Report of the Director

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Global perspectives of factors influencing agricultural, biological and environmental sciences, and their associated industries

In a buoyant year of scientific discovery which marked the 50th anniversaries of the Yalta Conference, the end of World War II, and the formation of the United Nations (UN), the Allies celebrated the initiation of economically thriving democracies in Germany and Japan and international initiatives to promote global prosperity. Entertainment and the arts flourished. The nearly 360-year conjecture of Fermat's last theorem was finally concluded, but not Goldbach's Primes, The Kepler Problem, the Poincaré Conjecture and the Riemann Hypothesis!

The largest gathering of world leaders in history took place in New York in October to celebrate the 50th anniversary of the UN and to reaffirm the principles of the UN Charter that had taken effect on 24 October 1945. Reforms to the organisation were acknowledged but there was still overwhelming confidence in the ability of the UN to promote rather than enforce peace and social development around the world.

Economics

In 1995, the world economy was relatively robust, and the year was one of favourable economic performance, with a broad increase in the production of goods and services. According to International Monetary Fund (IMF) estimates, total output grew by

about 3.5%, largely similar to 1994. Focal points of conflict, however, impeded development and destabilised various economies. Problems continued in the former Yugoslavia, in impoverished areas of Africa - especially Rwanda, Burundi, Zaire, Somalia, Liberia and Sierra Leone - in Middle Eastern countries and in the republics of the former Soviet Union, especially Chechnya. Worrying disturbances occurred also in Mexico and Haiti. The causes of these conflicts related to ethnic, racial, religious, national and regional identities, stoked by poverty. Even stable democracies were not exempt from these influences, and fragmentation of countries remained a real issue.

The strong global economic performance disguised a pronounced slowdown in the more-developed countries (MDCs) as a whole. Here, economic expansion slowed to an estimated 2.5% in 1995 from 3.1% in 1994. Turbulence in the foreign exchange markets and pre-emptive rises in interest rates to suppress

inflation undoubtedly contributed to the downturn. The world's stock exchanges were characterised in 1995 by an accelerated rise following earlier stagnation. Derivatives contracts were subject to detailed reviews after a prominent UK merchant bank was made bankrupt by unauthorised transactions.

Once again, the economies of the less-developed countries (LDCs) grew faster than those of the MDCs, prompted by economic reforms, steady interest rates, export growth and an influx of capital funds. Total growth in LDCs reached 6%, a rate exceeding birthrate and sufficient to lead to a small gain in living standards. The fastest economic growth was experienced in China particularly, and Asia in general, but the short-lived financial crisis in Mexico, and to a lesser extent in Argentina, slowed growth in Latin America.

Exchange-rate instability early in 1995 had an initial negative impact, starting with the collapse of the Mexican peso and leading to the outflow of much-needed capital funds from many LDCs. Mexico accepted the terms imposed by the USA as a condition for receiving an aid package of $20 billion. The IMF and the Swiss-based Bank for International Settlements agreed to disburse additional substantial contributions to stabilise the Mexican peso and to prevent the country from defaulting on its debt. During the year, as economic growth in the MDCs slowed, central bankers in North America, Japan and Germany allowed short-term interest rates to fall.

In contrast to the relaxation in monetary policy, many governments of the MDCs continued with tough policies to reduce their budget deficits with the aim of attaining properly balanced budgets. Thus, 1995 was another year of tight public spending and tax reforms. In the European Union (EU), economic measures to reduce the public-sector deficit to 3% of gross domestic product (GDP) by 1999 were implemented rigorously, in order to meet the convergence criterion stipulated in the Maastricht Treaty.

Urban and rural employment growth was disappointing. Although there was a reduction in the average unemployment rate in countries belonging to the Organisation for Economic Co-operation and Development (OECD), to 7.9% in 1995 from 8.1% in 1994, this meant that at least 33.6 million people were seeking work in the OECD countries.

There were three factors which favoured the maintenance of high unemployment and instability in employment in North America and Europe. Firstly, competitive pressures arising from an opening up of international markets depressed wages and profitability. Secondly, in the modern economy and polity, inflation is deemed to be worse than unemployment. The unemployed can be viewed as a stabilising force against those wage demands which force up prices for goods and services. Thirdly, the modern welfare state has within its structure, features that are adverse to employment. The employer is faced with substantial direct and indirect non-productive costs in addition to wages. These costs can be lessened by not employing more staff, resorting to overtime, taking on temporary workers, deploying new labour-saving technologies, contracting out or demanning.

Inflationary pressures remained subdued in nearly all countries. With the exception of Turkey and Mexico, average inflation in OECD countries was about 2.5% in 1995 compared with 2.7% the year before. The median inflation rate in the LDCs declined from 11.5% in 1994 to 8% in 1995.

The rationale of controlling inflation is straightforward: low and stable inflation encourages investment and R&D, and should stimulate growth. There was debate in 1995 as to whether reducing already low inflation impedes economic activity creating, in turn, lacklustre growth prospects.

World trade remained upbeat during 1995, expanding to 8%, close to the rate of 1994. This strength was mainly due to increasing trade between the MDCs and recovery of trade in several of the former communist countries in Europe. With the exception of Africa, the IMF expected the debt burdens of the LDCs to remain manageable. Even though the overall debt level of the LDCs rose gently in absolute terms, it declined as a proportion of exported goods and services.

While the economic decline of the former centrally planned economies persisted for the fifth consecutive year, the rate of decline fell sharply to 2%, and was uneven across the region. Those economies that were most advanced in their structural reforms to embrace global trade, conventional payment systems and privatisation, *viz.* the Czech Republic, Hungary, Poland, Slovakia, Slovenia and Albania, produced impressive trade performances and growth rates in the 4-6% range. Where reforms were less advanced, as in the Transcaucasus and Central Asia, inflation was high and economic decline evident. In an attempt to help

the Ukraine bring about economic reform, Russia rescheduled 50% of the $4.4 billion it was owed. In its three years of independence, Ukraine accumulated $7 billion of foreign debts and could no longer operate most of its factories following the termination of gas supplies from Turkmenistan for non-payment of bills.

By the end of 1995, 10 Central and Eastern European countries (CEECs) had signed association agreements with the EU. These were Bulgaria, Estonia, the Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. More than half of their trade was with the EU, but early accession to the union was not expected, given the potential impact on EU industries if the market place was opened completely. With regard to agriculture, the EU Common Agricultural Policy is unlikely to be dismantled rapidly and the massive dependency of the CEEC work force on agriculture would pose insuperable difficulties for both parties.

The European Parliament, the legislative branch of the EU, approved a customs pact with Turkey. By adopting many of the regulations governing trade within the EU, Turkey would be allowed to participate in the EU market as an outsider.

For the EU, 1995 was a year of introspection, growing cynicism and internal debate over future development. The year began with the formal accession of Austria, Finland and Sweden, bringing the number of EU states to 15. By the end of the year there were disagreements over the velocity and direction of EU development. The declared objective of full monetary union and a single currency by 1999, highlighted the difficulties facing a majority of members in fulfilling the economic conditions necessary for participating in the single currency, as stated in a protocol to the 1992 Maastricht Treaty on European Union. There was broad agreement on a technical strategy to introduce the single currency, the Euro, in stages after January 1999. Prior to a 1996 special conference to review the Maastricht Treaty which laid down the shape of the EU's decision-making institutions and processes, a "reflection group" was set up to seek consensus and prepare for the intergovernmental conference. The UK Government steadfastly resisted moves to closer political union, including qualified majority voting for almost all areas of policy including foreign and defence policies, immigration, justice, and police cooperation, and also resisted an enhanced law-making rôle for the EU Council of Ministers and the directly elected European Parliament. In addition to preparations for the forthcoming intergovernmental conference, the attention of the EU was concentrated on the war in Bosnia and Herzegovina, high unemployment and the declining competitiveness of many of the EU national economies.

At the end of the year, the four-year civil war in Bosnia and Herzegovina officially came to an end when the presidents of Bosnia and Herzegovina, Croatia and Serbia signed a peace agreement, triggering the deployment of 60,000 North Atlantic Treaty Organisation troops to maintain peace.

Acting on behalf of Spain, the EU settled a bitter six-week fishing dispute with Canada over fishing rights in international waters off Newfoundland. Both sides agreed to observe in future, the quotas assigned to each country by the Northwest Atlantic Fisheries Organization.

Chile and Bolivia approved plans to seek membership of the Southern Core Common Market (Mercosur), joining Argentina, Brazil, Paraguay and Uruguay in a trade organisation that largely eliminated tariffs from goods traded within the market.

Representatives of the 18 economic powers that comprised the Asia-Pacific Economic Co-operation (APEC) organisation, met in Japan to sign a declaration outlining general principles for achieving free trade among themselves by the year 2000. The APEC framework document, drafted by Japan, contained no sanctions because participation was voluntary and each state was allowed to work out its own policies for attaining APEC's ultimate goals. MDCs were to strive to reach these goals by the year 2010. An important development at the meeting was the agreement by China to cut its import tariffs so that it could join the World Trade Organization (WTO). To the disappointment of Australia and the USA, there was little progress otherwise on more liberalisation in agricultural products. The East Asian countries of China, Japan, South Korea and Taiwan voted to move cautiously and protect their domestic markets. Together, the members of APEC represented more than one third of the world's population, and accounted for more than 50% of the world's economic production and 40% of world trade. The two most affluent members of APEC were Japan and the USA.

In 1995, Commonwealth membership rose to 53 countries with the admittance of Cameroon, and most interestingly Mozambique, the former Portugese

colony with no formal historic connection with the old British Empire. Nigeria had its membership suspended because of its abuse of human rights.

The World Trade Organisation (WTO) became effective in January 1995 after the protracted six-year Uruguay Round of negotiations by the member states of the General Agreement on Tariffs and Trade (GATT). In essence, the WTO was established to oversee the fair implementation of agreed rules governing international trade. In view of the fact that most countries, and trading blocs such as the EU, had erected complex market-distorting barriers to external trade in agricultural and horticultural produce - mainly to protect farmers, rural economic infrastructure and to safeguard food security - the overall result has been to foster an inefficient, uncompetitive global agricultural system. In contrast, manufactured goods have been exposed to greater competitive pressures. Wars, conflicts, market collapses, unemployment and unfair trade practices in an unstable world, however, can rapidly alter perceptions of market protection mechanisms.

At this juncture, a set of five principles has been applied to international agricultural trade: (i) sanitary and phytosanitary regulations to be based on science rather than prejudice or unjustified discriminatory treatment; (ii) non-tariff barriers to trade to be converted to equivalent tariffs, with all tariffs to be reduced by at least 36% over six years; (iii) export subsidies to be cut by at least 36% and the volume of subsidised exports to be reduced by at least 21% over six years; (iv) all member nations must allow entry of duty-free agricultural imports of at least 3-5% of domestic consumption; and (v) all subsidies to domestic producers of traded products would be reduced by at least 20% over six years.

Populations

Estimates prepared by the Population Reference Bureau indicated that by mid-1995, the world's population was 5,702 million, representing an increase of 88 million over 1994. The annual rate of population increase declined to about 1.54% in 1995 from 1.6% in 1994, a result of birthrate declines in both LDCs and MDCs. If the 1995 growth rate were sustained, the world's population would double within 45 years. More than 85% of the population growth in MDCs occurred in the USA. In 1995, 32% of the world's population was below the age of 15, but the figure was 38% in LDCs outside China. Only 5% of the population in LDCs was over the age of 65 compared with 13% in MDCs. Urbanisation trends continued, with 43% of the total population living in urban areas; in LDCs 35% of their population was classified as urban compared with 74% in MDCs. The share of world population growth occurring in LDCs increased to 98% in 1995, and child-bearing females of LDCs were averaging about 3.5 children each during their lifetimes, a figure slightly more than double that of MDCs.

Africa's population stood at 720 million and the growth rate was the fastest in the world; Latin America grew to 481 million and Asia to 3.5 billion. Europe recorded its first negative rate of natural increase in modern history, -0.1%, largely the result of steeply declining birth rates in the European republics of the former Soviet Union. Italy had the lowest total fertility rate (average number of children produced by a woman in her lifetime assuming that the rate of childbearing in a given year remains constant) of 1.21 compared with world's highest of 6.2 in sub-Sahara Africa.

Against a background of governments throughout the world attempting to reduce the numbers of arrivals of illegal immigrants and asylum-seekers, the worldwide refugee population decreased to approximately 14.5 million by early 1995. Nonetheless, the total number of persons of concern to the office of the United Nations High Commissioner for Refugees (UNHCR) had risen to 27.4 million, a figure excluding 2.8 million Palestinian refugees living under the mandate of the UN Relief and Works Agency for Palestine Refugees in the Near East, and also omitting the estimated 26 million other displaced persons. In April, thousands of Hutu in the Kibeho refugee camp in southwestern Rwanda were slaughtered.

Officials in Guinea reported in January 1995 that more than 30,000 refugees had entered their country from neighbouring Sierra Leone. According to the UN World Food Programme, nearly one fifth of the population of Sierra Leone's 4.6 million population had been forced to flee their homes. Early in 1995, there was a feeling of optimism that the civil strife in Angola was coming to an end, as the UN Security Council voted to dispatch 7000 peace-keeping troops to the area. The conflict there has claimed about 500,000 lives since Angola won independence from Portugal in 1975.

Food-Aid

A study of the food-aid needs of more than 60 LDCs by the Economic Research Service of the USDA, indicated that economically poor countries would need

about 14 million tonnes of food-aid during the 1995-1996 marketing year, an increase of 12% from the previous year. FAO independently estimated that globally more than 36 million people faced severe food shortages, with 23 million of these people living in sub-Saharan Africa. Throughout the world, in both urban and rural areas, many more faced the insecurity of chronically scarce and uncertain food supplies. With the obvious exceptions of war-torn Bosnia and Herzegovina, and some countries of the former Soviet Union, the bulk of food-aid needs were in parts of Africa, southern Asia and parts of Latin America.

Food emergencies in Africa included the aftermath of severe drought in southern Africa; Mozambique, Zambia and Zimbabwe experienced the greatest needs. Civil strife hampered access to food-aid in Mozambique and Angola too. Grotesque conflicts in Rwanda and Burundi generated food-aid emergencies which extended to the refugee camps in neighbouring Zaire and Tanzania. As a result of civil war, large numbers of the populations of Sierra Leone and Liberia required aid, as did over one million people in the Sudan. Poverty, coupled to limited potential to produce adequate food supplies, again caused chronic food shortages in Ethiopia.

Elsewhere, Afghanistan and Bangladesh were the main recipients of the food-aid directed towards Asia, although floods in North Korea were thought to herald severe shortages of food in that country. Food shortages were reported in Central Asia and Transcaucasia, essentially as a result of poor harvests, unrest and disruption of the normal channels for distribution. Food-aid was also required in Armenia, Azerbaijan, Georgia, Kyrgyzstan, and the troubled Russian republic of Chechnya. Chronic food shortages persisted in Bolivia, Guatemala, Honduras and Peru. As always, Haiti suffered widespread poverty and poor crop production.

The UN Food and Agriculture Organization (FAO) Food Outlook report for 1995 estimates that during 1995-1996, the total shipment of food-aid in the form of cereals was 7.6 million metric tons (mmt, or million tonnes), declining from 8.4 mmt in 1994 - 1995, and from 12.6 mmt in 1993 - 1994. Much of the decline during this period was attributable to reduced releases from the USA. Further analysis shows that not all food-aid shipments were directed to the countries most in need: 10% less food-aid in 1994-1995 was received by the officially classified low-income (average annual income below $1345 in 1993), food-deficit countries. To solve poverty is to solve the problem of feeding people.

Agriculture and food supplies

In the Bulletin of Statistics of the FAO, total agricultural production and food production were static in 1995, whereas *per capita* food production declined slightly.

Grains In December 1995, the US Department of Agriculture (USDA) predicted that the world supply of grain at the end of the 1995-1996 marketing year (i.e. the year-end or carry-over grain stocks) would fall from 297 mmt to about 229 mmt in 1994-1995, a fall of 23% and down 37% from 1992-1993. The term 'grain' encompasses wheat, rice, and coarse grains such as maize, barley, sorghum and oats. Worryingly, the present year-end stocks represent just 13.1% of annual world consumption, down from 16.9% in 1994-1995, and as such is a record low and a percentage less than that available during the world grain crisis of the early 1970s, when international politics were more confrontational and the global economy was much weaker than now. Estimates by the FAO indicate that grain production worldwide would need to increase by at least 4% to ensure a minimal level of food security in 1996. Although grain prices increased sharply during the trading year, world grain consumption declined from 1761 mmt to 1747 mmt. Grain use in 1995 was calculated to be 305 kg per person per annum, representing a drop of 2.6% over the previous year and a decline of 8% from the peak in 1986. The decline in grain use reflected the drop in grain production concomitant with a rise in population. Moreover, meat production was more efficient and there were effects of economic restructuring in the former Soviet Union leading to a 10% decline there in demand for meat, milk products and human food based on cereals. Nearly 40% of world grain is fed to livestock (cattle, pigs, poultry, sheep, horses and goats), and over a period of nine years when the quantity of grain fed to livestock had not increased, meat production increased by 22%. This increased efficiency most probably reveals the impacts of improved breeds and management systems, as well as a pronounced transfer from cattle production to poultry and pigs.

China shifted from being a major grain exporter in recent years to being a major importer. Rapid economic growth of 8-9% in 1994 on the back of 50% growth over the previous four years led to increasing personal income despite an annual population growth of 14 million. China and drought-stricken Morocco

were expected to increase markedly their grain imports. In Japan, there was declining livestock production and consequently grain imports were down, but meat imports increased.

Wheat production increased from 522 mmt in 1994-1995 to 533 mmt, coarse grains declined from 863 mmt to 787 mmt, and rice also declined marginally from 361 mmt to 359 mmt.

Oilseeds In November 1995, the USDA Foreign Agricultural Service estimated that global oilseed production declined from the record crop of 259.4 mmt in the trading year 1994-1995 to 253.2 mmt in 1995-1996. Most of the decline was accounted for by the pronounced reduction in soybean production down from 136.7 mmt in 1994-1995 to 124.5 mmt over the same period in 1995-1996. Groundnut production also decreased from 26.4 mmt to 25.5 mmt, and copra 5 mmt to 4.8 mmt, contrasting with rapeseed which continued the long-term increase in production to 33.6 mmt over the year. Sunflower seed production also increased, from 23.7 mmt to 25.4 mmt, as did cottonseed, up from 32.9 mmt to 34.6 mmt. Palm kernal production increased marginally, 4.6 mmt to 4.8 mmt. As a consequence of lower production but higher consumption, year-end stocks of oilseeds were forecast to decline by about 20% from the previous year.

Livestock, Meat and Dairy World meat production expanded more rapidly than population growth in 1995, especially in the LDCs where FAO estimated that meat consumption per person would be 4% higher than in 1994. Nevertheless, contractions in meat consumption also occurred in much of Africa and in the Middle East as well as in the former republics of the Soviet Union. Australia began to rebuild sheep numbers following the devastating effects of prolonged drought and continued to switch from grass-fed to grain-fed cattle. Early in 1995, the Australian Cotton Foundation announced that the nation's cotton industry would suspend the use of chlorfluazuron (CFZ) until further notice, following the banned importation of Australian beef in 1994 by the USA and Japan after learning that some cattle had been fed cotton meal contaminated with CFZ. According to both the FAO and the USDA Foreign Agricultural Service, milk production (fresh weight) continued to decline slowly in the MDCs, down from 345 mmt in 1994 to 342 mmt in 1995 but slight rises were noted in North America and Oceania. An increase from 180 mmt in the previous year to 184 mmt in 1995 was recorded in the LDCs. As a result of enhanced demand by importing nations, world prices of dairy products such as cheese, butter and non-fat dry milk generally increased.

Sugar Forecasts by the USDA Foreign Agricultural Service point to a new record of 118 mmt world centrifugal sugar production in the crop year 1995-1996, and although total consumption rose to 116.6 mmt from 114.5 mmt in the previous crop year, production was expected to exceed consumption for the second successive year. Accordingly, rebuilding of world stocks took place from the record low levels at the beginning of the 1994-1995 crop year. Analysis of the data reveals that most of the growth in consumption took place in Asia, the Middle East and Latin America. Consumption was static in the MDCs as a result of the trend towards the use of alternative sweeteners such as high-fructose maize syrup and low-calorie sweeteners.

Coffee A decline in total world production of green coffee was projected by the USDA Foreign Agricultural Service following poor weather conditions in Brazil. Total production was estimated to be 88.2 million 60-kg bags, down from the outturn of 96 million 60-kg bags in 1994.

Cocoa For the 1995-1996 crop year, world cocoa bean production was expected to increase from 2.49 mmt in the previous year to 2.6 mmt, a new record. Both Côte d'Ivoire and Ghana registered record harvests in 1994-1995 as trees reached peak performance in good growing conditions and under improved management. As the world's major source of cocoa in 1994-1995, Côte d'Ivoire was forecast to produce another record-harvest. Brazil and Malaysia forecast declines in production.

Cotton A rise in world cotton production from 85.5 million 480lb bales in 1994-1995 to 89.3 million 480-lb bales in 1995-1996 was projected in November 1995 by the USDA Foreign Agricultural Service. Flooding, heavy rain, pests and diseases (most notably whitefly-transmitted cotton leafcurl geminivirus) caused a disaster for cotton growers in Pakistan. Falls in production also occurred in southern Africa, particularly Tanzania and Zimbabwe. Cotton growing was revitalised in Peru and Uzbekistan, the latter receiving a World Bank credit to this end. As projected consumption of 86 million 480-lb bales (circa 19 mmt) was less than production, year-end stocks probably accumulated.

Rubber The International Rubber Agreement, a pact sponsored by the UN to stabilise the prices of natural rubber and to encourage continued cultivation, was renegotiated during 1995 but was not ratified. Neither producers nor suppliers could agree on the efficacy of the Agreement.

Tobacco Notwithstanding adverse publicity in most MDCs, world manufacture and consumption of tobacco products were not unduly influenced in 1995. World production of raw tobacco declined from the 1994 figure to a level of 6.4 mmt because of large year-end stocks. Milder tobacco brands expanded at the expense of the darker, pungent and more socially offensive tobaccos. Significantly, in 1995, the US Food and Drug Administration (FDA) began the process of classifying nicotine as an addictive drug, eventually permitting the FDA to assert justification over the sale of tobacco products and providing a legal fulcrum for afflicted smokers.

Wood, Paper and Pulp

Analysis of prices reveals that the global wood supply was under pressure in 1995. Producers harvested smaller and younger trees than hitherto, and products based on wood residues were to the fore. Lumber mills in the western USA were forced to close by environmental restrictions, reducing the total number by 9% to 383. US, European and especially the Asian markets focused on South America and Russia for forestry resources. Brazilian softwood log exports attained 780,000 cubic metres in 1995, and Chilean forestry exports were anticipated to grow by 50%. Data on exports from Russia were lacking.

Whilst the International Standards Organization was engaged in developing international certification criteria for timber and products from sustainable forests, numerous certification initiatives such as "eco-labelling" were launched by organisations and individual companies in the USA and EU. Without the spur of legislation, it was unclear as to whether consumers would pay more for certified wood products. Related to this theme were developments in the regulation of international trade in forest products. Bilateral disagreements between the USA and Canada over Canadian exports of softwood lumber were resolved during the year. Membership of the EU enabled Finland and Sweden, the largest exporters of wood products in Europe, to bring expertise and to have voting rights in deciding future policies on the trade in wood and wood products within the EU countries. These Nordic countries would also assist in formulating policies to meet northern-temperate zonal needs in general within Europe.

The wood-panel industry increased production and capacity, predicated to some extent on demands from the furniture industry in Asia. Natural disasters, such as the Kobe and Sakhalin Island earthquakes in 1995, were expected to raise demands for prefabricated dwellings using structural laminated timbers and products which are resilient to earthquake damage.

At this juncture, it would appear that all sectors of the world marketplace in paper and pulp, from newsprint to recycled fibre, witnessed price increases in 1995. In 1994, the last year for which complete data were available, world pulp, paper and board production increased by 6.7% over 1993 values to 268.5 mmt, much of the increase taking place in Asia. Pulp production rose by 5.4% to 171.5 mmt in 1994 but the share of pulp employed in papermaking declined somewhat. The trend towards the use of recycled fibre in de-inked pulp was constrained by a shortfall in supplies. By far the biggest impediment to expansion of the pulping and cellulose industries was the shortage of cheap high-quality wood fibre, forcing the industries to examine low-fibre and "tree-free" paper and alternative fibre crops.

Food processing and retailing

Investments in food processing and retailing were attracted to the emerging markets of China, India, South Korea, Central and South America, and South Africa. In the MDCs, there was a slight fall in the sales of "low-fat" and "diet" foods, compensated by increases in the sales of vegetarian products and more traditional products including fatty foods. Perhaps as a result of relatively lax advertising laws in Japan, sales of so-called "health-promoting" functional foods prospered. Incidences of food poisoning increased regardless of the extensive nutritional and preparation instructions included on labels. Several of the major European food businesses expanded into global operators, and EU proposals to permit the use of vegetable fats to replace cocoa butter in chocolate manufacture prompted complaints from cocoa bean producer nations in Africa, South America, Indonesia and Malaysia.

Own-label or private-label products increased their market share globally, but the large international food-processing companies differed in their approach to the supply of own-label products to the major retailer chains.

New food products launches were fewer than in 1994. Various lactic fermented products were marketed explicitly as beneficial to human health; low-fat vegetarian products emerged at a slower rate than in recent years.

Use of the sweeteners acesulfame K, aspartame, cyclamate, neohesperidin DC, saccharin and thaumatin were permitted in the EU Sweeteners Directive effective from the end of 1995, but acceptable daily intake limits were prescribed.

Craft brewing of beers was a worldwide feature for both large and small brewing companies in 1995, but in the US and Europe the total production volume of beer was barely changed. For the distilled spirits industry, only the Asian market expanded rapidly, but in an attempt to overcome a staid image, marketing was directed towards the 20-35 year age group. New blended spirit products, especially those with fruit flavours and spices, came to market. A somewhat mixed year was reported for wine producers. Australian, Californian, New Zealand, South African and South American wines grew in stature in terms of export volumes and reputation, and the wine industry in some of the republics of the former Soviet Union made progress in adapting to export markets. In Europe, Italy experienced poor weather conditions for vine cultivation, and a dry hot summer followed by heavy rain troubled producers in France and Germany.

Fruit-juice and soft-drinks processing units expanded rapidly throughout 1995. Numerous new products coupled with intensive marketing campaigns were pronounced features of the soft-drinks industry. The market grew by about 2% over 1994 when North America accounted for 46% of soft drinks consumption, compared with 31% in Western Europe and 18% in Asia.

Environment

Floods and drought had enormous economic, social and environmental impacts in 1995. Flood management policies were under review in North America, northwestern Europe, Morocco, Egypt and North Korea. Sections of Belgium, France, Germany and the Netherlands were placed in a state of emergency following January floods. Drought lingered in the Caribbean, northern Mexico and northeastern USA. Large-scale dam-building projects in China and India were severely criticised on environmental and social grounds.

One trend of relevance to the life sciences was the introduction of new technologies for the mining industry to address environmental concerns. Bio-oxidation processes, bio-recovery and bio-remediation collectively represent key areas of high-priority scientific and industrial endeavour.

In September, the Intergovernmental Panel on Climate Change (IPCC) posted a draft of its report on the Internet (World Wide Web), which concluded that the observed increase in global mean temperature of 0.3°-0.6° C was unlikely to be solely due to natural causes. In fact, the threat of global warming dominated environmental concerns, validating the prescience of the SCRI report "Global Warming: The Implications for Agriculture and Priorities for Research", released in 1989.

Delegates from the 166 countries that signed the 1992 UN Framework Convention on Climate Change in Rio de Janerio held the so-called "Conference of the Parties" in Berlin in March 1995. From this meeting came the Berlin Mandate which acknowledged that the target agreed at the Rio Summit of returning carbon dioxide emissions to their 1990 levels in the MDCs by the year 2000 was inadequate and that further reductions post-2000 would be necessary. A permanent secretariat was to be established in Bonn together with a negotiating group representing the major power blocs. The IPCC would remain the principal advisory body.

Further discussions were held on the substances covered by the Basel Convention on international trade in hazardous wastes, deflecting attempts to prevent an extension of the numbers of banned substances. By September, the 89 signatory countries to the Convention agreed to an extension which forbids the 25 OECD members from transporting wastes to non-OECD members for recycling after 1997. During the year, the major lead-producing countries of Australia and Canada blocked an agreement in the OECD to reduce the amount of lead in the environment, encouraging instead a "voluntary action plan".

A downside to the reduction of industrial emissions of sulfur dioxide was reported in 1995. Sulfur depositions fell by 80% from the late 1970s to 1995. Vegetation across a swathe of Europe may be showing signs of sulfur deficiency, with crop diseases increasing and crop yields falling; oilseed rape and other brassicas were the worst affected.

The first comprehensive UN report on global biodiversity, released in November, estimated that there were about 15 million plant and animal species, of which only 1.75 million had been formally identified.

Environmentally-friendly, alternative energy systems suffered limited market demand and research funding in 1995. Crude conventional market analyses of production costs restricted any large-scale developments to remote locations where alternative energy sources had a competitive advantage. Current predictions point to some of these sources reaching competitive parity in 20 years with oil priced at $20 a barrel.

Soil erosion, encroachment on natural ecosystems, pollution, overfishing, loss of biodiversity, excessive demands on forests, modified atmospheric composition leading to climate change, fresh-water use exceeding the sustainable yield of aquifers and shared river systems, and the irresponsible wholesale ignorance of sustainability remained bleak symptoms of mankind's activities on the planet. Crop and food production were universally assumed to benefit from ongoing improved efficiency and yield, emphasising the urgency to maintain investments in research and development.

United Kingdom perspectives

In the United Kingdom, the pace of economic growth slowed in 1995 to an annual rate of 2.5%, down from 4% in 1994, under the impact of higher taxes and interest rates introduced in 1994, and combined with a slackening demand for exports by its major trading partners. This rapid slowdown in economic activity, coupled with subdued wage and price inflationary pressures, led to lower interest rates before the end of the year. The public-sector deficit for 1995-1996 was some £6 billion higher than the revised target of £23.5 billion, largely attributable to lower taxation revenues. A cautious, tax-cutting budget was announced in November, the reduction in taxation counterbalanced by reductions in public spending. During the year, the unemployment rate declined to 8.1% compared with an EU average of 11.4%.

The rate of return achieved by UK industrial and commercial companies (ICCs, both quoted and unquoted but excluding pharmaceutical companies) declined in 1995 to 9%, contrasting with 9.5% in 1994, according to the Office for National Statistics. To what extent future trends might be influenced by the incorporation of innovation in companies is not wholly clear. The 1996 UK R&D Scoreboard published by the Department of Trade and Industry, noted that R&D investment by companies in the UK rose by only 4.2% in 1995, compared with increases of 6% and 7.5% in the two previous years. Since sales increased by 9% and profits by 18% (i.e. there was a decline in R&D intensity) the results were disappointing, especially in a year when public-sector R&D funding declined. The pharmaceutical industry accounted for nearly one third of the R&D undertaken in the UK.

The R&D intensity of companies based in the UK was less than half that of companies in competing countries, with the exception of Italy and Norway. Of the sectors relevant to SCRI (alcoholic beverages; breweries; chemicals; diversified industrials; extractive industries; food manufacturers; health care; paper, packaging and printing; pharmaceuticals; food retailers; textiles and apparel; tobacco, and water) there were certain companies that performed at or close to the top of the world R&D league.

In May, a government-appointed committee chaired by Lord Nolan published its first reports on the standards of conduct in public life. The Nolan Committee is expected to have profound effects on individuals and organisations that utilise public funds.

Unlike other members of the EU, farming prosperity in the UK improved markedly in 1995, for the fourth successive year, and overall profits attained levels akin to those in the early 1980s. Support payments, however, were around £3000 million as a result of CAP reform and the devaluation of sterling. The arable sector thrived and there was a sharp upturn in the fortune of horticulture, an area of activity in the UK barely affected by CAP inputs. Investment levels increased as a safeguard against short-term fluctuations in interest rates and land prices rose by around 25% in the year.

In production terms, the agricultural and horticultural output of the UK reflects the constraints of land area and climate. Comparisons of production with Europe and the rest of the world (Ministry of Agriculture, Fisheries and Food Internet site http://www.open.gov.uk/maff/stats/) reveal that the UK arable and horticultural sectors were a small pro-

portion of European production. A valuation of £6,798 million was given to the major UK arable and horticultural crops at 1995 prices. On the other hand, the industry was highly efficient. For wheat, barley, potatoes, cabbage, onions, carrots and tomatoes, for example, the crop yield on a kg per ha basis was considerably greater than the average for the rest of Europe or the world.

According to the Forestry Commission, only 10% of the UK land area (2.45 million ha) is forested, but is expanding at a rate of 20,000 ha per year. In 1994, production of wood and wood products was 7.6 million m^3 of which 3.5 million m^3 was softwood sawlogs, 0.3 million m^3 hardwood and 3.1 million m^3 particle board, fibreboard and paper board, levels that met just 15% of UK demand.

As a share of the UK economy in 1995, agriculture and horticulture constituted *circa* 1.5% of the Gross Domestic Product (GDP), approximately £9 billion, and forestry only 0.05%. These figures belied the importance of successful value-adding industries with larger GDP valuations, downstream and upstream, and were based on current market valuations of primary production. Perturbations to the supply and low costs of primary produce would have dramatic effects on these secondary industries and commerce in general.

Evaluation of the non-monetary costs and benefits of agriculture, horticulture and forestry is fraught with difficulty. Perceived and real beneficial effects include such aspects as sustainability (e.g. carbon sinks, atmospheric cleansing, waste disposal, recycling of nutrients); hydrological benefits; creation and preservation of landscapes, habitats, ecological refugia and dispersal corridors; and provision of recreational facilities. Perceived and real detrimental effects include the reduction of biodiversity, excessive use of water for irrigation, alteration of rural lifestyles with the onset of modern farming methodology, pollution, adverse impacts on animal dignity and welfare in highly intensive systems, amended landscapes and restrictions on access to the countryside.

Agriculture, horticulture and forestry represent the major UK land use industries and are a bastion against unfettered urbanisation. There are also huge regional variations in their relative roles in the local economy. Increasing efficiency of production inexorably leads to declining employment and hence political influence as alternative forms of rural employment take hold. To this scenario must be added the pressures of cheaper imported supplies, competition with other forms of land use, and calls for reduction in the costs of the CAP. Realisation has dawned that R&D, access to intellectual property and innovation are the routes by which these primary industries can thrive in open world markets, meeting consumer preferences and avoiding degeneration to peasant industries competing solely on the grounds of cheap labour costs.

In future Reports I shall analyse the biotechnology industry and SCRI's involvement in this rapidly expanding area of wealth creation and intellectual challenge.

UK food plants

The current range of home-grown and imported plants consumed in the UK is large (Table 1), although most are of minor importance and diets can be depressingly narrow. Advancements in modern retailing arrangements and marketing efforts, aided by changes in lifestyle and a massive increase in professional catering, all raise demands and expectations in the quality and type of food rather than quantity. Even though there are residual historical, ethnic, social and economic factors that favour specific diets, growing health awareness and hedonism have become incompatible with restricted, narrow supplies and regional seasonality of produce. Blemish-free and safe produce, meat and milk products are universal expectations of processors, retailers and consumers alike, and dominated by the perceptions of urban dwellers.

Economists recognise that neither import substitution nor a trade deficit justify unfettered agricultural and horticultural production in the present- day international trading environment, even if the land resource and labour were available. Economic justification is a prerequisite.

Plant breeders and geneticists, physiologists, biotechnologists, pathologists, agronomists and engineers, using advanced mathematics, chemistry and physics are providing new, improved, low-input cultivars with extended growing seasons, as well as better cultivation, protection, harvesting and storage technologies. This R&D combines fundamental, strategic and applied research approaches, usually within a single project. Natural tolerance or resistance to biotic and abiotic stress whilst sustaining quality, yield performance and efficiency of production are foremost in the minds of major institutions such as SCRI, but to the intellectual challenges are added products for the rapidly expanding biotechnology, food processing and environment industries. We aim to deliver (for the UK) plants, products, processes and concepts that meet

dietary, health, environmental and wealth-creating needs and to play a key role in rural prosperity.

Scotland's climate and latitude have both advantages and disadvantages for agriculture, horticulture and forestry. There are relatively few pests and diseases and "green-bridging", the overwintering of pests and diseases is rarer than in most competing countries. Scottish plant material is typically of high-health status. The long summer daylengths favour a productive, albeit short, growing season. Growing habitats are diverse, with wide temperature ranges and varying degrees of exposure to wind and salt. Excellent grass production on the wetter areas enables livestock production to function with inputs often lower than elsewhere. By and large, supplies of fresh water are plentiful. Transport costs to the major markets are a problem, however. Production units in Scotland differ enormously in their size, sophistication of opera-

1. *Poaceae (Gramineae)*

The cereals	- barley, oat, rice, rye, wheat
Coarse grains	- maize, sorghum
Forage grasses	
Sugar cane	

Grass fruits (caryopses or grain) are the largest single source of carbohydrate on earth.

2. *Leguminosae*

Forage legumes	
The pulses	- adzuki, blackgram, broadbean, chickpea, cowpea, haricot, horsegram, jack, kidney, lablab, lentils, lima, mat, mung, pea, pigeonpea, soya, string- and snapbean, sword, vetches, yambean

Proteinaceous, sometimes contain toxins, allergens or haemagglutinins. Also produce oils.

3. *Solanaceae*

Aubergine	**Potato**
Capsicum	**Tomato**

4. *Cruciferae*

Broccoli	**Kohl-rabi**
Brussels sprout	**Mustard and Cress**
Cabbage	**Oilseed rape**
Cauliflower	**Radish**
Chard	**Swede**
Chinese leaves	**Turnip**
Kale	

Proteins, oils and carbohydrates. The most important group of green vegetables.

5. *Chenopodiaceae*

Beet	- fodder, garden, spinach, sugar
Mangold	
Spinach	
Swiss chard	

6. *Liliaceae*

Chives	**Onion**
Garlic	**Onion** - Egyptian, spring, Welsh
Leek	**Rakkyo**

7. *Rosaceae*

Soft fruit	- blackberry, currant (black/red/white), gooseberry, hybrid berries, raspberry, strawberry
Stone fruit	- almond, apricot, cherry, damson, greengage, nectarine, peach, plum
Top fruit	- apple, medlar, pear, quince

8. *Cucurbitaceae*

Courgette/Zucchini	**Melon**
Cucumber	**Melon (water)**
Gourd	**Pumpkin**
Marrow	**Squash**

9. *Umbelliferae*

Carrot	**Parsley**
Celeriac	**Parsnip**
Celery	

10. Major imported families

Anacardiaceae	- mango, cashew
Araceae	- cocoyams, dasheen, yautia, taro
Bromeliaceae	- pineapple
Convolvulaceae	- sweetpotato
Euphorbiaceae	- cassava
Musaceae	- banana, plantain
Palmae	- date palm, sago palm, oil palm, betel nut
Rubiaceae	- coffee
Rutaceae	- citron, grapefruit, lemon, lime, orange, pummelo, tangerine
Sterculiaceae	- cocoa, cola
Theaceae	- tea

11. Miscellaneous horticultural plants

Artichoke	**Macadamia**
Avocado	**Mulberry**
Blueberry & cranberry	**Okra**
Breadfruit	**Papaya**
Chestnut	**Passionfruit**
Endive	**Pecan**
Fig	**Pistachio**
Grape	**Pomegranate**
Guava	**Rhubarb**
Hazelnut	**Tamarind**
Lettuce	**Walnut**

Also includes flavourings, fumatories, herbs and spices and masticatories.

Table 1 Range of food plants consumed in the UK.

tion, levels of investment, profitability and relationships with customers. Our R&D, regulatory, advisory and educational base is impressive - there are five Scottish Agricultural and Biological Research Institutes (SABRIs; Scottish Crop Research Institute, Hannah Research Institute, Macaulay Land Use Research Institute, Moredun Research Institute, Rowett Research Institute), the Scottish Agricultural College, and the Scottish Agricultural Science Agency. All these bodies are members of the Committee of Heads of Agricultural and Biological Organisations in Scotland, which also includes the Fisheries Research Service, Forestry Commission and the Royal Botanic Garden, Edinburgh, and have long histories of achievement in the international arena (see also the SCRI 1994 Annual Report).

Man is the only animal to cook food, a process which widens the range of species consumed. Compared with fresh plant food, cooking modifies the appearance, taste and texture, frequently removing anti-nutritional, toxic and other components, and affecting cell integrity. Vitamins and micronutrients may be lost, too, but more cellular material is made accessible to gut secretions. Only in recent times has attention been given to antioxidants and free-radical scavengers in the diet, to dietary fibre, to personal bioremediation possibilities by dietary intake, and to the psychology of food choice. A future challenge is the problem of processing sewage resulting from the modern diet and medication.

My 1994 report detailed two activites which were heralded in the landmark science White Paper *Realising our Potential: A Strategy for Science, Engineering and Technology* (Cm 2250, May 1993), namely the UK Technology Foresight Programme (TFP) and the Multi-Departmental Scrutiny of Public Sector Research Establishments (PSREs). Both activities took place in 1994 and 1995 and both involved SCRI.

Technology Foresight Programme

The UK TFP is defined as a systematic, ongoing process for assessing those scientific and technological developments which could have a strong impact on industrial competitiveness, wealth creation and quality of life over the next 10 to 20 years. The aims of the much-needed TFP are to form networks and recommend priority areas for research and development funding, and for related education and training. This information would be used by Government in determining policy, and by the Research Councils and others responsible for the allocation of research funds in the public and private sectors.

In April 1995, the Agriculture, Natural Resources and Environment (ANRE) Panel of the TFP (which I chaired), published a report along with 14 other panels that together covered all the major UK industrial and service sectors. Summaries of the Panel Report and the overarching report from the TFP Steering Report are presented in my 1994 Report of the Director. The ANRE Panel recommendations called for investment in research in key areas, better coordination of research and its integration into specific technologies, and for more investment into public perception and understanding of new technologies.

Agriculture, Horticulture & Forestry	John Hillman	SCRI & MRS Ltd
Chemicals	John Beacham	ICI
Construction	Herb Nahapiet	UK Detention Services Ltd
Defence & Aerospace	Tony Edwards	Messier-Dowty Int.
Energy	Gordon MacKerron	University of Sussex
Financial Services	Michael Hughes	Barclays de Zoete Wedd
Food & Drink	Peter Lillford	Unilever Research
Health & Life Sciences	Mark Ferguson	University of Manchester
IT, Electronics & Communications	John Taylor	Hewlett Packard Laboratories
Leisure & Learning	Peter Wallis	SRU Ltd
Manufacturing, Production & Business Processes	David Grant	GEC plc
Marine	David Goodrich	British Maritime Technology Ltd
Materials	John Campbell	Cookson Group plc
Natural Resources & Environment	Kerry Turner	University of East Anglia
Retail & Distribution	Graham Winfield	Booker-Tate Ltd
Transport	Stephen Gibbs	Docklands Light Railway

Table 2 List of Technology Foresight Panels, Phase 2, and their Chairmen.

Members

J R Hillman	Scottish Crop Research Institute
J Braunholtz	Horticultural Development Council
P Chisholm	The Wellcome Trust
J Evans	Forestry Commission
A B N Gill	National Farmers Union
G Harrington	Meat & Livestock Commission
R B Heap	Babraham Institute
T Hegarty	SOAEFD
B J Legg	Silsoe Research Institute
B J Miflin	Institute of Arable Crops Research
J MacArthur Clark	Consultant
P Maplestone	BBSRC
C H McMurray	Department of Agriculture for Northern Ireland
R Morrod	Zeneca Agrochemicals
J S Marsh	University of Reading
J F Oldfield	Farmer and HGCA
J Sherlock	MAFF
M Tricker	NERC
R Turner	British Society of Plant Breeders
J Vowles	Agricultural Engineers' Association
David Rawlins (Secretary)	Office of Science and Technology

Methods of working

- Sub-Groups-
  - Livestock Systems(J MacArthur Clark)
  - Forestry & Wood Products (J Evans)
  - Plant Systems (R Turner)
  - Foresight Challenge Awards Group (R B Heap)
- Short & medium-term projections
- Cross-Sector/Panel activities
- Dissemination of new report
- Visionary concepts
- Promoting & monitoring coordination of priority setting between research sponsors
- Providing inputs to EU programmes
- Directory of databases

Remit

- Dissemination of Panel findings and recommendations
- Development of networks, both regional and national
- Promote implementation of findings to Private Sector, Research Councils, Government Departments, Universities, Research Institutes
- Monitor progress
- Review recommendations

Lifespan

- Five years, but dynamic

Table 3 Agriculture, Horticulture & Forestry Sector Panel.

Also recommended was that in the subsequent phases of the TFP, consideration should be given to splitting the ANRE Panel into more focused panels, and this was done in the Summer of 1995, as phase two of the TFP was launched by the Office of Science and Technology (OST).

My responsibility is now for the Agriculture, Horticulture and Forestry (AHF) Sector Panel whose membership and activities are detailed in Table 3. Reports will flow from the new AHF Panel in 1996.

Prior Options

In its response to the Scrutiny Reports, the Government announced in 1995 a series of Prior Option reviews, each addressing the actual and potential relationship of the PSRE in question to others in similar or related areas of activity, with an eye to potential privatisation or rationalisation. Reviews would also take explicit account of the outcome of the UK TFP, and the requirements of customer Government Department. The findings of the reviews, which were to be conducted in three tranches in late 1995 and through 1996, would be considered by Ministers collectively to ensure that all cross-departmental aspects had been fully covered.

The Scottish Office established a single review team to cover SCRI, the Scottish Agricultural Science Agency (SASA, East Craigs), and the Macaulay Land Use Research Institute (MLURI), as three of 11 establishments in the Agriculture and Plant Science grouping - the first tranche. An Interdepartmental Steering Committee chaired by Professor Tom Blundell of the BBSRC was also established to co-ordinate all the reviews in this grouping, with a remit to report to Ministers by the end of March 1996.

Announcements of the reviews of SCRI, SASA and MLURI were made by the Secretary of State for Scotland on 23 November 1995. Comments were invited by 8 January 1996, and comments were also invited in a general notice which appeared in the December edition of 'Government Opportunities' (published on 24 November 1995). Several other bodies were consulted directly.

The review focused on five key questions and on the privatisation guidance issued by OST, Office of Public Service and the Treasury. The Key questions were: Is the function needed?; Must the public sector by responsible for funding the function?; Must the public sector provide the function itself?; What is the scope for rationalisation?; How will the function be managed?

The final outcome of the Prior Options exercise was expected to be announced towards the end of 1996.