Prospects for Food Production and Consumption in Developing Countries

Malcolm D. Bale
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Abstract

This Paper analyzes recent trends in world food production and consumption with special reference to developing countries. It continues by outlining the World Bank's approach to projections of food production and consumption providing results to the year 1995. It is shown that levels of consumption of various food items have improved in developing countries and are expected to continue to improve. Moreover, the results indicate favorable prospects for food production in developing countries. The paper comments throughout on areas where further work is required to refine the projection method and qualifies the generally optimistic outlook by identifying the types of actions that will be needed to accelerate food consumption and production in developing countries. Pricing policies in agriculture are seen as being particularly critical to the optimal development of the agricultural system in developing countries.
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PROSPECTS FOR FOOD PRODUCTION AND CONSUMPTION IN DEVELOPING COUNTRIES
Introduction

1. The available evidence indicates that, in aggregate, the growth in world food production over the past two decades has more than kept pace with the growth in population. Improvements in per capita consumption among the developing countries have been widespread. The important exceptions have included many of the countries of sub-Saharan Africa. Associated with this improvement has been the adoption and success of improved technologies, increased investment in infrastructure vital to increased agricultural production and, for some countries, a diminishing of the price distortions which have disadvantaged agricultural production. Substantial production increases have been recorded particularly in the case of rice and wheat, leading to declining actual and expected prices for grains.

2. We believe it is likely that these improvements in food availability in the developing countries will continue, but that any such improvements would be considerably enhanced by widespread adoption in developing countries of pricing policies which remove the existing distortions under which agricultural production labors.

3. In this paper we illustrate the changes that have occurred in food consumption in developing countries over the past 20 years and compare them to changes in the industrial countries. We then present the forecasts of food consumption growth which have recently been assembled in the World Bank and briefly outline their implications for per capita consumption, production and prices in developing countries.
4. We are not directly concerned here with the question of hunger, whether chronic or periodic. We agree with the view that hunger is not directly related to the level of world food availability, but is more a question of income level, or as Sen puts it, the "entitlement" to sufficient resources to purchase enough food to live. The many studies which the World Bank for one has done on the cost effectiveness of programs to meet chronic hunger among specific groups and periodic hunger due to sharp reductions in food supplies have recently been summarized by Reutlinger, (1981/82).

Historical Growth of Income and Food Consumption

5. The last 20 years has been a period of substantial growth for some developing countries. The concentration of this growth can be shown as follows: of the 68 developing countries (World Bank definition) for which there are purchasing-power-parity (PPP) estimates1/ of GDP/capita available, only 19 countries recorded GDP/capita growth, in real terms, in excess of 2% p.a. for both the 1960-70 decade and the period 1970-79. 2/ There are no PPP estimates available for them, but to this list should probably be added Hong Kong, Republic of Korea, Singapore and perhaps the Peoples' Republic of China.

1/ Purchasing-power-parity estimates of national income, (i.e., estimated in terms of a set of international prices) are preferred to traditional exchange rate adjusted GDP estimates because they better reflect the purchasing power of income in each country. The PPP estimates flow from the United Nations/World Bank project on International Comparisons of Real Product carried out by Irving Kravis, et. al.

2/ The countries are: Barbados, Brazil, Costa Rica, Cyprus, Egypt, Gabon, Guatemala, Indonesia, Iraq, Malaysia, Malta, Nigeria, Portugal, Sri Lanka, Saudi Arabia, Thailand, Tunisia, Turkey and Yugoslavia.
Of this group of 68 developing countries, another 15 recorded GDP/capita growth in excess of 2% p.a. for the 1970-79 period only. 1/ By comparison, of the 23 industrial countries for which similar national income data are available only seven countries (Australia, Luxembourg, Netherlands, New Zealand, Sweden, Switzerland and United Kingdom) did not grow at rates in excess of 2% p.a. for either one of these two periods, and only New Zealand grew at less than 2% p.a. for both periods. 2/

6. How has this growth, or lack of growth, of the per capita incomes of developing countries affected food consumption in those countries? To give a broad picture of the impact, growth in per capita calorie consumption of all foodstuffs has been plotted against growth in income (PPP) for the developing countries in Figures 1 and 2. In Figure 1 each developing country's average income/capita growth for the 1960-70 period is plotted against its growth rate of total per capita calorie consumption for the period 1963-70 (end-point growth estimates). In Figure 2 income/capita growth for the period 1970-79 is plotted against calorie growth for the period 1970-77. 3/ In using this measure of improvements in food consumption we recognize the difficulties

1/ The countries are: Algeria, Bolivia, Cameroon, Colombia, Dominican Republic, Ecuador, Gambia, Kenya, Mauritius, Morocco, Paraguay, Philippines, Sudan, Surinam, and Trinidad and Tobago.

2/ The industrial country group includes Greece, Israel and Spain—countries that have until recently been classified as developing countries.

3/ For calorie consumption, the periods 1963-70 and 1970-77 are the closest approximations we can get, given the available data, to the decades of the 1960s and 1970s. The figures for calorie consumption in 1963 are the averages of the years 1961 to 1965 while the figures for 1970 and 1977 are the averages of the three years about these mid-points. The data on per capita calorie consumption are taken from FAO, 1980.
associated with the measurement of "adequate" diets. 1/ All that is being implied in our use is that at these levels of food consumption, growth in calorie consumption does represent an improvement in living standards.

7. In Figures 1 and 2 the north-east quadrant represents an increase in both per capita income and food consumption. The south-west quadrant represents a decline in both. There is a positive correlation between per capita income and food consumption growth in both periods. In the 1960s all but four of this group of developing countries registered growth in income/capita, while eight registered a decline in per capita food consumption. When a country at these levels of food consumption registers growth in per capita income but declining per capita food consumption, as most of these eight did, the answer must lie in the shape of the income distribution of the new income generated (i.e., it is so unevenly distributed in favor of the already wealthy that demand for food is affected little) or in the food-pricing policies of the country (i.e., relative prices are so distorted that food consumption is seriously disadvantaged). Four of those countries which had declining food consumption in the 1960s (Algeria, Colombia, Guyana, and Upper Volta) were able to reverse the situation in the 1970s— even though in the case of Guyana and Upper Volta they experienced declining income/capita in the latter period. India, the Ivory Coast, Niger and Nigeria, along with many others, suffered declining food/capita levels in the second period. In this latter period there

1/ For a critique of the estimation of basic food needs see Eberstadt.
FIGURE 2: INCOME AND CONSUMPTION GROWTH - 1970s
DEVELOPING COUNTRIES

INCOME GROWTH (X P.C.)

CONSUMPTION GROWTH (X P.C.)

seems to have been a worsening of the factors which have led to the countries appearing in the south-east quadrant. 1/

8. The obvious difference in the developing countries' performance in the two time periods is that the 1970s gave rise to much more dispersed behavior than the 1960s. The increased number of countries registering lower per capita incomes in the 1970s explains part of this dispersion; with the countries in the north-west quadrant more likely to be those with food policies favoring low-income consumers than those countries in the south-west quadrant. Increased agricultural instability in the 1970s together with pricing policies discriminating against agricultural production are likely causes of the large number of countries in the south-east quadrant. 2/

1/ We tried, without success, to explain these differences in performance in terms of income distribution and relative price distortion measures. To measure distortions in consumer prices nominal protection coefficients on grains production, which measure the distortions in producer prices, were assembled for 18 of these countries. Nominal protection coefficients are probably not a good measure of distortions in consumer prices, but no other measures are available. Gini coefficients were used as one measure of income distribution. These are available for about 30 of these developing countries. Like the nominal protection coefficients the Gini coefficients have been estimated at different periods of time over the last two decades. Further, the quality of the data on which they have been estimated is extremely varied. Neither of these variables could explain any of the variation in equations in which the growth of calorie consumption was to be explained by the growth of per capita income, the level of per capita income, income distribution and distortions in consumer prices. Life expectancy in 1960 and 1980 was tried as a proxy for income distribution, but it also gave insignificant results. The results for this last equation were as follows:

\[ C = 0.17 Y + 0.003 LE + 0.0003 YCAP, \quad R^2(adj) = 0.42 \]

\[ (4.5) \quad (0.12) \quad (3.0) \]

t statistics are in parentheses

For this equation the observations for both periods were combined; also, the constant is constrained to zero.

2/ Barr shows that the variability of world food production was higher in the 1960s than in the 1950s and higher again in the 1970s.
Reutlinger has shown that, in the face of reductions in domestic production, developing countries have been unwilling to compensate for the shortfall by increasing food imports. Therefore, artificially low food prices in developing countries (a widespread practice, often aimed at the politically more powerful urban consumers) do not necessarily mean increased consumption. Besides the restriction on imports, artificially low producer prices (also a widespread practice, particularly in African countries) mean lower incomes and hence lower consumption in the rural areas—where most of the population and most of the poor often reside.

9. To give an idea of what these changes in food consumption have meant in aggregate terms for the developing countries we have constructed Table 1. These figures show the improvement in per capita food supplies in the developed and developing market economies (FAO definition) over the period between 1961-65 (average) and 1977 and the sources of the calories and protein consumed. Over this approximately 15-year period the per capita consumption of calories in developing countries has increased by 4.1% and the consumption of protein by 2.8%. 1/ Both in absolute and percentage terms the developed market economies have done much better—with per capita calorie consumption increasing by 6% and per capita protein consumption increasing by 7.6%. During this period food production actually increased more slowly in industrial countries than in developing countries, but their rate of population increase was much slower than that of developing countries, giving rise to the higher per capita gains. 2/

1/ These are average figures which convey little information about how well the different income groups in the developing countries have fared.

2/ See Barr, op. cit.
### Table 1: Per Capita Food Supplies by Major Economic Regions and by Food Category, 1961-65 (Average), and 1977

<table>
<thead>
<tr>
<th>Food Category</th>
<th>Per Capita Calorie Supply 1961-65 (calorie/day)</th>
<th>Per Capita Calorie Supply 1977 (calorie/day)</th>
<th>Per Capita Protein Supply 1961-65 (gram/day)</th>
<th>Per Capita Protein Supply 1977 (gram/day)</th>
<th>Percentage of World Calorie Supply 1961-65 (%)</th>
<th>Percentage of World Calorie Supply 1977 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>961</td>
<td>1,229</td>
<td>27.3</td>
<td>29.5</td>
<td>51.4</td>
<td>51.1</td>
</tr>
<tr>
<td>Wheat</td>
<td>642</td>
<td>1,274</td>
<td>20.7</td>
<td>10.9</td>
<td>18.1</td>
<td>18.6</td>
</tr>
<tr>
<td>Rice</td>
<td>192</td>
<td>1,299</td>
<td>3.4</td>
<td>10.4</td>
<td>19.3</td>
<td>20.2</td>
</tr>
<tr>
<td>Maize</td>
<td>71</td>
<td>1,175</td>
<td>1.7</td>
<td>4.4</td>
<td>5.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Millet &amp; Sorghum</td>
<td>2</td>
<td>175</td>
<td>0.1</td>
<td>4.2</td>
<td>4.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Roots and Tubers</td>
<td>148</td>
<td>147</td>
<td>3.2</td>
<td>1.5</td>
<td>8.0</td>
<td>6.4</td>
</tr>
<tr>
<td>Sugars and Honey</td>
<td>384</td>
<td>209</td>
<td>0.2</td>
<td>0.2</td>
<td>8.5</td>
<td>9.4</td>
</tr>
<tr>
<td>Pulses</td>
<td>35</td>
<td>92</td>
<td>2.3</td>
<td>1.6</td>
<td>2.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Nuts and Oilseeds</td>
<td>53</td>
<td>44</td>
<td>2.6</td>
<td>1.6</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Vegetables</td>
<td>57</td>
<td>29</td>
<td>3.1</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Fruit</td>
<td>89</td>
<td>66</td>
<td>1.1</td>
<td>0.7</td>
<td>2.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Meat and Offals</td>
<td>420</td>
<td>63</td>
<td>22.3</td>
<td>4.7</td>
<td>7.3</td>
<td>8.2</td>
</tr>
<tr>
<td>Eggs</td>
<td>50</td>
<td>7</td>
<td>4.0</td>
<td>0.3</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Fish and Seafood</td>
<td>40</td>
<td>15</td>
<td>5.9</td>
<td>1.8</td>
<td>0.8</td>
<td>1.0</td>
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<tr>
<td>Milk</td>
<td>279</td>
<td>67</td>
<td>16.2</td>
<td>3.9</td>
<td>5.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Oils &amp; Fats</td>
<td>440</td>
<td>154</td>
<td>0.2</td>
<td>0.2</td>
<td>8.4</td>
<td>9.0</td>
</tr>
<tr>
<td>Vegetable Oils &amp; Fats</td>
<td>256</td>
<td>123</td>
<td>0.1</td>
<td>0.1</td>
<td>5.4</td>
<td>6.4</td>
</tr>
<tr>
<td>Animal Oils &amp; Fats</td>
<td>*184</td>
<td>31</td>
<td>0.1</td>
<td>0.1</td>
<td>3.0</td>
<td>2.6</td>
</tr>
<tr>
<td>Total Vegetable Products</td>
<td>2,151</td>
<td>2,016</td>
<td>41.4</td>
<td>42.9</td>
<td>83.5</td>
<td>83.1</td>
</tr>
<tr>
<td>Total Animal Products</td>
<td>977</td>
<td>2,178</td>
<td>48.6</td>
<td>53.3</td>
<td>89.4</td>
<td>54.8</td>
</tr>
<tr>
<td>Grand Total (Excl. Alcohol)</td>
<td>2,977</td>
<td>2,092</td>
<td>89.4</td>
<td>54.8</td>
<td>16.9</td>
<td>16.9</td>
</tr>
</tbody>
</table>

/A FAO Country Classification.

10. When examined in terms of the sources of these food supplies there have been some marked changes for some food categories and for others a disappointing lack of change. While the total per capita direct supply of calories and protein obtained from the cereals group by people in developing countries has increased slightly over the period, there have been sharp changes for individual cereals. The amount of wheat consumed directly, measured in terms of calories, increased by 28% while the per capita calorie supply of millet and sorghum fell by 16%. On a geographical basis the regions responsible for these changes were Africa and Asia. In per capita terms wheat consumption rose by 44% in Asian countries and by 32% in African countries. Millet and sorghum consumption fell by 11% in Asian countries and by 16% in African countries. Within the developing countries there have generally been the kinds of changes in food sources that would be expected with improved living standards, but just as the total increase in food consumption has been small over this period, most of the changes observed have been small. For example, we would expect per capita consumption of roots and tubers and pulses to decline and consumption of fruit, vegetables, meat, eggs, fish and seafoods and milk to increase. These changes have indeed taken place, and in percentage terms some of the changes are large, but in absolute terms the only significant change has been the decline in pulses (20%).

11. At the world level (see the last two columns in Table 1) the percentages of total calorie consumption supplied by these various categories of foodstuffs have also changed little. Cereals still account for 51% of the total, with wheat and rice becoming more important and maize and millet and sorghum relatively less important. The decline in per capita consumption of
roots and tubers in both developed and developing countries is the most significant change. The improvement in meat consumption is absolutely and proportionately mostly a result of the increase in developed countries. The declining importance of milk products and animal fats and their substitution by vegetable fats and oils, shows up here, even in developing countries.

12. If we take the present consumption levels of the developed countries as the norm towards which developing countries are moving we can see that the major changes that will take place in the pattern of food consumption, and which will be reflected in production and trade patterns, will be in terms of considerable decreases in the importance of cereals and roots and tubers, and considerable increases in the importance of sugars and honey, meat, milk, and vegetable oils and fats. Of course, when allowance is made for both livestock feed as well as direct human consumption, the net impact on cereals consumption in total may well be an increase in importance in absolute and per capita terms.

13. But such conjectures can only give a guide to the products which can be expected to be more or less important over the very long run. More to the point, what are the changes we are likely to see in the next 20 years in terms of the levels of food consumption reached in the developing countries and the changes in importance of the various categories of foodstuffs? Further, what will the expected developments in food consumption mean for the future pattern of production and prices of foodstuffs?
World Bank Forecasts of Food Consumption by 1995

14. Within the Commodities Division of the World Bank we have recently carried out an exercise which in part led to forecasts to the year 1995 of world (and regional) production, consumption, trade and prices of many primary commodities of importance to developing countries. The commodities included do not cover the entire food basket of developing countries, but represent about 70% of the total.

15. For the most part these long-term projections were derived using comparative-static equilibrium models, disaggregated by region, where prices are used to achieve a unique equilibrium solution. Since the models are long-run, stock level changes are ignored. The models are demand-determined and the consumption projections were made first by applying income elasticities of demand by region to projected per capita GDP and population. Given a set of regional price elasticities of supply and demand and productivity growth rates, prices were adjusted such that through successive iterations global production and consumption converged to equilibrium. The models assume an absence of shocks on both the consumption and production sides. Information concerning production developments in key countries and likely changes in factors affecting the market such as international commodity agreements were incorporated at the appropriate level. Income and price elasticities are assumed to change over time with the evolution of a region's income level.

16. The basic position that we take on projections of food consumption is that the amount and composition of food is, in the aggregate and in the long
run, determined by aggregate demand. In this we differ from those who take a physical capacity-cum-productivity possibility approach. That is, we believe that the resources allocated to food production, including resources allocated to productivity-enhancing research, are endogenous. We acknowledge that in some countries the food-producing sector is so large a proportion of total national product that it cannot be regarded as not being simultaneously determined with aggregate demand. Further, there are also distortions of prices which disturb food production from the levels that would otherwise be determined by aggregate demand. However, while these influences are important, often extremely important for individual countries, for this exercise we chose to assume that they are captured in the projections of income growth.

17. In looking at the level and composition of food consumption, our focus on aggregate demand implies that both at the world level and at the country level access to food is not determined by physical constraints on food production either within individual countries (because a country can import whatever food it can pay for) or at a world level (because production will respond to price incentives). Thus, it follows that we do not see the solution of any "food problem" at the world level or within a particular country as a question of overcoming food production problems on a world basis or within a country, but as a problem of obtaining the maximum economic growth—within the economic constraints. However, distortions of relative prices within a country which tax food production and consumption may well reduce national income growth and make the task of improving food consumption levels more difficult than it otherwise would be.
18. The long-term forecasts shown in Table 2 are conditional in nature. On the demand side they rest critically on the assumptions made about the world economy in the 1980s and 1990s. The forecasts, moreover, are positive rather than normative. They are based on the most likely assumptions concerning government policies affecting production and trade, the likely market structures and demand conditions. Given the use of the resulting price forecasts in project and balance of payments analyses by the World Bank Group, trying to determine what is most likely to happen, as opposed to what would happen if desirable changes in policies and market structure were to take place, becomes inescapable and appropriate.

19. The assumptions adopted about growth in the world economy and in the industrial, centrally planned and developing economies, represent the midpoint of the High and Low scenarios described in the World Bank's World Development Report, 1982. The population projections are also those of World Development Report, 1982. These projections of income and population are shown in Table 3.
TABLE 2: FOODSTUFFS - PROJECTIONS OF APPARENT CONSUMPTION, BY ECONOMIC REGIONS /A

<table>
<thead>
<tr>
<th></th>
<th>INDUSTRIAL COUNTRIES</th>
<th>CENTRALLY PLANNED ECONOMIES</th>
<th>DEVELOPING COUNTRIES</th>
<th>GROWTH RATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEAT</td>
<td>89.3</td>
<td>94.8</td>
<td>104.2</td>
<td>114.5</td>
</tr>
<tr>
<td>RICE</td>
<td>9.5 (-0.6)</td>
<td>10.0</td>
<td>10.3</td>
<td>10.5</td>
</tr>
<tr>
<td>COARSE GRAINS /D</td>
<td>252.6</td>
<td>252.9</td>
<td>260.3</td>
<td>270.4</td>
</tr>
<tr>
<td>SUGAR</td>
<td>25.1</td>
<td>25.6</td>
<td>26.2</td>
<td>26.8</td>
</tr>
<tr>
<td>BEEF AND VEAL</td>
<td>20.6</td>
<td>22.4</td>
<td>24.2</td>
<td>27.0</td>
</tr>
<tr>
<td>FRESH CITRUS FRUITS</td>
<td>26.1</td>
<td>28.7</td>
<td>31.1</td>
<td>34.0</td>
</tr>
<tr>
<td>VEGETABLE FATS AND OILS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOYBEANS (OIL EQUIVALENT)</td>
<td>6.8</td>
<td>7.6</td>
<td>8.6</td>
<td>9.6</td>
</tr>
<tr>
<td>PALM OIL</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>COCONUTS (OIL EQUIVALENT)</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

/A WORLD BANK CLASSIFICATION OF COUNTRIES, SEE WORLD DEVELOPMENT REPORT, 1982. NOTE THAT CHINA IS INCLUDED.

/B THE NUMBERS IN THIS COLUMN ARE THE ACTUAL GROWTH RATES (LEAST SQUARES TREND) FOR THE PERIOD 1961-80.

/C THE NUMBERS IN THIS COLUMN ARE THE PROJECTED GROWTH RATES (END POINTS) FOR THE PERIOD 1980-95.

/D COARSE GRAINS HERE INCLUDE MAIZE, BARLEY, OATS, RYE, GRAIN SORGHUM AND MILLET.

TABLE 3: PROJECTED REAL GDP GROWTH AND POPULATION GROWTH, BY MAJOR ECONOMIC REGION, 1983-95 (\% CHANGE PER ANNUM)

<table>
<thead>
<tr>
<th></th>
<th>REAL GDP GROWTH</th>
<th>POPULATION GROWTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDUSTRIAL COUNTRIES</td>
<td>3.7</td>
<td>3.5</td>
</tr>
<tr>
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<tr>
<td>WORLD</td>
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<td>3.8</td>
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</tbody>
</table>

* EXCLUDES PEOPLES' REPUBLIC OF CHINA IN THE GDP DATA BUT INCLUDES IT IN THE POPULATION DATA.

SOURCE: WORLD BANK, ECONOMIC ANALYSIS AND PROJECTIONS DEPARTMENT, INTERNATIONAL TRADE AND CAPITAL FLOWS DIVISION AND ECONOMIC AND SOCIAL DATA DIVISION.

20. Looking at the growth rates in world consumption for the period 1961-80 (Table 2) we can see that the importance of industrial countries in world consumption of these foodstuffs has declined in the past 20 years. Growth in consumption of these commodities has been faster in the centrally planned economies and the developing countries, reflecting their lower levels of income, and their faster income and population growth. However, as we have seen earlier, on a per capita basis food consumption has grown much faster in industrial countries than in developing countries.
21. Overall, the growth in total consumption of these commodities is expected to be lower in the period 1980-95 than in the period 1961-80 except for rice and coconuts (see growth rates in last two columns). 1/ The decline in the expected rate of growth of wheat consumption is largely a function of the expected much slower growth in the centrally planned economies; and the expected slowdown in growth of coarse grains consumption is a result of the expected slowing of growth in industrial countries and centrally planned economies and the consequent adverse effect on the demand for meats and feed-stuffs. The developing countries are expected to maintain their historical growth in grains consumption. This, together with the expected slower growth in population in developing countries should mean a slightly faster growth in per capita grains consumption in developing countries than in the past 20 years. Bringing together the consumption growth rates of Table 2 and the population growth rates of Table 3, it can be seen that the per capita consumption of wheat, rice and coarse grains by the developing countries was 2.5%, 0.8% and 0.6% per annum, respectively, over the 1961-80 period. The projected per capita consumption growth rates for these grains in the period 1980-95 are 2.3%, 0.9% and 1.3% respectively. The much higher rate of growth of coarse grains is a reflection of the expected increase in the consumption of animal products.

22. In its major study of future food availability scenarios for developing countries the FAO made the following projections. If, in the period 1980 to 2000, the GDP of developing countries grows at much the same rate as in the

1/ A large part of this increase in coconut product consumption will be for non-edible uses, particularly soaps and detergents.
past 20 years per capita food demand is projected to average 0.44% p.a. growth. This is a faster rate of growth in per capita consumption of developing countries than the 0.3% p.a. rate achieved in the 1963-77 period (see Table 1). Under an assumption of much higher GDP growth, coincident with greater investment in agriculture and relaxation of trade distortions within developing countries and between developing countries and industrial countries, it was projected by FAO that per capita food demand could grow by 0.75% p.a. The projections of the first FAO scenario appear compatible with our expectations of a slightly faster growth in per capita grains consumption in the next 15-20 years.

Price Developments

23. The cereals price forecasts to which this exercise led show a continuation of the long-term declining trend in real terms (see Figures 3, 4 and 5 for long-term price series for wheat, rice and maize). 1/ Even though incomes are increasing, and the growth of incomes in the developing countries is having a larger impact in terms of total food demand, food demand remains essentially price and income inelastic. Supply will respond to any increase in demand with improvements in technology. The result will be a fall in prices. The events of the past decade seem to bear this out. With an expansion of demand for cereals for human consumption and for feed grains--from the fast-growing developing countries and the centrally planned economies--supply has

1/ The maize price has shown a different pattern than wheat and rice prices with a period of higher prices in the post-World War II period than in the period prior. As maize is the premium feed grain, this is consistent with the fact that beef prices were significantly higher also during the post-World War II period.
FIGURE 3: WHEAT PRICE INDEXES, 1900-1982

(1975=100)

SOURCE: COMPILED AND SUPPLIED BY ENZO GRILLI AND MAW-CHENG YANG, ECONOMIC ANALYSIS AND PROJECTIONS DEPARTMENT, WORLD BANK, THE PRICE SERIES IS CANADIAN NO. 1 NORTHERN, IN STORE PORT WILLIAM/PORT ARTHUR FOR 1900-47; CANADIAN NO. 1 WESTER RED SPRING IN STORE THUNDER BAY FOR 1948-82 AND THE DEFLATOR IS US WHOLESALE PRICE INDEX.
FIGURE 4: RICE PRICE INDEXES, 1900-1982
(1975=100)

SOURCE: COMPILED AND SUPPLIED BY ENZO GRILLI AND MAW-CHENG YANG, ECONOMIC
ANALYSIS AND PROJECTIONS DEPARTMENT, WORLD BANK. THE PRICE SERIES IS
BOAT PADDY, RANGOON FOR 1900-47; THAI 5% BROKEN, FOB BANGKOK FOR
1948-82. THE DEFLATOR IS THE US WHOLESALE PRICE INDEX.
FIGURE 5: MAIZE PRICE INDEXES, 1900-1982

(1975=100)

responded. Much of this supply response has been in the grain growing areas of North America and Oceania, which have a comparative advantage in production of grains.

24. Our analysis indicates that the increase in the per capita growth rate for rice consumption (the staple food of the major proportion of low-income people) through the projection period will be accompanied by a substantial reduction in price and in trade in rice. Among the developing countries, Indonesia (historically the largest importing country) has displayed the most remarkable growth in consumption and production, with both increasing at 5% p.a. over the past 20 years. This has resulted in an increase in self-sufficiency and the likelihood of smaller imports in most years, as in 1981. Other developing country importers (such as Republic of Korea, India and Bangladesh) have also become less reliant on trade, one of the consequences of the Green Revolution. Together with a continuation of the expansion of rice production in the United States (since 1975 when acreage controls were relaxed) and production subsidies in Japan, it is anticipated that world prices on the relatively small international market will face continuing downward pressure.

Production and Yields

25. Grains occupy by far the largest part of land under agricultural production. Continuing increases in area harvested similar to those experienced in the past are unlikely. 1/ Reliance on yield increases will probably rise.

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1/ However, the FAO, ibid. estimated that there was still considerable potential for area expansion in developing countries.
The potential for such increments exists and past experience, particularly in developing countries is encouraging.

26. Over the 1980-95 period world production growth for the major food-crops is projected as follows: rice 2.8% p.a. wheat 3.1% p.a. and coarse grains 2.3% p.a. If yields of wheat and coarse grains were to continue to grow at recent rates these production increases would be achieved with little increase in area harvested. Attainment of the rice production projections, however, will necessitate just as much reliance as in the past on increases in area harvested, or more likely, a faster rate of growth in rice yields than in past years. Such a possibility exists as the major rice growing countries are envisaged to increase the use of fertilizer, continue to develop water control systems, as well as adopt other improved production practices. Unlike industrial countries, where wheat, coarse grains and rice yields are already growing at best at a constant rate, and in some cases at a declining rate, yields in developing countries are generally growing at an increasing rate. In other words, in both rice and wheat, developing countries appear to be on the way to catching up to the industrial countries in yields. For coarse grains the picture seems similar but perhaps not so strong. The exception to this encouraging performance by the developing countries has been in Africa, where production of grains has lagged as improvements in yields have been much slower than in other developing areas. This has been particularly evident in rice and coarse grains (see Table 4 below). In Table 4 we also provide our developing countries projections on a regional basis; these indicate that African countries will fall even further behind other developing countries in the years ahead. Domestic price distortions which reduce incentives for agricultural production may well be a leading factor in reducing the incentives to adopt
new technology in these countries. Under these circumstances the pay-off to agricultural research and to other public investments such as roads and dams will not be as profitable as they otherwise would be.

TABLE 4: GROWTH /A IN PRODUCTION 1961-80 (ACTUAL) AND 1980-95 (PROJECTED), AREA HARVESTED AND YIELDS 1961-80, IN MAIN DEVELOPING COUNTRIES

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
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<td>2.9</td>
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</tr>
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</tr>
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</tbody>
</table>

/A LEAST SQUARES TREND GROWTH RATES FOR 1961-80, END-POINT GROWTH RATES FOR 1980-95.

SOURCE: FAO, PRODUCTION YEARBOOK, VARIOUS ISSUES (ACTUAL); WORLD BANK (PROJECTIONS).

27. Considerable expansion of wheat, coarse grains, and even rice production is possible in the industrial countries, if warranted by global demand. Currently, agricultural policies in the United States and Canada, two of the largest wheat exporters, restrict wheat output in order to maintain farm prices and incomes. If world prices rise, as they did in 1972-74, acreage currently held out of production can be readily brought back into use; though
this response cannot be as great in terms of area as it was in the 1970s when there was a 20% increase in the area under wheat and coarse grains—land that farmers had been paid to hold out of production. Further, the livestock herds of these two countries may be regarded as an enormous bufferstock of grains. As grain prices rise livestock on feed falls thus releasing for export and human consumption quantities of grain formerly destined to be consumed by livestock. This indeed occurred during the 1972-73 crop shortfalls. Supply elasticities for wheat and coarse grains in the United States, Canada, the European Community and Australia indicate that the production response to increased price is quite elastic. Export supply elasticities are considerably larger than supply elasticities.

28. The grains projections have been based largely on a continuation of 1961-80 rates of growth of yields. Since many developing countries are mounting successful efforts to increase yields, it is believed that the yields assumptions used are conservative. Shown in Table 5 below are the historical rates of growth of production, area harvested and yield for the cereals, differentiated by main economic regions. Table 6 gives average 1970-80 yields for the grains by major regions. As the growth rates of area harvested and yield sum to the growth rate of production, the relative contribution of yield and area harvested to the changes in production that have occurred can be easily inferred. World wheat yields have been growing at the rate of 2.5% p.a., implying that 80% of output growth during the 1961-80 period has been due to yield improvements. Wheat yields have been increasing most rapidly in developing countries, especially China (5.5% p.a.), yet yields in developing countries are still 40% below those of industrial countries.
TABLE 5: CEREALS - GROWTH /A IN PRODUCTION, AREA HARVESTED AND YIELDS, 1961-80

<table>
<thead>
<tr>
<th></th>
<th>AREA SHARES IN WORLD PRODUCTION, 1980</th>
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<th>CENTRALLY PLANNED ECONOMIES</th>
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/A LEAST SQUARES TREND GROWTH RATES.

SOURCE: DERIVED FROM FAO, PRODUCTION YEARBOOK, VARIOUS ISSUES.

TABLE 6: AVERAGE YIELDS FOR MAJOR CROPS IN REGIONS OF THE WORLD, 1970-80 AVERAGE

<table>
<thead>
<tr>
<th>(KG/HA)</th>
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<td>1,631</td>
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</table>

/A COARSE GRAINS INCLUDE BARLEY, MAIZE, RYE, OATS, MILLET, SORGHUM.

SOURCE: FAO, PRODUCTION YEARBOOK, VARIOUS ISSUES.
29. World yields of coarse grains have been growing at 2.3% p.a., implying that almost 90% of output growth has been due to yield increases. Coarse grains yields have been growing most rapidly in industrial countries as a rule, although again China has achieved very good yield increases in sorghum (5% p.a. for 1961-80). Two-thirds of the growth in the world production of rice in the past 20 years has been due to increases in yields. Over the last few years, rice yields in the United States have averaged 5,000 kilograms per hectare and in Japan 6,000 kilograms per hectare. The average for developing countries has been about 2,000 kilograms per hectare. Clearly there exists a great potential for "catching up."

30. Figures 6, 7 and 8 present yield growth rates in selected countries for wheat, rice and coarse grains over the past 32-year period. The vertical axis are logarithmic in order that yield data can be interpreted directly as growth in yields. The conclusions that can be drawn from these figures are that yields are increasing at a constant or diminishing rate in industrial countries while they are increasing at an increasing rate in developing countries. This is a very favorable indication of the future productive potential of developing countries; especially when the differences between yields in industrial countries and developing countries are considered. Even if developing countries never achieve yields of the same magnitude as industrial countries, merely approaching current yields in industrial countries would represent a substantial improvement and would have a significant effect on production. Since achieving yields similar to those now common in industrial countries involves adopting well-developed technologies, the technical challenge is not difficult. The main difficulty is an organizational one that involves providing correct incentives and removing obstacles to production increases.
FIGURE 6: WHEAT - YIELD GROWTH RATES IN SELECTED MAJOR PRODUCING COUNTRIES /A

(100 KG/HA)

THE VERTICAL AXIS IS LOGARITHMIC SO THAT YIELD DATA ARE INTERPRETED DIRECTLY AS GROWTH IN YIELDS.

SOURCE: FAO, PRODUCTION YEARBOOK, VARIOUS ISSUES.
FIGURE 7: COARSE GRAINS - YIELD GROWTH RATES IN SELECTED PRODUCING COUNTRIES /
('00 KG/HA)

ARGENTINA: MAIZE

FRANCE: MAIZE

INDIA: SORGHUM

UNITED STATES: MAIZE

/A THE VERTICAL AXIS IS LOGARITHMIC SO THAT YIELD DATA IS INTERPRETED DIRECTLY AS GROWTH IN YIELDS.

SOURCE: FAO, PRODUCTION YEARBOOK, VARIOUS ISSUES.
FIGURE 8: RICE - YIELD GROWTH RATES IN MAJOR PRODUCING COUNTRIES /A

('00 KG/HA)

UNITED STATES

PHILIPPINES

JAPAN

PAKISTAN

CHINA

THAILAND

/A THE VERTICAL AXIS IS LOGARITHMIC SO THAT YIELD DATA ARE INTERPRETED DIRECTLY AS GROWTH IN YIELDS.

SOURCE: FAO, PRODUCTION YEARBOOK, VARIOUS ISSUES.
31. World wheat yields grew at an annual rate of 3.1% from 1961 to 1970, and at the much slower rate of 1.7% over the 1970-79 period. The slow growth in the 1970s was entirely due to almost negligible growth in Canada, the United States and the USSR. It is evident from Figure 6 that the 1970s saw some disturbing fluctuations in yields in the United States due to weather. There were sharp reductions in 1974 due to the cold, wet spring and early fall freeze, and in 1976-77 due to the extended drought. All three industrial countries shown in Figure 6 exhibit a slowing down in the historical growth of wheat yields. The sudden increase in the United Kingdom in the late 1970s probably represents the partial changeover from bread wheat to higher-yielding feed wheat. In many developing countries, as exemplified by the three examples in Figure 6, wheat yields are growing at an increasing rate. It is hard to see why there might be a sudden change from these recent trends.

32. In examining coarse grains' yields, it is important to split the total into maize and other coarse grains (where "other" include sorghum, millet, rye, oats and barley). There are large differences in production and yields between the other coarse grains and maize, which has received the bulk of research and development expenditures and which is more often irrigated than the other coarse grains. As a result, there has already been a substantial shift from sorghum and millet to the higher yielding maize. Maize production is now more than half of total coarse grains production.

33. The industrial countries have maize yields two to three times greater than those of the rest of the world, mainly as a result of greater irrigation and fertilizer inputs. The United States has, by far, the highest yields, producing over 6.5 tons of maize per hectare. This is twice the yields achieved in Argentina and four times the yields achieved in Brazil. Yields in the
centrally planned economies are only about half those of the United States. Yields in the United States, producer of about half the world's total, grew strongly in the 1961-80 period. Argentina, one of the more important developing country producers, recorded growth rates in maize yields during the 1970s of 4.4% p.a. However, growth in maize yields in the industrial countries has been slowing down while in the developing countries growth rates are still increasing (Figure 7).

34. Yields of other coarse grains are generally less than one-half of the yields of maize. Yields in the United States, the second largest producer, are around 2.5 tons per hectare. The USSR, the largest producer, has yields less than half those of the United States. France and Canada are other major industrial coarse grain producing countries. India, Argentina and Mexico are important developing country producers. Data on the other coarse grains generally show constant growth in industrial countries’ yields, a sharp slowdown in growth in centrally planned economies’ yield growth during the 1970s by comparison with the 1960s, and yields in the developing countries growing faster in the latter period (see, for example, India’s sorghum yields in Figure 4).

35. In the United States and Japan, the only major industrial country rice producers, yields grew at an increasing rate throughout the 1950s and early 1960s, slowing down in the late 1960s, and growing at a constant rate during the 1970s (Figure 8). Recent yields (1978-80 average) of rice in the United States and Japan have been 5 and 5.8 tons per hectare, respectively, and in industrial countries yield increases have accounted for all of the production increases as area harvested has actually declined. The contrasting experience of developing countries is striking. In China and the Philippines, for example, and to a lesser extent in Thailand and Pakistan, growth rates of
yields are still increasing (Figure 8). In China, growth in yields has increased at a fairly steady rate over the last 30 years to 4.2 tons/ha in the period 1978-80. In the Philippines the rate of growth in yields since 1957 has been much greater than in China, but is still only 2.1 tons/ha. Yields over the period 1978-80 averaged 2.4 tons/ha in Pakistan and 2.0 tons/ha in Thailand. In Pakistan, growth in yields, after being stagnant during the 1950s and early 1960s, accelerated greatly during the late 1960s and early 1970s and has since flattened off; though yields are still increasing. Thailand displays a similar pattern to Pakistan, though the changes have been more moderate than in Pakistan. Over the most recent decade, increasing yields in China and the Philippines have contributed to approximately 80% of the output increase, while in Pakistan and Thailand increasing yields have only contributed 57% and 39%, respectively, of the increased output. Considerable area expansion has taken place in the latter two countries.

Other Factors

36. The projections of food consumption to 1995 leave out some important components of the food basket, such as eggs, milk, vegetables and other meats. Besides changes in income, population and the income elasticity of demand for food, other factors affecting food consumption may also change over time. Two factors that could be important are the distribution of income and the age distribution of the population. Allowance was made in the above projections for changes in income elasticity of demand over time. However, these were the result of educated guesses. No allowance was made for change in income distribution and population distribution. We need to get a better idea of how income elasticities change with changes in income for different commodities and for this we need extensive time-series and cross-section studies. The age distribution of the population should also affect food consumption patterns, especially for commodities such as milk and meat. With developing countries
expected to experience some significant changes in population distribution as their population growth slows in the years ahead, there is also room for work on this aspect of demand.

37. As we noted earlier it is likely that within many developing countries growth in food consumption has been affected, negatively, by distorted prices and income distribution which is biased against the poor. From data assembled by the World Bank, nominal protection coefficients (NPCs) have been calculated for agricultural production in various countries. \(^1\) In Table 7 we have presented NPCs for 19 developing countries, calculated in most cases for the most important grain grown in each country. \(^2\) Bearing in mind the qualifications attached to these estimates, it is obvious that food production faces severe implicit or explicit taxes in many developing countries. It is our opinion that this factor has been the most important disincentive to the adoption of improved agricultural production performance in Africa, the region of most persistent concern about human nutrition, and that there would be a marked improvement if these disincentives were removed. And to reiterate, the pay-off to public investment in research and infrastructure designed to assist agriculture will not be as effective as it could be, so long as such distortions remain.

---

\(^1\) The nominal protection coefficient measures the incentives or disincentives faced by producers by comparison with prices they would receive if there were free trade. The NPCs take account of tariffs, quotas and non-tariff barriers which protect farmers as well as export taxes or other restrictions that may penalize them. These NPC estimates are also adjusted for exchange rate under- or over-valuation, but they are not adjusted for the protection given to tradable inputs such as fertilizer or machinery. For an evaluation of the effects of such price distortions for several industrial and developing countries, in terms of income transfers and welfare reductions, see Bale and Lutz.

\(^2\) For a larger set of NPC estimates refer to World Bank, 1982, pp. 48-9.
### TABLE 7: NOMINAL PROTECTION COEFFICIENTS CALCULATED FOR GRAINS PRODUCTION IN DEVELOPING COUNTRIES

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>GRAIN</th>
<th>NCP ESTIMATE</th>
<th>/A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AFRICA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egypt</td>
<td>Maize</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>Rice</td>
<td>0.97</td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>Maize</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>Senegal</td>
<td>Rice</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Sudan</td>
<td>Sorghum</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>Maize</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td>Wheat</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Zambia</td>
<td>Maize</td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td><strong>ASIA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Rice</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>Wheat</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>Rice</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>Rice</td>
<td>0.58</td>
<td></td>
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<tr>
<td><strong>EUROPE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>Wheat</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>Wheat</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td><strong>LATIN AMERICA</strong></td>
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<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>Wheat</td>
<td>0.64</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>Rice</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>Rice</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>Wheat</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>Uruguay</td>
<td>Wheat</td>
<td>1.25</td>
<td></td>
</tr>
</tbody>
</table>

/A A VALUE GREATER THAN 1.0 INDICATES A SUBSIDY ON PRODUCTION AND A VALUE LESS THAN 1.0 INDICATES A TAX. THESE ESTIMATES HAVE BEEN MADE AT DIFFERENT POINTS OF TIME AND NOW MAY WELL BE OUT OF DATE: HOWEVER, THE ESTIMATES DO VARY WIDELY FROM YEAR TO YEAR WITHIN A COUNTRY.


38. World Bank and other estimates of Gini coefficients and other measures of income distribution suggest that incomes are generally much more unevenly distributed in developing countries than in industrial countries. A redistribution of incomes in these countries would certainly improve access to food supplies by the poor in those countries. However, we would not argue
therefore for massive redistribution programs. Our opinion is that improved
pricing policies would, by encouraging agricultural production, raise the
levels of incomes of farmers and landless rural people who rely on farming for
their income. This would improve income distribution in favor of the sector in
which most of the poor are found, more effectively than any direct
intervention to change the distribution of incomes.

39. Two final points. The creation and development of a "world food
system" that has occurred since World War II has greatly alleviated the
possibility of widespread food shortages. At this time, virtually the entire
population of the world has access to the world food markets. Vastly improved
communications, lower surface and air transportation costs, the availability
of shipping, the construction of storage facilities, and the development of
infrastructure at dockside and in the hinterlands have all contributed to the
creation of this complex. Food merchants receive worldwide market reports on a
daily and sometimes hourly basis such that arbitrage opportunities largely
equalize the price of food commodities across the world (net of transportation
costs, government intervention activities, quality differences, and the like).
Because of these developments it is now possible to eliminate food shortages
caused by natural events. 1/

40. And finally, it is well-known that projections of economic behavior
are notoriously unreliable (or are notoriously misinterpreted). All we know
about the future is what we have observed in the past. We know that the future
will be similar to the past because in the past the future has been similar to

1/ D. Gale Johnson observed this development to one of the authors.
the past. Given this dictum we interpret the information provided here of over 30 years of declining agricultural prices and over 30 years of increasing crop yields (now increasing at an increasing rate in developing countries) as _prima facie_ evidence of the robustness of the world food system and of the likely continuation of such trends. We feel that it is incumbent on those who view the global food situation in a pessimistic way to provide a strong case of why trends that have been in existence for at least thirty-five years will be suddenly reversed. While we are cautiously optimistic about the continued improvement of food consumption and food output throughout the world, there is no room for complacency. As Johnson has observed, "if circumstances are to improve it is because efforts are made to make the improvement occur and at least some of the hinderences that exist, such as trade restrictions, low farm prices due to government constraints, and inadequate provision of farm inputs, are ameliorated."
REFERENCES


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