized in the past by the overvaluation of the three local currencies. Overvaluation causes prices of agricultural imports which compete with local production to be cheaper in the local currency then they would with no overvaluation. Overvaluation also reduces the local currency income from agricultural exports. This situation arose out of (a) the policy emphasis in each country on production of import substituting industrial goods, (b) in Algeria and to a lesser extent in Tunisia the increase in foreign exchange earnings from petroleum exports making the costs of an overvalued exchange rate less visible, and (c) the Governments' emphasis on providing inexpensive food to urban consumers. Import substitution policy has involved protection of domestic manufactured products through high tariffs and import quotas. The prices of these products are considerably higher than world prices (effective protection is high for industrial import substitutes). The local price structures have evolved in response, so that national prices are on average higher than world prices. This means that the local currency is overvalued in terms of foreign exchange. It does not follow that the local currencies have required devaluation. The distortion in the structure of prices has been the necessary result of an extensive system of industrial protection. Since agricultural production has not been protected from cheapened imports, and agricultural exports are not compensated for the tax of overvaluation, the internal terms of trade have evolved against agriculture. This situation has been exacerbated for some agricultural products for which agricultural prices have been set at artificially low levels in order to minimize the fiscal cost of providing subsidized food to consumers. Income has been transferred out of agriculture to other sectors as a result.\(^1\)

6.04 The effects of price policy on income obtainable from the production of agricultural commodities has been recently estimated in Tunisia.\(^2\) A methodology was used which computes a range of net revenue from production per hectare for each commodity in domestic prices. This is compared to net value in world prices adjusted for the overvalued exchange rate and for subsidies and taxes. The numerous input subsidies tend to increase farm income, while price controls and the overvalued exchange rate decrease it. If the subsidies exceed the implicit tax caused by low official prices, then income in domestic prices will exceed income in world prices. In this case effective protection is positive. If the subsidy on inputs does not exceed the implicit tax of low official prices, effective protection is negative. Price data was from 1980. The result was that in 1980, input subsidies did not compensate the implicit tax of price policy for cereals, non-irrigated fruits (olives, wine grapes), sugar beet, beef, and milk production based on feed from natural pasture or farm production of forage. Irrigation water subsidies, combined with subsidies of fertilizer and pesticides have been great enough to cause a net

\(^1\) Data is provided and analysis undertaken in IBRD Agricultural Sector Surveys for each country: Algeria in 1979, Morocco in 1980, Tunisia in 1982.

\(^2\) IBRD Agricultural Sector Survey of Tunisia, June 1982.
subsidy of irrigated vegetable and fruit production (positive effective protection). Similarly, the extremely high feed concentrate subsidies, as well as subsidies on animal shelters and genetically superior cows, caused a very high net subsidy for industrial poultry production and milk production based on the use of subsidized animal feed concentrate. Since subsidized irrigated crops cover only about 3% of Tunisian farm land and most farmers do not produce milk using subsidized cows and concentrate, most agricultural production is effectively taxed. Incomes from production of effectively taxed commodities have been reduced to levels of from one-fifth to one-half of what they would be with a neutral price policy. Similar results have been derived from analysis in Morocco and Algeria in earlier years. The direction of price policy was therefore similar in each country.

6.05 The first effect of this price policy has been to reduce income from rainfed farming and from production of commodities effectively taxed. This transfers income from producers of these commodities to consumers. According to the analysis referred to above, the average Tunisian farm of 14.4 ha, producing only bread wheat, would earn about US$575 p.a. in 1980, compared to expenditure by the average Tunisian household equal to US$2,480. About 80% of Tunisian farms are smaller than 14.4 ha, hence earning less. In a poor year the farmer may earn half this amount. Had world prices been paid for wheat, and for farm inputs, the average farmer would have earned about 4 times this amount making his income comparable to that of the average Tunisian household. Similar conclusions apply for olive production, wine grapes, and beef, for which official prices are fixed at low levels.

6.06 Secondly, the transfer of income from agriculture to urban sectors has reduced economic growth in each country, since agricultural investment has been more efficient than non-agricultural investment. Paragraph 2.13 shows the incremental capital output ratio in agriculture to be less in each country than that of manufacturing, indicating agriculture's greater average output response to investment. A favorable agricultural price policy stimulating agricultural investment is therefore conducive to growth. Output prices which permit an adequate profit permit farmers a greater margin to take the risk of introducing more productive, but more costly inputs, including those identified in Chapter V. In each country, crop yields are below potential in rainfed agriculture. Higher prices attract smaller farmers into the market place. Once farmers begin producing for the market and using income to purchase consumption goods, they become attuned to market signals and to new agricultural knowledge. They begin to respond more rapidly to cost-cutting or output-expanding technologies such as those discussed in Chapter V. They introduce new crops corresponding to consumer demand rather than to the exigencies of self-sufficiency. Savings may be made, and invested in productive assets (a genetically superior cow, animal shelter, metal plow, well, water pump). This is the beginning of self-sustained agricultural growth. Adequate prices are a necessary, although not sufficient, condition for this growth. As a country moves into middle income levels, appropriate and flexible price signals combined with adequate market outlets become of paramount importance in stimulating growth.
6.07 **Input Subsidies:** Input subsidies have been insufficient in each country to offset discriminatory price policy, except for irrigated fruit and vegetables, and for industrial poultry and milk production making use of highly subsidized feed concentrate. Large farmers (socialist sector farms in Algeria) obtain nearly all of these subsidies. They are able to do this because they use most of the subsidized inputs. Since large farmers and socialist sector farms would tend to use modern inputs anyway, subsidies are wasteful when going to them. The smallest farmers may be stimulated to demand more modern inputs than otherwise as a result of the subsidies, but often cannot obtain the inputs due to inadequately developed input distribution systems. Subsidies on all purchases of farm inputs having a stimulative effect only on a few small farmers, is inefficient, and is not a substitute for adequate prices for farm produce.

6.08 Input subsidies also cause distortions in technological choice by farmers. In Tunisia, extremely high subsidies on manufactured animal feed concentrate have stimulated the substitution of such concentrate for traditional sources of animal feed such as pasture and cultivated forage crops by large and small farmers alike. Feed concentrate is manufactured almost entirely from imported cereals. The result has been increased use by dairy producers of imported feed having a high cost to the economy but low cost to the farmer. This has led to neglect of domestic forage and pasture production. Imported feed uses a scarce resource: foreign exchange, and discourages use of a less scarce resource: pasture-land and forage production. Similarly, subsidies for the purchase or the use of tractors encourage the more rapid acquisition of this equipment, and more rapid displacement of labor than otherwise. Tractors represent the use of scarce foreign exchange, while labor is underemployed. Subsidies of irrigation water encourage wasteful use of water. As the price of energy increases, the use of low energy-consuming production techniques becomes more viable on the margin (draft animals instead of tractors; manure instead of fertilizers; cropping patterns which reduce weeds, and hand weeding, instead of herbicides; cropping patterns making optimum use of water). These technological shifts, on the margin, are desirable for the economy because they economize the resource (energy) which has become increasingly scarce. If most input prices are fixed at low levels, the farmer will receive no signal that the economic cost of some of these inputs has increased. He will not use them less, and he will not seek out inputs or investments which use less of the costly inputs (as recommended in Chapter V). Fixed input prices therefore tend to discourage the introduction of new and economically more efficient technology. This is less of a problem in Algeria where in the past input use has been defined more by planners at the Central and Provincial (Wilaya) levels than by farmers. Price signals are less relevant to resource allocation and the efficiency of its use in Algeria. However, greater autonomy is being given to socialist sector farms. Greater responsiveness to price signals can be expected in Algeria.

6.09 In all these countries, the above situation was becoming increasingly distorted through 1980, with farmers in irrigated areas increasingly favored and rainfed farmers increasingly discriminated against. Since 1980 Governments in all three countries began to recognize the problem, and fixed producer prices have been increased (on average) more rapidly than has domestic price inflation, reducing price discrimination against agriculture.
In addition, the world price of sugar has fallen dramatically. Sugar beet producers in each country are now protected by domestic fixed prices. Finally, the Moroccan Dirham has depreciated significantly, and the Tunisian Dinar has depreciated slightly, also reducing discrimination against agriculture. The impact of these changes in relative prices of agriculture and industry have not been measured. There should be monitoring of both the changes in terms of trade between agriculture and other sectors, and the impact on agricultural investment, input use, crop yields, incomes, and eventually rural-urban migration.

Recommendations

6.10 The new direction of policy change in each country appears to be correct according to the above. However, the best way in which to avoid future price distortions is to fix producer prices only in contracts mutually agreed by marketing or processing enterprises and farmers (as is now done for industrial crops in Tunisia). Floor prices should be announced for cereals and pulses prior to planting. Announced prices should be maintained at world levels plus an amount equal to the average tariff levels on all imports, which is a proxy for the degree of currency overvaluation. Tariffs should be established on food imports (cereal, meat, milk, sugar, vegetable oil) equal to the degree of currency overvaluation to protect local producers from artificially cheapened imports. If producer prices were free in such a situation, they would quickly approximate the world price plus the tariff. Exported products (olive oil, wine grapes, exported fruits and vegetables, cotton) should receive an export subsidy equal to the average tariff on imports to offset the effect of overvaluation. This is relatively simple for commodities where subsidies can be provided through Government marketing agencies. This is the case for all commodities in Algeria, olives and wine grapes in Tunisia, and most export crops in Morocco. For other products such as fruits and vegetables in Tunisia, subsidies might be provided through marketing cooperatives, which would also aid in establishing such cooperatives. Prices for fruits and vegetables sold on local markets should be free, since wide variations in quality and in daily supply and demand make fixed prices impossible to implement and risk discouraging production. As tariff levels on manufactured goods fall, and local average price levels come closer to international prices, export subsidies and import tariffs should be reduced. This system is much simpler to implement than are the present systems which require administrative control exercised through public marketing monopolies, combined with complex calculations of producer income corresponding to various prices. These calculations do not adequately reflect agricultural reality in any of the three countries.

6.11 The above price changes would increase gross farm income from production of all commodities except sugar beet, though the increase would vary from commodity to commodity. Input subsidies could then be reduced progressively.
6.12 The effects of the above changes would be as follows:

(a) The incomes of farmers would be increased except those dependent on irrigated fruit and vegetables, poultry production, or industrial milk production dependent on the use of subsidized inputs. For the latter, incomes would decline due to the reduction in input subsidies greater than the increase in producer prices. Incomes would decline toward the value of production in world prices. The net effect will be greater equity within agriculture, and between agriculture and other sectors.

(b) Crops and livestock systems previously discriminated against will tend to occupy more of the land, receive greater investment and input intensification. Crops and livestock systems previously supported by heavy subsidies will be cut back. Since most commodities were discriminated against, there will be a net increase in agricultural investment and growth due to expanded agricultural incomes which can be invested. This will also have a favorable balance of payments effect since almost all agricultural commodities are import substitutes or exportables.

(c) Either Government subsidies to consumers will increase, or retail food prices will have to be increased. Subsidies are presently high and merit reduction in each of the three countries.

If retail food prices are permitted to increase, the increase should be slow and progressive. Food subsidies could be directed to the urban poor by channeling cheaper food through special stores established in poor areas. Alternatively, food stamp systems could be used. A major objection to these recommendations might be made by Algeria. Algeria has consciously reduced agricultural exports to make way for production destined to satisfy local consumption. This pursuit of food self-sufficiency was intended to contribute to economic independence. However, as indicated in Chapter II, policies which generate added income and investment in agriculture may contribute more to economic independence in the long-term than policies which promote that independence in the short term at the expense of agricultural growth. Nevertheless, the issue merits further analysis.

B. Policy with Respect to Agricultural Marketing, Processing and Input Supply

6.13 Chapter IV showed the importance of the "pull" effect on agriculture caused by general growth of the economy. In low income countries growth is often the result of Government "push". "Push" consists of the introduction of simple technologies (better seed, some fertilizer, improved animal drawn implements). Much of agriculture in a middle income country has passed this stage. Farmers have largely introduced the improved standard technologies. They begin to fine tune. This consists of responding quickly to technologies adaptable to their specific circumstance (greenhouses, drip irrigation, a graft for a fruit tree, a mechanical olive harvester if labor is short, a motor-cultivator for cultivation in vegetable fields). Such farmers also begin responding to the rapidly evolving urban demand. This demand moves from low cost cereals and pulses; to higher cost vegetables, fruit, milk and meat; to highly processed food (off-season fruit and vegetables which have been preserved, cheese, ice-cream, fruit preserves). The enterprises through which farmers market their produce, or from which they buy inputs, must be
able to recognize evolving demand, and effectively communicate this information to farmers. They must increasingly change food procurement practices in response to changes in demand, and efficiently transport and handle a changing product mix on its way to consumers. Farm input supply enterprises must be able to identify the new inputs and investments which will prove profitable to farmers, and efficiently provide these technologies to farmers.

6.14 Agricultural marketing enterprises include initial assemblers of goods in rural areas, transporters, wholesalers, wholesale market-places, retailers, and often various brokers between these institutions. In the Western European and North American countries the functions described above have been performed with increasing efficiency and effectiveness by enterprises which pursue profit. This pursuit consists of the identification and satisfaction (and often the shaping) of consumer desires. Those marketing enterprises that survived and grew did this with increasing efficiency. Those which were not efficient stopped functioning.

6.15 After independence, Algeria established state monopolies for marketing agricultural produce, farm inputs and investment goods. Government-owned companies were established for processing. Tunisia established marketing monopolies for certain products (cereals, exports of wine and olive oil), and for supplying fertilizers. However, in Tunisia most marketing and processing is undertaken by private enterprise. In Morocco, private enterprise predominates except in cereal marketing, fruit and vegetable export, and fertilizer distribution. Mixed Government-private enterprises process industrial crops in both Morocco and Tunisia, but otherwise processing is left largely to the private sector. Public sector intervention was important in Algeria following independence due to the destruction of marketing infrastructure during the Algerian revolution, and because the departing French had maintained tight control over most of the organized agricultural marketing. Tunisian and Moroccan agriculture were less controlled by the French, and were not destroyed by a revolution. Performance of the new public sector marketing and processing enterprises was adequate in each of the three countries for the period in which the objective was to provide a simple outlet for farm produce and to transport what was available to consumers. Fine tuning was unnecessary. Public export-oriented enterprises in each of the three countries were able to export, though often in declining amounts.

6.16 The importance of responsive marketing and processing enterprises is increasing as the three countries move into middle income, for the reasons given above. The public agricultural marketing and processing enterprises in the Maghreb are slow to respond to market signals and to introduce cost cutting efficiencies or consumer satisfying innovations. This is partly caused by the lack of an incentive to be efficient (losses are financed by Government), and partly by Government price policy which does not permit public marketing enterprises to generate financial surpluses. Without such surpluses, these enterprises must solicit Government budget transfers to finance investment. This is a slow process. Infrastructure and maintenance needs are often not met as a result, reducing the efficiency of operations. This situation results from the several conflicting objectives given to the public marketing enterprises by each of the three Governments. These include the application of Government price policy to subsidize consumption of basic foodstuffs, assure the supply of food to consumers (and to foreign markets), assure the collection of crops from farmers, and provide other services (such as input supply) on the minimum budget possible. These objectives conflict,
and their simultaneous pursuit causes a reduction in the efficiency of the public enterprises. Where these enterprises have become monopolies, their existence keeps private and cooperative enterprises from participating, except on a small scale and illegally.

6.17 Food processing industry in each country faces the same price discrimination as agriculture. An over-valued exchange rate cheapens imported processed food. In the absence of import duties, local processors cannot compete with cheapened imports. Processed foods are also often subject to price controls, causing prices to be artificially low. This reduces the incentive to invest in such activity. Lack of interest by the private sector is often the justification used by Government to establish public enterprises, which are subsidized to maintain their financial solvency. Government ownership of such enterprises would not be necessary if their product prices were not artificially lowered by Government and if the exchange rate was not overvalued.

6.18 Problems of marketing and processing are partially indicated by low calorie intake. Less efficient marketing systems are likely to inadequately satisfy food needs. Algeria's lower per capita calorie consumption partly reflects inefficient marketing and processing sectors.

<table>
<thead>
<tr>
<th>Calorie Intake Per Capita</th>
<th>1977/79 a/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>2,363</td>
</tr>
<tr>
<td>Morocco</td>
<td>2,640</td>
</tr>
<tr>
<td>Tunisia</td>
<td>2,698</td>
</tr>
<tr>
<td>Middle Income Countries</td>
<td>2,580</td>
</tr>
</tbody>
</table>


6.19 The easy recommendation is for each Government to divest itself of most agricultural marketing and processing activity. However, there is a legitimate role for Government institutions in importing, stocking, and participating in the distribution of strategic commodities important to the internal stability of the country (cereals, sugar, and perhaps milk). In addition, the fixing of food prices, at least at the retail level, will continue to be an instrument of social policy. This is most effectively done through public enterprises.

6.20 On the other hand the strategy for agricultural marketing and processing in middle-income countries like those of the Maghreb cannot be simply to assure an outlet for farm production and to satisfy basic consumer demand. Accent should be put on the speed and efficiency of market and enterprise response to changing consumer demand and farm supply. It is recommended that Government undertake:
(a) promotional activity to identify private investors for specific agricultural marketing and processing projects, to assist these investors to mobilize finance, develop marketing strategies, choose equipment and deal with Government regulations, etc.;

(b) preparation of feasibility studies for marketing and processing sub-projects, for dissemination to private promoters and public enterprises. Competition should not be stifled by restrictive licensing requirements designed to maintain monopoly positions for existing producers;

(c) to establish a line of credit, to be used to finance private marketing and processing projects, to be managed by participating banks;

(d) to provide public budgetary funds to finance projects in the public domaine for agricultural marketing and processing;

(e) to provide a package of reform in the areas of price policy, marketing, and processing regulation;

(f) to encourage, through incentives, public marketing and processing enterprises to seek cost cutting innovations and increase efficiency. In a Government-owned organization the best way to do this is to establish a contract-plan between the enterprise and Government specifying the rights and obligations of both the enterprise and Government. Management would be evaluated against these objectives and provided bonuses for good performance. Penalties should be imposed for poor performance. An end-of-the-year audit should be undertaken to judge performance;

(g) promotion of marketing cooperatives;

(h) reduction in legislative restrictions on the development of private wholesale enterprises;

(i) introduction of standard grades and measures to facilitate pricing according to quality differentials and to permit long-distance depersonalized trading. Broadcasts of market information would be useful to facilitate competition and arbitrage (movement of goods from surplus areas where prices are low to deficit areas where prices are high);

(j) to introduce contracts between growers and both processing enterprises and cooperatives. Contracting farmers would receive inputs, credit and technical advice from processors or cooperatives. Farmers would guarantee that production be sold to the factory or the cooperative. Processors and cooperatives must be willing to renegotiate prices based on wholesale (or free market) prices if farmer respect for contracts is to be assured. Hence the desirability of freeing processor resale prices;

(k) to avoid marketing investments by regional project authorities since such authorities usually are poor at marketing, and undermine private and cooperative marketing enterprises.
6.21 Recommendations for the supply of farm inputs are identical. In particular, experimentation with input distribution by private enterprises should be contemplated where this is not yet allowed. Public enterprises capable of importing and distributing large quantities of fertilizer, high yielding seed varieties, and other inputs identified by research institutions will continue to be useful, and sometimes necessary. However, Tunisia's experience in which private enterprises efficiently distribute farm machinery, herbicides, pesticides, and fruit tree plants is revealing. The distribution in Tunisia of fertilizer and high yielding seed varieties by a public enterprise is much less satisfactory (inadequate quantities delivered at unsatisfactory schedules). In Algeria, all input supply is publicly controlled. Morocco's situation is mixed like that of Tunisia.

6.22 In order for private enterprises to be interested in distributing farm inputs, the profit obtainable must be adequate. Official prices often do not permit such profit.

C. Agricultural Credit and Financial Markets

6.23 In each of the three Maghreb countries (Algeria, Morocco, and Tunisia), agricultural credit is provided primarily by Government-owned development banks. Morocco's is a specialized agricultural credit bank, while Tunisia's and Algeria's provide credit to other sectors as well. Credit is important in each country as the principal source of financing for farm investments. Other sources of finance are direct Government investment, farmer equity, and equity contributions by people outside agriculture (family members living abroad or in cities), traditional money lenders and input suppliers. Autonomous projects often provide a line of credit to farmers living in project areas. The banks responsible for agricultural credit in all three countries are dependent on Government funds both for equity and for annual transfers to cover losses. Losses occur because interest rates are not high enough to permit income to cover costs, and because some loans are not repaid. Losses are highest in Algeria followed by Tunisia. The problem is less severe in Morocco where interest rates are higher and loan defaults much lower.

6.24 Indicators of efficiency of the banking institutions responsible for distributing agricultural credit are as follows:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Algeria 1980</th>
<th>Morocco 1978/80</th>
<th>Tunisia 1979</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. % of Farms Receiving Credit p.a. a/</td>
<td>2</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>2. Average Rate of Return on Investments Financed (%) b/</td>
<td>0-5</td>
<td>5-20</td>
<td>0-15</td>
</tr>
</tbody>
</table>

Source: a/ Ministry of Agriculture in each country and Banks providing agricultural credit.

b/ World Bank estimates (subject to considerable errors due to the great dispersion of rates of return on investment on different farms).

Credit is more productive in Morocco, followed by Tunisia. Algeria's credit system serves almost exclusively the 7,000 production cooperatives and 2,000 "self-managed" farms; the approximate 700,000 private farms receive nearly no credit (since 1979 an increasing number of private farms have received credit, although the percentage served remains low).

6.25 The following indicators suggest causes for the variation in performance between the three credit systems:

1. Real Interest Rates on Medium Term Credit (Interest Rate Minus Inflation)  
   - Algeria: -9.5  
   - Morocco: 1.2  
   - Tunisia: -1.5

2. Credit Recovery from Farmers as a percent of Repayment Due a/  
   - Algeria: 50.0  
   - Morocco: 85.0  
   - Tunisia: 50.0

3. Timeliness of Credit (Rank Order)  
   - Algeria: 3.0  
   - Morocco: 1.0  
   - Tunisia: 2.0

a/ Does not include Government transfers received to finance farmer defaults.

6.26 Morocco's efficient agricultural credit system has the highest interest rates, the best recovery performance, the greatest density of credit staff and branch offices, the most rapid processing time (the administratively least complex), and the greatest dependency on non-Government financial resources. Other characteristics are an emphasis on staff training, considerable resources devoted to financial planning and accounting, an effort to monitor and evaluate credit use, and little Government interference in credit policy. The credit institution, not the agricultural services of Government, is responsible for appraisal of credit requests.

6.27 Good recovery performance requires that the credit institution have legal tools which permit it to take rapid action against defaulters. This works best in Morocco, which has legally equated credit repayment to tax collection. Credit defaulters, like tax defaulters, are quickly penalized by recovery of farm assets.

6.28 Morocco's system works well because it requires self-discipline among borrowers, recycles funds through recovery and relending, and satisfies the farmer's need for processing speed and accountability. In Morocco, farmers have an incentive to identify and evaluate the risks and returns on their proposed investments. Credit institutions cannot reach the majority of farmers and at the same time carefully evaluate all investment proposals. Moroccan farmers tend to evaluate their own investments because they know with certainty that they must repay the loan, with positive interest. If they do not repay, they know they will lose their assets. If the farmer knows that there will be no penalty for non-repayment and/or that the real interest rate is negative, he will be considerably less concerned about the productivity of the use to which he puts the credit. In credit systems having poor recovery
rates farmers are likely to use much credit for purposes of consumption. Morocco's seemingly harsh system increases the likelihood that credit will be recycled rather than captured by farmers who do not repay. Investment subsidies to the poorest farmers can be provided outside the credit system.

6.29 Algeria's credit institution is used to disburse Government funds to agriculture. Government planners determine the objects to be financed by credit and amounts allocated to each cooperative farm. The Algerian credit bank has decision-making authority only over the small amount lent to the private sector (about 1% of agricultural credit). In Algeria, the poor recovery performance, the lack of staff resources devoted to credit, and slow credit-processing have inhibited the development of an adequate agricultural credit system. Guaranteed supply of Government financial resources to the credit bank leads to laxity with respect to recovery performance. Algeria has recently decided to create a specialized agricultural credit bank which may correct these problems. Greater decision making power in allocating credit is being given to banks, and this may serve to improve efficiency.

6.30 Tunisia's situation is between that of Algeria and Morocco. Its credit institution has greater discretion in evaluating credit requests than does Algeria's. However, credit discipline is poor and there is no inclination by the credit bank to respond to farmer needs in order to grow. In these situations, credit is being used as an instrument to transfer Government resources to selected farmers. Such credit systems most often serve only a small number of farmers. Lax recovery efforts, negative real interest rates, limited supervision of loan use encourage demand for credit which exceeds supply. Credit is rationed, often going to the largest farmers, state farms, and cooperatives. Social policy is really not served since the poorest farmers, who may need subsidies, do not obtain the credit. Credit is not a good vehicle for providing subsidies. Direct investment benefitting poor farmers is preferable. The Tunisian Government has responded to the inadequacy of its formal agricultural credit system by establishing numerous parallel credit sources through individual project authorities, and public enterprises. This has succeeded in reaching more farmers with credit, but at some (unmeasured) cost in efficiency and resources. Project related lines of credit disappear after investment periods end, and new credit lines must be constantly created. Such a solution is therefore short-run in nature, and cannot substitute for a properly functioning agricultural credit system at the national level.

6.31 It is not necessary for the agricultural credit systems in Algeria and Tunisia to become like Morocco's to be effective. Agricultural credit distribution in a planned economy like Algeria's, and to a lesser extent like Tunisia's, will legitimately be used as an instrument of Government planning. However, in Algeria and Tunisia, progress can and should be made to (a) increase loan recovery, (b) decrease the financial loss to banks resulting from agricultural lending, (c) mobilize additional rural resources for lending, and (d) attempt innovation in rural finance.
6.32 Loan repayment can be improved by (a) denying further credit to borrowers in arrears at the discretion of the bank (permitting exceptions in justifiable cases), (b) imposing penal charges on loan accounts in arrears, (c) realizing the security used by farmers to obtain credit in case of default, (d) providing special incentives to personnel of the credit bank to collect loan arrears, (e) establishing better relationships between lenders and borrowers in which lenders advise borrowers on investment viability, savings opportunities, etc.

6.33 Financial losses by banks involved in agricultural credit operations can be reduced by permitting increased interest rates. Financially independent banks should be the long term objective. Avoidance of dependence on Government budgetary allocations will encourage better financial management. Morocco's agricultural credit bank is close to financial independence. It's lending rate is 9%. Algeria's and Tunisia's banks would not have to impose an interest rate higher than this to approximate financial self-sufficiency in agricultural credit operations, if loan recovery performance was improved. This would liberate Government transfers to credit banks for other purposes. A higher lending rate would also have the advantage of inducing greater self-discipline among borrowers in the use to which credit is put for the reasons given in para 6.28.

6.34 Greater rural savings may be mobilized by increasing interest rates paid on savings and by undertaking promotional efforts (mobile banks, checking facilities). Higher interest rates on savings would be made possible by higher lending rates. In the long term the mobilization of savings in this manner will become necessary. The present system of mobilizing foreign savings by foreign borrowing, and local savings through Government taxation (with fiscal resources transferred to Banks) is more costly to the economy in the case of the former, and administratively difficult in the case of the latter.

6.35 More rapid loan processing is essential in Algeria and Tunisia. Greater self-discipline among borrowers caused by higher interest rates combined with penalties for loan default, will cause less time and effort to be needed for loan appraisals. Presently, particularly in Tunisia, there is an effort to offset the lack of farmer self-discipline in seeking credit by detailed and time consuming appraisal. This would be unnecessary if interest rates were higher and recovery better for the reasons given in paragraph 6.28. In Algeria, BNA has used detailed controls over borrower finances to avoid abuses. Socialist sector farms must transit all payments and income through their account with BNA, which permits financial control by BNA. The problem is that the lack of financial control by farms acts as a disincentive for farms to manage their finances efficiently. Farm managers would be more efficient if they were given more autonomy and responsibility, and at the same time if they were penalized for poor performance. Better recovery efforts and a higher interest rate, combined with more socialist sector farm management autonomy, would provide proper signals to farm managers to increase efficiency.

6.36 Other innovations in rural finance may be attempted.

(a) Contract-growing arrangements might be encouraged. Under such arrangements a marketing or processing enterprise enters into contracts with farmers, in which the enterprise provides
certain services including credit. The farmer guarantees to sell a certain percentage of his output to the enterprise at an agreed price, minus the cost of the services. This links credit with inputs and investment, facilitates technical assistance, and increases the likelihood of repayment.

(b) Leasing of machinery and animals may present opportunities for efficient utilization of resources and greater access by small farmers. Instead of providing agricultural credit to farmers who then purchase these assets, the assets are purchased by Government and rented to farmers.

(c) Expansion in the range of intermediaries having access to Government and project funds could expand access to credit. Institutions disbursing project and government funds tend to be high cost operators, and to have loan collection problems. Other intermediaries such as cooperatives, private traders and other suppliers of machinery and inputs may be in a position to provide credit at lower cost and obtain better recovery. These "semi-supervised credit" operations could be undertaken by a large number of intermediaries. However, the phasing out of special schemes financed by Government would be a long-run objective, as the formal credit mechanism develops.

D. Land Tenure

6.37 All three countries expropriated land belonging to colonists after independence. Algeria created production cooperatives ("self-managed" farms) on this land. These cooperative farms were created by merging an average of 5 colonist farms (of 200 ha each) into a larger farm so that the average cooperative is 1,000 ha. About 25% of Algeria's arable land is worked by these production cooperatives. The land worked by the cooperatives is owned by the State, which appoints a manager. Land, equipment, and inputs belong to the cooperative and cooperative members are paid what amounts to a wage. Morocco created both state farms managed by several large Government farming enterprises (5% of arable land), and distributed the remainder of the colonist's land to private farmers organized into service cooperatives (5% of arable land). Tunisia also created state farms (agro-combinates) managed by a Government agricultural enterprise, and production cooperatives similar to Algeria's (9% of arable land). The remainder of the colonists' land was distributed to private farmers.

6.38 Remaining privately held land was very unequally distributed in each country. The distribution of private land was as follows in the early 1960s:

<table>
<thead>
<tr>
<th>% of Land Owned by</th>
<th>Smallest 50%</th>
<th>Largest 50%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>of Farms</td>
<td>of Farms</td>
</tr>
<tr>
<td>Algeria</td>
<td>9</td>
<td>91</td>
</tr>
<tr>
<td>Morocco</td>
<td>9</td>
<td>91</td>
</tr>
<tr>
<td>Tunisia</td>
<td>11</td>
<td>89</td>
</tr>
</tbody>
</table>

Sources: Algeria No. 14; Morocco No. 11; Tunisia No.15.
The Algerian Government began in the early 1970's to expropriate land from farms having more than 50 ha. The land so expropriated, combined with traditionally collective land which was also distributed, totalled about 1.6 million ha by 1980. Beneficiaries were grouped into about 6,800 new production cooperatives. Now, about 50% of Algeria's land is farmed by production cooperatives and the cooperatives (called "self-managed farms") created from colonists' holdings.

Farm income is determined by farm size, among other factors. Therefore, Morocco and Tunisia, now having a less equitable land distribution than does Algeria within the private sector, will have a less equal distribution of income. Algeria's cooperative farm employees however have benefitted from guaranteed salary payments and other benefits not provided to private farmers. The inequality is between the cooperative members and private sector farmers. Nonetheless, Algeria does not have cases of extremely high wealth among a few landowners.

Algeria's land reform, although equalizing, has not accelerated growth. The cooperative sector, despite receiving large Government transfers, is less productive than the private sector. The causes appear firstly to be the lack of incentive for cooperative farm sector participants to produce. Even if a production cooperative consistently looses money, workers are not penalized. Salaries are received regardless of farm performance, or of an individual's performance. The cooperative member must merely appear for work; he need not work. Losses by the farm are supported by Government transfers. Profits would be shared by cooperative members. However, prices have been so low (until 1981) that additional effort has been likely merely to reduce the financial loss: reducing the Government transfer and benefitting the workers not at all. Stagnation of production in the cooperative sector has been the result. Agricultural growth has largely occurred in the production by the private sector of vegetables, fruit, milk and meat for which prices are impossible to effectively control and for which there is an uncontrollable private (parallel) market. Cooperative sector workers also sell these products illegally on the private market. The Algerian Government has recently recognized these problems, and is presently planning management and organizational reform of the cooperative sector.

There is evidence in all three countries that small farmers in irrigated areas are more efficient than larger farmers (higher crop yields and incomes per hectare). In rainfed areas, the most efficient farms are medium-sized: 15-60 ha. This suggests, but does not prove, that a more equitable distribution of land between private farmers would not only have a beneficial impact on equity, but on growth.

Additional land tenure issues in all three countries include (i) extreme fragmentation of farms which reduces the efficiency of operation on the larger ones, and contributes to the lack of viability of the smaller; (ii) lack of land titles by many private farmers which would facilitate credit distribution and which would provide security of tenure to owners thereby encouraging investment in the land; (iii) lack of security of land tenure for tenant farmers reducing their incentive to invest in farm assets and to conserve the soil; (iv) a high incidence of absentee land ownership (in Morocco and Tunisia) and tendency for absentee owners to underexploit their land; and (v) the tendency for collectively owned land (generally pasture land) to be poorly managed and over-exploited causing soil erosion and low productivity.
6.44 Tunisia and Morocco have undertaken measures to resolve some of these problems in irrigated areas through land consolidation, and legislation of an obligation for farmers to irrigate at least 2/3 of their land (directed to the problem of underutilization of irrigable land by absentee landlords). Only land consolidation has been effective. The two countries have undertaken no measures outside of irrigated areas. Algeria is now about to embark on a significant program of land consolidation for production cooperatives. It has also rendered absentee ownership of land illegal: such land is subject to expropriation.

6.45 Land reform is needed in all three countries, although the nature of the land reform will differ. Algeria's principal problem is the low efficiency of land use by the production cooperatives, and the fragmentation of small private farms. Resolution of the first issue requires a decision to drastically reform the management of the production cooperatives. An incentive system must be created for production cooperatives which encourages work and financial responsibility. Resolution of the second problem requires a national land consolidation program. This could involve at a minimum informal land exchange between farmers, encouraged by the extension service. A more ambitious approach would be for a public institution to purchase and re-sell land to be consolidated. Tunisia and Morocco require a decision with respect to incentives (and penalties) to induce large, and often absentee, landowners to efficiently exploit their land, as well as a land consolidation program. Heavy taxation of unused land is one method to induce better land use. Progressive taxes on land are another. Outright expropriation and redistribution of large land holdings would probably not be an efficient solution in either country. All three Governments could accelerate the provision of land titles, or certificates of land possession which have legal equivalence. Legislation providing greater security for tenants is needed. Collective land could be distributed or sold to private farmers. Small farmers could receive special assistance (credit, inputs, extension) to make up somewhat for the inequality in land distribution.

E. Agricultural Research and Extension

6.46 Agricultural research, either fundamental or adaptive is the principal source of technological innovation, which as indicated in Chapter V is the source of most agricultural growth. Research in each country has been successful in adapting the high yield cereal varieties developed in Mexico to the North African environment. Adaptive research was also undertaken on required fertilizer application for the new cereal varieties, as well as on improved livestock, fast growing trees, irrigation systems, and chemical plant protection among others. Most adaptive research has been in reality evaluative research which investigates the applicability of innovations made in Europe and North America to the Maghreb. Most of the products evaluated were introduced without much alteration in the Maghreb (cereal seeds were the exception since there was important modification for these). Most of the innovative technologies would have been introduced had the evaluative research not been undertaken, although perhaps more slowly. The major problem of agricultural research in the three countries is its lack of responsiveness to current agricultural problems faced by farmers. Research tends to look at each production process in isolation from the farming unit, and from farmer capability. Research programs are directed to crop yield optimization rather than to farm income maximization, hence overlooking farmer behavior. Research generally ignores the resource poor farmer, and recommends capital intensive and labor-saving technologies. Research recommendations often ignore risk of loss to farmers. Since farmers are risk-averse, it is not surprising that
many ignore the recommendations. The link between research and extension is unsatisfactory in all three countries. Government's reaction to the unsatisfactory pay-off from research in all the countries has been to provide fewer resources to it. A new system is needed for specifying research needs, insuring that appropriate research is undertaken, and obtaining feedback from farmers. More operating resources should be allocated to research. Research is needed on fertilizer response, forage varieties and systems, genetic improvement of livestock, pasture varieties, tillage methods, weed control, and range management. Research is also needed on ways in which to improve or intensify traditional farm technology. Lack of such research in all three countries has contributed to the neglect in public investment projects and in the distribution of agricultural credit, of traditional irrigation systems; traditional crops such as barley, pulses, and olives; traditional methods of cultivation based on the use of draft animals; locally bred livestock adapted to harsh North African climatic conditions; and natural means of maintaining soil fertility based on crop diversification and the integration of crop and livestock production.

6.47 Extension is provided in all three countries by numerous institutions in an uncoordinated manner. In Tunisia, extension is provided by irrigation offices, Government agricultural services at the Province level (CRDA), marketing offices (for cereals, livestock, olive oil, wine), autonomous project authorities, and semi-public associations (groupements). Similarly, in Morocco extension is provided by irrigation offices, provincial agricultural services, a marketing office (OCE), and autonomous project authorities. In Algeria, there is no formal extension system, although technical advice is provided by provincial agricultural staff, the research and development institutes (of which there is one for each major agricultural crop and livestock category), and semi-autonomous Project authorities.

6.48 Extension messages provided by these services have consisted of recommendations for optimizing yield of a particular crop or animal product and, mostly, from this standpoint have been reasonably sound, particularly in the irrigation perimeters. Input recommendations are more closely correlated to yield improvement than income. This development was not entirely wrong but it is now essential to develop more messages adapted to different farmer situations (resource poor farmers given different recommendations than resource rich for example). Messages should be designed to maximize (or increase) farmer income, not just crop yields. This will require resolution of the deficiencies in extension activity common to all three countries. These include: (i) staff responsible for extension spend little of their time in extension work. Most time is spent in assisting farmers with credit applications, collecting statistics, and administrative work; (ii) extension staff are poorly trained in communications and in extension methods; (iii) the work of extension agents has not been systematic, extension themes do not exist for many regions and extension messages which exist are often technically or financially inappropriate to the farmer, and hence rejected by him. The budget allocation to extension has been low in each country. The numerous extension systems do not contribute to building viable institutions to provide extension.
Considerable effort is now being directed in all three countries to resolve these problems. National extension services are being considered in each country to be staffed by agents who would devote full time to extension, would be trained in extension methods, would direct at least some effort (in Tunisia all of their effort) to small and medium farmers, and would be assisted by a systematic management system. Support stations should be the basic unit for research, accommodating field researchers and technical subject matter specialists who generate the extension messages. Support stations are needed to provide a link between research and extension. Extension agents should be housed in work centers supervised from the support stations. Agents should be supported with continuous programs and specialized technical information provided through support station subject matter specialists.
Sources of Agricultural Growth in the 1970s
Algeria, Morocco, Tunisia

I. Direct Causes

<table>
<thead>
<tr>
<th>Rainfall</th>
<th>Land/</th>
<th>Farm Size</th>
<th>Improvement</th>
<th>Human Resources</th>
<th>Agricultural Investment/ha</th>
<th>Introduction of seed/fertilizer/machinery technology</th>
<th>Area Under Irrigation</th>
<th>Management, Operation, Maintenance of Irrigation Perimeters</th>
<th>Livestock Investment</th>
<th>Fruit Tree Investment</th>
<th>Soil Conservation &amp; Forestry</th>
<th>Infrastructure</th>
<th>Fisheries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Morocco</td>
<td>1</td>
<td>2</td>
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<td>2</td>
<td>3</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>Tunisia</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
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</tbody>
</table>

II. Indirect Causes

<table>
<thead>
<tr>
<th>冯</th>
<th>Price Policy (long-term)</th>
<th>Credit Policy</th>
<th>Land Tenure</th>
<th>Marketing and Processing</th>
<th>Research and Extension</th>
<th>Absorptive Capacity of Agriculture Services</th>
<th>Emphasis on Operation &amp; Maintenance</th>
<th>Farm Management</th>
<th>TOTAL</th>
</tr>
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<td>Algeria</td>
<td>1</td>
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<td>1</td>
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<td>2</td>
<td>3</td>
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<td>Morocco</td>
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<td>1</td>
<td>1</td>
<td>2</td>
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<td>1</td>
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<tr>
<td>Tunisia</td>
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<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>27</td>
</tr>
</tbody>
</table>

If no observable difference exists, a weight of 1 is given to each country.

This table summarizes for each factor affecting agricultural development, the judgment made about the relative performance of each country. A country's aggregate performance with respect to factors causing growth should determine its actual agricultural growth. A rank of 1 indicates best performance among the three countries; a 3 indicates poorest performance. When the performance of each is too similar to distinguish, a 1 is given to all. The country having the lowest total is that which performs best those activities which cause growth. The table suggests that performance by each country with respect to these causal variables is remarkably similar. Tunisia ranks slightly better than Morocco, which ranks slightly better than Algeria. This is also the order of performance in terms of long-term agricultural growth. These rankings are extremely judgmental, and serve mostly to summarize briefly the judgements, and analysis, made in the report.
DATA SOURCES

2. World Development Indicators, World Bank, 1981.
   Séries - Statistiques Agricoles.
10. Tunisia: Ministry of Planning.
Agricultural Price Policies and the Developing Countries
George Tolley, Vinod Thomas, and Chung Ming Wong

This book first considers price policies in Korea, Bangladesh, Thailand, and Venezuela, bringing out the consequences for government cost and revenue, farm income, and producer and consumer welfare. Other effects, including those on agricultural diversification, inflation, economic growth, and the balance of payments are also discussed. The second part of the book provides a methodology for estimating these effects in any country. Operational tools for measuring the effects on producers, consumers, and government are developed and applied.


Agricultural Research

(See Publications of Particular Interest, page 1.)

Agroindustrial Project Analysis
James E. Austin

Provides and illustrates a framework for analyzing and designing agroindustrial projects.


The Book of CHAC: Programming Studies for Mexican Agricultural Policy

Edited by Roger D. Norton and Leopoldo Solis M.

The principal tool of analysis is the sector model CHAC, named after the Mayan rain god. This model can be used throughout the sector to cover short-cycle crops, their inputs, and their markets. It can also be broken down into submodels for particular localities if more detailed analysis is required. The model helps planners weigh the costs among policy goals, which can vary from region to region. This volume reports the experience of using the CHAC model and also presents purely methodological material.


Adoption of Agricultural Innovations in Developing Countries: A Survey
Gershon Feder, Richard Just, and David Silberman

Reviews various studies that have provided a description of and possible explanations for farmers' responses to the adoption of technological improvements in the agricultural sector in developing countries and finds that uniform acceptance of technological change is rare and that responses differ across socio-economic groups and over time. Explores new directions for research in this area.


Stock No. WP-0444. $3.00.

The Agricultural Economy of Northeast Brazil
Gary P. Kutcher and Pasquale L. Scandizzo

This study, based on an agricultural survey of 8,000 farms, assesses the extent and root causes of pervasive rural poverty in northeast Brazil. The authors review a number of policy and project options; they conclude that courageous land reform is the only effective means of dealing with the problem.


LC 81-47615. ISBN 0-8018-2581-4, $25.00 ($17.50) hardcover.

Nutritional Consequences of Agricultural Projects: Conceptual Relationships and Assessment Approaches

Per Pinstrup-Andersen
Provisions a survey of past and ongoing activities aimed at incorporating nutritional considerations into agricultural and rural development projects and policies and makes recommendations for future activities.


Stock No. WP-0456. $5.00.

Price: Distortions in Agriculture and Their Effects: An International Comparison
Malcolm D. Bale and Ernst Lutz


Sociocultural Aspects of Developing Small-Scale Fisheries: Delivering Services to the Poor
Richard B. Pollnac

Presents a framework for assessing the sociocultural feasibility of small-scale fisheries projects.


Stock No. WP-0490. $5.00.

Agrarian Reform as Unfinished Business—The Selected Papers of Wolf Ladejinsky
Louis J. Wallinsky, editor

Studies in agrarian policy and land reform spanning four decades, grouped chronologically according to Ladejinsky's years in Washington, Tokyo, and Vietnam and while at the Ford Foundation and the World Bank.


Agrarian Reforms in Developing Rural Economies Characterized by Interlinked Credit and Tenancy Markets
Avishay Braverman and T. N. Srinivasan


Stock No. WP-0433. $3.00.

Agricultural Credit
Outlines agricultural credit practices and problems, programs, and policies in developing countries and discusses their implications for World Bank operations.


Agricultural Extension: The Training and Visit System
Daniel Benor and James Q. Harrison

Describes the Training and Visit System of extension developed by Daniel Benor and introduced in a number of projects assisted by the World Bank in developing countries.


Stock Nos. PM-7701-E, PM-7701-F, PM-7701-S. $5.00 paperback.

Agricultural Land Settlement
T. James Goering, coordinating author

Examines selected issues related to the World Bank's lending for land settlement, and gives estimates of the global rate of settlement and the world's ultimate potentially arable land.


Stock Nos. PP-7801-E, PP-7801-F, PP-7801-S. $5.00 paperback.

Agricultural Price Management in Egypt
William Cuddihy


Stock No. WP-0386. $5.00.

Agricultural Project Analysis: Case Studies and Exercises
Case studies and exercises on agricultural project preparation and analysis, developed for, and used in, EDI's rural development and rural credit courses.


$9.00 paperback.

Agricultural Research and Productivity
Robert E. Evenson and Yoav Kislev

Examines the role of scientific research and technological change in increasing agricultural productivity.

Yale University Press, 302 Temple Street, New Haven, Connecticut 06520, U.S.A. 1975. xi + 204 pages (including 10 appendices, references, index).


Argentina: Country Case Study of Agricultural Prices, Taxes, and Subsidies
Lucio G. Reca


Stock No. WP-0386. $5.00.

Attitudes Toward Risk: Experimental Measurement in Rural India
Hans P. Binswanger


Behavior of Foodgrain Production and Consumption in India, 1960-77
J. S. Sarma and Shyamal Roy


Stock No. WP-0339. $3.00.
A Development Model for the Agricultural Sector of Portugal
Alvin C. Eggert and Hyung M. Kim
Spatial mathematical programming is used to develop comprehensive and quantitative methods to suggest development strategies in Portugal's agriculture sector.
LC 75-26662. ISBN 0-8018-1793-5, $6.50 (£4.00) paperback.

Different Smallholder Types and Their Development Needs; Simulating the Decision Making Process of a Nigerian Smallholder
Paul S. Zuckerman

An Econometric Application of the Theory of the Farm Household
Howard N. Barnum and Lyn Squire

Economic Analysis of Agricultural Projects
J. Price Gittinger
A practical method for comparing alternative investment projects in agriculture in relation to each other and to investments in other parts of the economy to ensure the most economical and efficient use of scarce resources.
The Johns Hopkins University Press, 1972; 8th printing, 1980. v1i1 + 221 pages (including appendix, bibliography).

Farm Budgets: From Farm Income Analysis to Agricultural Project Analysis
Maxwell L. Brown
Clarifies the relation between simple farm income analysis and the broader field of agricultural project analysis and emphasizes the more practical aspects of project preparation and gives guidance to those responsible for planning in agriculture.

Farmer Education and Farm Efficiency: A Survey
Marlaine E. Lockheed, Dean T. Jamison, and Lawrence J. Lau

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Gershon Feder
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Shlomo Reutlinger and Keith Knapp

Stock No. WP-0393. $5.00.

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Stock Nos. PP-7804-E, PP-7804-F, PP-7804-S. $5.00 paperback.

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Towards an Operational Approach to Savings for Rural Developers
J. D. Von Pischke

Rural Credit Project Design, Implementation, and Loan Collection Performance
J. D. Von Pischke

Investment in International Agricultural Research: Some Economic Dimensions
Grant M. Scobie

Land Reform
Examines the characteristics of land reform, its implications for the economies of developing countries, and the major policy options open to the World Bank in this field.

Stock Nos. PP.7503-E, PP.7503-F, PP.7503-S. $5.00 paperback.

Land Reform in Latin America: Bolivia, Chile, Mexico, Peru and Venezuela
Shlomo Eckstein and others

Managing Information for Rural Development: Lessons from Eastern Africa
Guido Deboeck and Bill Kinsey

Measuring Project Impact: Monitoring and Evaluation in the PIDER Rural Development Project—Mexico
Michael M. Cernea

Measuring the Indirect Effects of an Agricultural Investment Project on its Surrounding Region
C. L. G. Bell and Peter Hazell

Pesticides, Information, and Pest Management under Uncertainty
Gershon Feder

Predicting Agricultural Output Response
Howard N. Barnum and Lyn Squire

Price Distortions in Developing Countries: A Bias against Agriculture
Ernst Lutz and Pasquale L. Scandizzo

Prices, Taxes, and Subsidies in Pakistan Agriculture, 1960–1976
Carl Gotsch and Gilbert Brown

Priorities of Developing Countries in Weather and Climate
Raaj Sah

Rethinking Artisanal Fisheries Development: Western Concepts, Asian Experiences
Donald K. Emmerson

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