Wheat in the world food economy

Increasing role in developing countries

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Wheat is the oldest and most important of the cereal grains in world food supply. In the last two decades the role of wheat in the world food economy has increased substantially, especially in the developing world. This article describes and analyses the role of wheat and highlights and interprets changes that have occurred in the last two decades of rapid change. The authors analyse, in turn, trends in production, consumption, trade and prices with special emphasis on the developing countries.[1] Finally, the authors speculate on how these trends are likely to be effected by future events.

Keywords: Wheat; International trade; Economics

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Wheat production occurs in a wide range of environments. Average world wheat production in the period 1978–80 totalled 440 mt compared with 384 mt of rice (paddy) and 378 mt of maize. Wheat production is almost equally divided among the developed market economies, Eastern Europe and USSR, and the developing countries (see Table 1). Within the developing world, the bulk of production occurs in East Asia, South Asia and in the Middle East/North African countries.[2] Latin America accounts for 10% of wheat production of developing countries; production in sub-Saharan Africa and South-east Asia is negligible.

As a proportion of total cereal production, wheat is the dominant cereal crop in the traditional wheat belt that runs through Europe, the USSR, and the Middle East/North African countries (Table 1). In South Asia and East Asia, wheat is second to rice, and in Latin America, wheat ranks behind maize in the share of total cereal production.

Wheat consists of three main types: bread wheat, both spring and winter habit, and durum wheats.[3] These wheats are grown in widely varying environments ranging from fully irrigated to semi-arid conditions. In developing countries, roughly 60% of the wheat area is planted to spring bread wheats (Table 2). The largest area of spring bread wheat is in South Asia, much of it under irrigated conditions (Table 3). Nearly all of the Latin American wheat area is spring bread wheat produced under rainfed conditions, much of it semi-arid. Winter bread wheat accounts for 30% of the wheat area, most of it in East Asia (China) and the Middle East (Turkey and Iran). Durum wheats are sown on only a little over 10% of the total area but are important in North Africa and the Middle East.

A large part of the durum wheat in this region is produced under semi-arid conditions. Overall, the wheat area in developing countries is roughly equally distributed between irrigated wheat, rainfed wheat grown under generally adequate moisture, and wheat grown in semi-arid conditions where moisture is often limiting. Wheat yields reflect these different producing environments. In irrigated areas of developing countries, we have etimated that yields average about 2 t/ha compared to less than 1 t/ha in semi-arid regions. This implies that over half of the

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Table 1. Average world wheat area, yield and production (1978–80) and growth rates by region (1961–65 to 1978–80).

	Area (mha)	Yield (t/ha)	Production (mt)	% of world area	% of world production	Wheat as % of total cereal production in region	Annual growth rates, 1961–1980 Area (%)	Yield (%)	Production (%)
Developing countries	105.1	1.4	150.9	44	34	19	2.1	2.5	4.6
Middle East/North Africa	25.5	1.3	34.4	11	8	56	1.0	2.1	3.0
South Asia	29.3	1.5	43.7	12	10	24	2.8	3.6	6.4
East Asia	39.4	1.4	56.7	16	13	18	2.7	3.0	5.6
Latin America	9.8	1.5	14.8	4	3	16	1.1	0.4	1.5
Other developing countries[a]	1.1	1.2	1.3	1	0.3	1	0.7	2.0	2.7
Developed countries	135.6	2.1	288.6	56	66	35	0.1	2.8	2.9
Developed market economies	66.7	2.4	158.2	28	36	28	0.7	1.9	2.7
Eastern Europe and USSR	68.9	1.9	130.4	29	30	47	–0.5	3.7	3.2
World	240.8	1.8	439.5	100	100	27	0.9	2.5	3.4

Note:[a]Sub-Saharan Africa and South-east Asia.
Source: Calculated from FAO computer tapes on production and trade.

wheat produced in developing countries comes from irrigated areas. By contrast, irrigated wheat production in developed countries is negligible.

Trends in world wheat production

In global terms, cereal production has expanded rapidly in the last two decades. Among cereals, wheat and maize production have increased at an annual rate of about 3.4% from 1961–65 to 1978–80, while rice has increased at 2.6% (Table 4).[4] Although wheat and maize have similar overall growth rates in production, there are sharp differences between trends in developed and developing countries. Wheat production in developing countries expanded rapidly at an average annual rate of 4.6% compared with a 2.9% growth rate in developed countries; ie wheat production in developing countries more than doubled in less than 20 years. During this period, the share of world wheat produced in developing countries increased from 28% to 34%. By contrast, maize production increased at an annual rate of only 2.5% in developing countries, significantly below the 3.8% growth rate in developed countries.

Higher rates of yield increase largely explain the high growth rate of wheat output relative to maize and rice in developing countries. In developing countries, per capita wheat production has increased substantially, by more than one-third in the last two decades. Wheat is the only cereal grain in developing countries where yield increases have matched the population growth rate, indicating an ability to sustain per capita production without increasing area.

During the 1960s, the rate of increase of wheat yields in developing countries lagged behind developed countries. But in the last decade, yields increased more rapidly in developing countries while those in developed countries slowed (Table 5).[5] Nonetheless, despite the importance of irrigation in developing country wheat production, yields

[1]Unless otherwise indicated, we have used for the analysis in this article the FAO computer tapes on production and trade for the period 1961–80 and 1961–79, respectively, and FAO Food Balance Sheets for the period 1961–1977.

[2]For this analysis, developing countries have been divided into several producing regions. They are sub-Saharan Africa, Middle East/North Africa (Morocco to Afghanistan), South Asia (India, Pakistan, Bangladesh, Nepal), East Asia (China, Korea DPR and Republic of Korea), South-east Asia (Burma to Indonesia) and Latin America. For data on individual countries, see CIMMYT, *World Wheat Facts and Trends*, Mexico, 1981.

[3]These wheat types have evolved relatively independently with little genetic intermixing until recently. Winter habit bread wheats require a period of vernalization of below freezing temperatures to tiller and flower. Durum wheats are primarily grown in the Mediterranean region for couscous or spaghetti and macaroni.

[4]Growth rates, g, have been calculated by $g = 100 \times [\ln (x_t/x_0)]/t$ where x_0 is production in the period 1961–65 and x_t is production in 1978–80 and t in this case is 16, the time between the midpoints of the two periods. Growth rates based on regression analysis were also estimated but gave almost identical results.

[5]Largely due to reduced area in the USSR and in some European countries, the wheat area in the developed countries has remained steady over the last two decades.

Table 2. Approximate distribution of wheat types for major regions in the developing world.

Region	% of wheat area Spring habit bread	Winter habit bread	Durum
Middle East/North Africa	29	40	31
South Asia	95	0	5
East Asia	40	60	<1
Latin America	95	1	4
All developing countries	59	30	11

Source: D. Byerlee and D. Winkelmannm, *Accelerating Wheat Production in Semi-Arid Developing Regions: Economic and Policy Issues*, CIMMYT Economics Working Paper No 80/2, Mexico, 1980.

Table 3. Approximate distribution of wheat area by moisture environment in major regions of the developing world.

	% of wheat area		
	Irrigated	Adequate rainfed moisture	Semi-Arid
Middle East/North Africa	14	34	51
South Asia	73	4	23
East Asia	25	39	37
Latin America	9	49	43
All developing countries	34	28	37

Source: As for Table 2.

in all developing regions are still well below yields in developed countries (Table 1). This indicates the potential for further yield increases in developing countries.

Rapid aggregate increases in wheat production in the developing world mask substantial variability in performance among countries and within countries. This variability is evident in Table 1. In South Asia and East Asia, major wheat producers have consistently experienced high rates of increase in yields and area of wheat over the last two decades and yield increases have easily exceeded population growth.[6] A large part of the yield increase in these regions is associated with the widespread adoption of high yielding varieties (HYV), greater use of irrigation and the increasing use of fertilizer. High yielding wheat varieties which are generally shorter, more input responsive and disease resistant, have now been adopted on over 70% of the wheat area of India, Pakistan and Bangladesh and on most of the irrigated wheat area of China.

In the traditional wheat area of the Middle East/North Africa region, annual yield and production increases have averaged 2.1% and 3.0% respectively. However, this largely reflects the rapid production increases in Turkey. Here, under rainfed conditions, use of high yielding varieties combined with improved management practices, especially in semi-arid areas, have resulted in annual yield increases of 3.3%. Meanwhile, North African countries have generally experienced low yield increases and stagnant production.

In Latin America, most production increases have resulted from area expansion, especially in Brazil. Only Mexico has experienced rapid yield increases, largely due to the use of higher yielding varieties and associated management practices under irrigated conditions.

Another way of showing this variability is to classify developing countries by performance in rate of growth of yield. Because of the

[6]In India, for example, wheat production tripled from 1961–65 to 1978–80; and in Bangladesh, not traditionally a wheat producer, production has expanded almost twenty fold in this period.

Table 4. Trends in world wheat production in comparison with other major cereal crops.

	Annual growth rates (%) (1961–65 to 1978–80)		
	Area	Yield	Production
Developing countries			
Wheat	2.1	2.5	4.6
Rice	1.0	1.7	2.7
Maize	1.3	1.2	2.5
All cereals	1.1	1.9	3.0
Developed countries			
Wheat	0.1	2.8	2.9
Rice	0.3	0.7	1.0
Maize	0.9	2.9	3.8
All cereals	0.3	2.6	2.9
World			
Wheat	0.9	2.5	3.4
Rice	1.0	1.6	2.6
Maize	1.1	2.3	3.4
All cereals	0.8	2.1	2.9

Source: Calculated from FAO computer tapes on production and trade.

Table 5. Comparison of trends in world wheat area, yield and production in the 1960s and 1970s.

	Annual growth rates (%)					
	1961–65 to 1969–71			1969–71 to 1978–80		
	Area	Yield	Production	Area	Yield	Production
Developing countries	2.1	2.3	4.4	2.2	2.6	4.8
Developed countries	–0.5	3.8	3.3	0.6	1.9	2.5
World	0.5	3.1	3.6	1.2	2.0	3.2

Source: Calculated from FAO computer tapes on production and trade.

achievements of China, India and Pakistan, over half the wheat area in developing countries has experienced average yield increases of 3% or more. At the same time, yield increases in over half of the developing countries – many in the Middle East and North Africa – have been less than one percent per year.[7]

The role of wheat in food consumption

The bulk of world wheat production (67%) is destined directly for human consumption. By contrast, less than 25% of world maize production is used as human food. However, the use of wheat (usually of lower quality) as an animal feed has increased dramatically in Eastern Europe and the USSR since 1960 as these countries have striven to increase the availability of livestock production for consumers and as the price of wheat has fallen relative to other grains (see Figure 2). Close to half of the total wheat supply in these countries is now destined for animals. Significant amounts of wheat are also fed to animals in Western Europe. For the world as a whole, about 80 mt of wheat (or 18% of total production) are consumed as animal feed. Industrial non-food uses of wheat are small in most countries.

In developing countries almost all wheat is destined for human consumption. Statistics on average calories supplied by wheat in a given country do not reflect the heterogeneity in diets due to such factors as income and local food preferences. Nonetheless, clear regional differences are shown in Table 6. In the Middle East and in North Africa, wheat provides about half of all calories. Average per capita wheat consumption in these countries is about 150 kg per year. In South Asia and East Asia, per capita wheat consumption is 45 kg per year and wheat

[7]Only countries producing 100000 ha or more of wheat were included in this analysis.

Table 6. Total wheat utilization, wheat for food and trends by region.

					Annual growth rates (%)	
	Per capita wheat supplied for food, 1975–77 (kg/year)	Per capita total domestic wheat supply, 1975–77 (kg/year)[a]	% cereal calories from wheat, 1975–77	% total calories from cereals, 1975–77	Per capita wheat supplied for food[b]	Total wheat utilization[c]
Developing countries	45	56	26	61	1.5	4.6
Middle East/North Africa	147	205	71	63	1.3	4.0
South Asia	45	49	27	68	2.4	4.8
East Asia	45	57	23	66	3.5	5.3
Latin America	46	62	37	40	0.7	2.6
Other developing countries	11	12	8	56	3.8	7.1
Developed countries	105	191	71	31	–0.6	2.6
Developed market economies	77	116	66	27	–0.5	1.7
Eastern Europe and USSR	127	325	75	39	–0.9	3.2
World	58	93	36	50	0.5	3.4

Note: [a]Includes all wheat available for domestic use, ie human consumption, animal feed, industrial uses, seed and waste. It is the sum of production, net imports and stock changes; [b]Based on change in per capita calorific supply from wheat, 1961–65 to 1975–77; [c]Production plus net imports, 1961–65 to 1977–79.
Source: Calculated from FAO Food Balance Sheets, 1980 and from FAO computer tapes on production and trade.

accounts for about 25% of calories supplied as cereals. In Latin America as a whole, wheat accounts for over one third of calories supplied as cereals and for almost all cereal calories in Argentina, Chile and Uruguay. Finally, in South-east Asia and sub-Saharan Africa, wheat is only consumed by a small part of the population although per capita consumption is over 10 kg per year.

For the developing world as a whole, cereals provide over half of total calorific intake, with wheat consumption of 45 kg per head accounting for one quarter of the total calories provided by cereals. By contrast, cereals provide only about one third of total calories in developed countries with most of this provided by wheat (Table 6). As a result, overall per capita human consumption of wheat in developed countries is about 100 kg per year (77 kg per year in developed market economies and 127 kg per year in Eastern Europe and the Soviet Union). These are well below the figures for the Middle East and North Africa where wheat is the staple food source.

Trends in wheat utilization

Direct human consumption, by far the most important use of wheat, changes largely in response to population, income, prices, and tastes. Total wheat utilization (production plus net imports) in the developing world has increased at an average annual rate of about 4.5% per year from 1961–65 to 1977–79, against a population growth rate of 2.4%. That is, per capita utilization has increased by about 2.1% per year.

Trends in per capita food supplied by wheat by region are shown in Table 6. In the developed countries (and in some developing countries such as Argentina and Turkey) with already high per capita wheat consumption and moderately high per capita incomes, per capita consumption of wheat is steady or falling as consumers with rising incomes switch from cereals to higher value vegetable and animal products. In these countries, income elasticities of demand are zero or negative for wheat products. In most other developing countries where wheat is important, rising incomes and reduced real prices of wheat have resulted in increases in per capita consumption of two to three percent per annum.

There are also many countries in South-east Asia and sub-Saharan Africa where wheat is not a traditional food but where high income elasticities, changing food tastes, especially associated with urbanization and government policies favouring consumption and imports of wheat over other food grains, have led to rapid increase in wheat consumption in recent years. Income elasticities of demand for wheat in these countries are often close to one. Moreover urbanization is proceeding rapidly; eg the growth of urban population in Africa is estimated to be close to 6% annually.[8] The combined effects of these two factors has led to explosive annual growth rates of well over 10% in wheat consumption over the last two decades in two of the major countries in these regions, Indonesia and Nigeria, where per capita incomes are increasing rapidly.

In the developing world as a whole, the proportion of cereal calories provided by wheat increased from 21% to 27% in the relatively short period, 1961–65 to 1975–77. Per capita calories supplied by wheat increased by 2.3% per year compared to 0.4% for rice and no increase for maize. Meanwhile, in developed countries, per capita calorific intake from wheat has fallen steadily.

[8]Income elasticities of demand for wheat have been estimated for sub-Saharan Africa by Cheryl Christensen, *et al, Food Problems Production and Prospects in Subsaharan Africa: The Decade of the 1980s,* Foreign Agricultural Economics Report No 166, International Economics Division, Economics Research Service, USDA, Washington, DC, 1980. For estimates in Indonesia, see S.L.Magiere, *An Analysis of the Role of Wheat in the Indonesian Food Sector,* USDA Foreign Agriculture Report, USDA, Washington, DC, August 1981.

Wheat in world cereal trade

Wheat has traditionally been the major cereal grain in international trade. Between 1961 and 1965, some 16% of world wheat production entered international markets, compared with 9% for maize and 4% for rice. Although wheat exports have grown substantially from 50 mt in 1961–65 to 80 mt in 1977–79, their share in total cereal trade has dropped from 55% to 43%. This is due to the rapid increase in maize trade from 20 mt to 66 mt over the same period. Rice accounted for only a small percentage of traded cereals.

The pattern of expansion of wheat and maize trade, however, has been quite different. The bulk of the increase in wheat imports of 29 mt went to developing countries for human consumption. These countries increased their average share of total world wheat imports from 49% to 59%. Increased maize imports largely went to the developed countries including Eastern Europe and the USSR, for animal feed.[9]

Wheat imports to developing countries

The last two decades have seen important shifts in the direction of wheat imports within the developing world. In the early 1960s, imports by South Asia – mainly India, Pakistan and Bangladesh – were 26% of all wheat imports to developing countries. In recent years this share has dropped to 8% and wheat imports to these countries are only half the levels in the 1960s (Table 7). The Middle East/North African countries are now the major wheat importers accounting for one third of wheat imports by developing countries. Over the last two decades, wheat imports by these countries have grown at 7% per year. The most rapid increases in wheat imports have been to South-east Asia and sub-Saharan Africa. These countries, which produce little wheat, now make up 16% of the developing country market.

Although wheat imports to developing countries have expanded rapidly, net imports as a proportion of total wheat utilization in developing countries have barely changed because of rapid increases in domestic wheat production. However, the pattern of self-sufficiency among developing countries has changed markedly. As would be expected from the pattern of trade and production, dependence on wheat imports has been drastically reduced in South Asia and to a lesser extent in East Asia. Dependence on wheat imports in all other regions has sharply increased. The Middle East countries, excluding Turkey, now import 32% of their wheat needs. Similarly, Latin American countries, excluding Argentina, import 53% of wheat consumed.[10]

Meanwhile developing countries play a small role in world wheat exports. Argentina is the only developing country that consistently exports wheat – its share of the market is about 5%. Other developing

[9]Developing countries increased imports of maize rapidly over this period at an annual rate of 13.9%. Nearly all of this was, however, imported by middle income countries for animal feed (CIMMYT, *World Maize Facts and Trends*, Mexico, 1981).

[10]Both Turkey and Argentina are currently wheat exporters.

Table 7. Wheat imports to developing country regions.

	Imports		% of developing countries		Annual growth rates (%)
	1961–65 (mt)	1977–79 (mt)	1961–65	1977–79	
Developing countries	24.0	45.9	100	100	4.3
Middle East/North Africa	4.7	14.4	20	31	7.5
South Asia	6.3	3.7	26	8	-3.5
East Asia	5.7	10.6	24	23	4.1
Latin America	5.0	9.8	21	21	4.5
Other developing counties	2.3	7.4	9	16	7.8

Source: Calculated from FAO computer tape on trade.

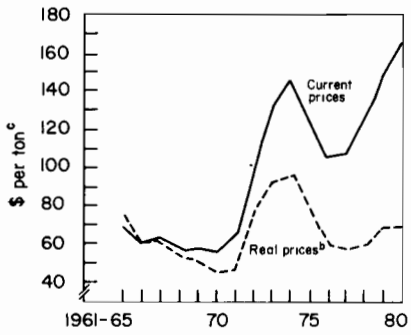

Figure 1. Current and real prices of wheat (three-year moving average).
Note: [a]Data for 1979 and 1980 are single year data; [b]In 1967 US dollars; [c]For wheat, No 2, HRW, Kansas City.

Prices

The marked fluctuations that have occurred in world wheat prices in response to changing supply and demand over the last two decades are evident in Figure 1. Although current wheat prices are more than double the prices of the early 1960s, the real price, measured in 1967 US dollars, is lower now than in the early 1960s. Wheat prices have also tended to fall relative to the price of other grains in the world market (Figure 2). This reflects the relatively rapid growth of world wheat production over the last two decades.

On the other hand, the world price of nitrogen fertilizer, a key input in wheat production in many countries, increased sharply in the mid-1970s and then declined (Figure 3). The index of nitrogen prices has tended to follow that of wheat prices so that prices of nitrogen relative to wheat have changed little compared with the early 1960s. However the decline in relative prices of nitrogen that was evident in the 1960s has levelled off.

At the same time, ocean freight charges have become an important cost for developing countries that import wheat. Again, the index of ocean freight rates generally followed the index of wheat prices but it has increased sharply above the wheat price index in recent years (Figure 3). A number of factors such as distance, lower trade volumes, and higher port handling costs contribute to high freight rates of grain to developing countries relative to developed countries.[12]

Wheat's changing role in the world food economy

The foregoing summary of major characteristics and trends in wheat production, consumption, trade and prices clearly points to three distinct groups of developing countries. First, two-thirds of the wheat in the developing world is produced in South Asia and East Asia, although wheat consumption is second to rice. Rapid technological change in wheat in these countries, especially under irrigated conditions, have led to rapid increases in yield and a considerable expansion of area. This has had a number of important implications for the food economy of these regions.

Rapid increases in production have allowed substantial increases in per capita wheat consumption generated by moderately high income elasticities of demand for wheat and reduced prices of wheat relative to other cereals. Increased wheat availability has accounted for practically all the increase in total calories supplied for human consumption. These average figures do not indicate what is happening to low income groups of the population which are deficient in calories although there is some evidence that these groups have also benefitted.[13] Finally in the case of South Asia, import dependence has been substantially reduced as a result of increased domestic production. China also reduced the proportion of wheat imported from 1961–65 to 1977–79.[14]

The second group of countries consists of the Middle East and North African countries where wheat is a basic staple with per capita consumption usually above 100 kg per year. Here, technological change in wheat production has been slow except for a few countries, most notably Turkey. Although wheat in the region is often grown in more difficult

[11]Wheat exports have continued to be dominated by the USA with close to 40% of the share of the market, and by Canada and Australia with a collective share of about 30%. These countries export close to half of their total wheat production. The only major change in the share of wheat exports over the last two decades has been the increase in exports from Western Europe, largely France, where surplus production has been stimulated by domestic wheat price supports substantially above world prices. These countries now account for 16% of world wheat exports.

[12]At current wheat prices and freight rates, it costs about $240 per ton in 1981 to land wheat in South Asia compared to less than $90 per ton at the beginning of the 1970s.

[13]For evidence see D. Byerlee and L. Harrington, 'New wheat varieties and poor producers', Paper presented to the 18th International Conference of the International Association of Agricultural Economists, Jakarta, Indonesia, 24 August –2 September 1982.

[14]In 1980 and 1981 this proportion increased substantially due to poorer harvests, local transportation problems and policies to increase cereal supplies to consumers. There are also signs that wheat imports to South Asia, especially India, may be increasing again, as the growth rate of local wheat production has slowed.

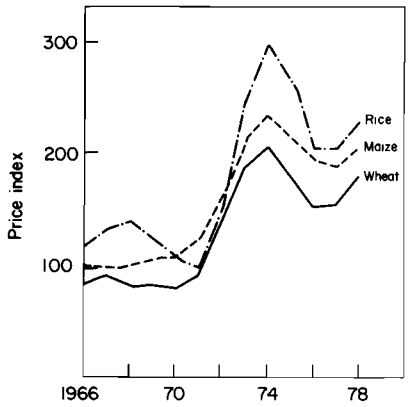

Figure 2. Indices and changes in wheat, maize and rice prices (three-year moving average).
Note: Index base is the average 1961–1965 price for wheat, No 2 HRW, Kansas City ($70 per ton), maize, No 2 Yellow, Chicago ($49 per ton), and rice, Thai, 5% broken, Bangkok ($142 per ton).

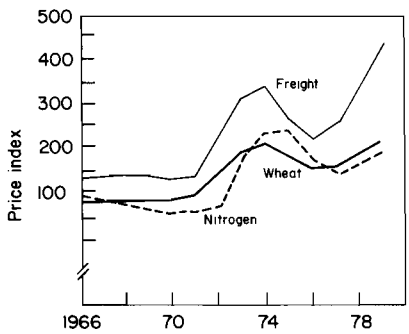

Figure 3. Indices of changes in freight rates, nitrogen and wheat prices (three-year moving average).
Note: Indices based on the average 1961–65 price for wheat, No 2 HRW, Kansas City ($70 per ton), the average 1963–65 nitrogen price from urea, fob bagged Western Europe ($188 per ton), and the average 1961–65 freight rate from US Gulf ports to India (East Coast) ($11.3 per ton).

environments, much of it semi-arid and with durum wheat as an important species, the rapid progress in Turkey indicates that substantial yield increases are possible.[15] In these countries, per capita wheat consumption has increased, although there is evidence that income elasticities may have fallen to low levels in several countries with high consumption levels and moderate incomes. Consumption increases have largely been sustained by increased dependence on wheat imports (except for Turkey, a small exporter).

Latin American countries share some of these characteristics. Wheat consumption levels are high (over 100 kg per capita per year) in some countries such as Chile, Uruguay and Argentina and are not likely to increase with further increases in income. The position in other Latin American countries is variable, but all (except Argentina) are characterized by heavy dependence on imported wheat to meet local consumption needs.

Finally, wheat production in most of sub-Saharan Africa and Southeast Asia is insignificant, largely because of unsuitable production environments. However, these regions have experienced the highest consumption growth rates of any region. Consumption is almost completely based on wheat imports. A number of factors have operated to stimulate wheat consumption in these regions. Most countries are food deficit countries and import food, especially for urban consumers. Rice and wheat have often become preferred food staples for these consumers especially for higher income groups.[16] At the same time, wheat is substantially cheaper in world markets so governments have turned to wheat imports although rice imports have also risen but less rapidly. Government policies such as overvalued exchange rates, direct subsidies and international food aid (largely wheat) have also encouraged consumption through lower prices for wheat products.[17] These countries, especially those with rising per capita incomes and less serious foreign exchange constraints such as Nigeria and Indonesia, have now become significant in the world wheat market.

Over the last two decades, wheat has strengthened its role as the major food grain in international trade. Developing countries largely depend on wheat imports to meet food deficits. In 1977–79, developing countries imported 46 mt of wheat and 8 mt of rice (milled) to meet food needs. Other cereal grains imported by developing countries are largeley destined for animal feed. For example, although the bulk of maize in developing countries is used as human food, less than 2 mt out of the 14 mt of maize imported by developing countries in 1977–79 was destined for human consumption. The rest was imported largely by middle income developing countries for animal feed.[18] It is significant that wheat imports have become important in meeting food deficits in both regions where wheat is a traditional staple food (eg Middle East) and in regions where wheat was not traditionally consumed (eg sub-Saharan Africa). The decreased price of wheat relative to other cereals partly reflecting rapid technological change in some developing countries has been one factor in this trend.[19]

The combination of increased wheat production in developing countries and increased imports of wheat has given wheat a dominant place in increasing total food supply to developing countries. According to FAO Food Balance Sheets, per capita calorie supply in all developing countries from all foods increased by 150 calories per capita from 1961–65 to 1975–77 and wheat accounted for two-thirds of this increase. Even in

[15]For evidence, see D. Byerlee and D.L. Winkelmann, *Accelerating Wheat Production in Semi-Arid Developing Regions: Economic and Policy Issues*, CIMMYT Economics Working Paper No 80/2, Mexico, 1980.
[16]Evidence from Indonesia, a major wheat importer in this group of countries, indicates that urban consumers strongly substitute rice and wheat for maize and cassava as incomes increase (Magiere, *op cit*, Ref 8).
[17]Wheat imports are subsidized in several sub-Saharan countries (Christensen, *et al, op cit*, Ref 8, p 51; and D. Byerlee and G. Varughese, *The Potential for Commercial Wheat Production in Senegal: Some*

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sub-Saharan Africa and South-east Asia, wheat accounted for one quarter of the increase in per capita calorific supply.

Future trends

Looking to the future, the rate of increase in wheat production in developing countries is unlikely to continue at the high level of the last two decades. Yield expansion at over 2% per year as in the recent past, may be possible if countries of the Middle East, North Africa and Latin America which showed little yield changes over the last two decades, organize successful wheat production programmes. Although most wheat in these countries is produced under rainfed conditions, there is evidence that when effective research and extension are combined with appropriate agricultural policies, wheat yields can be increased substantially although less rapidly than experienced in South Asia and East Asia in the recent past.[20] However, area expansion, which was also important in explaining high production growth rates in South Asia and East Asia over the last two decades, is likely to slow down. Meanwhile, wheat production in sub-Saharan Africa and South-east Asia is now beginning on a small scale but will make little contribution in the 1980s.

At the same time, wheat consumption may also increase more slowly. As we have seen, many countries of the Middle East, North Africa and Latin America have reached high levels of per capita wheat consumption, which are likely to taper off or decline. However, rapid increases in South-east Asia and sub-Saharan Africa may continue given current food deficits and policies. Also, total demand will expand by 2% per year in most developing countries due to population growth alone.

Finally, in developed countries, food use of wheat is unlikely to increase since increased demand due to population growth is balanced by decreasing per capita consumption. However, feed use of wheat has increased rapidly over the last two decades again partly because of the decreased price of wheat relative to other cereals, especially maize. The use of wheat for animal feed is likely to continue to increase, especially if grains such as maize are used for alcohol production. This growing interdependence of cereal grains tied to their multiple uses are likely to lead to a tighter wheat market in the next few years and increased cost of wheat imports to food deficit countries.

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Issues, CIMMYT, Mexico, 1981). Wheat consumption is also subsidized in Indonesia (Magiere, *op cit,* Ref 8). In Ghana and Nigeria, imported wheat flour sells for less than the price of locally produced maize because of substantially overvalued local currencies.

[18]CIMMYT, *op cit,* Ref 9.

[19]In the last few years, not included in the above analysis, these trends in the role of wheat imports in the world food economy have been further strengthened. World wheat trade in 1981/82 has increased to 99 mt of which 65% went to developing countries. Increased wheat imports to China have been particularly significant in this trend.

[20]Byerlee and Winkelmann, *op cit,* Ref 15.