Chapter 2. The World Food Context

Agricultural Advances and Persistent Food Poverty

2.1 Agriculture is the world's largest single industry. It employs 1.3 billion people, and produces $1.3 trillion worth of goods per year. Over the past 40 years, per capita world food production has grown by 25%, and food prices in real terms have fallen by 40%. Between the early 1960s and mid-1990s, average cereal yields grew from 1.2 t/ha to 2.52 t/ha in developing countries (1.71 t/ha on rainfed lands and 3.82 t/ha on irrigated lands), whilst total cereal production has grown from 420 to 1176 million tonnes per year (FAO, 2000).

2.2 The scale of modern food production has also been transformed during this period, particularly in industrialised countries, resulting in some cereal yields greater than 12 tonne/ha, and single feedlots with 100,000 head of cattle, or pigsheds housing 4000 sows at a time (Conway and Pretty, 1991; Heffernan, 1999; Smil, 2000).

2.3 Yet despite such advances in productivity, the world still faces a fundamental food security challenge. The world population exceeded 6 billion people in late-1999, and it is expected to grow to about 7.5 billion by 2020, and then to 8.9 billion by 2050 (UN, 1999; du Guerny, 2000)[2]. By this time, 84% of the world's population will be in those countries currently making up the `developing' world (Table 1).

2.4 These predictions are lower than those made a decade ago, as the marginal increase has fallen from a net annual increase of 100 million in 1990 to 77 million in 1999 (UN, 1999). Annual additions will still be 58 million by 2015.

Table 1. Population changes, 1995 to 2020

Location	Population in 1995	Population in 2020	Increase (%)	Share of total increase (%)
Africa	697	1187	70%	27%
Asia (not Japan)	3311	4421	34%	61%
China	1221	1454	19%	13%
India	934	1272	36%	18%
Latin America and Caribbean	480	665	39%	10%
Developing countries	4495	6285	40%	97.5%
Industrialised countries	1172	1257	4%	2.5%
World	5666	7502	32%	100%

Source: Pinstrup-Andersen et al, 1999; FAOSTAT, 2000

Note: World population was 3.08 billion in 1960; 3.69 billion in 1970; 4.44 billion in 1980; and 5.27 billion in 1990.

2.5 At the turn of the century, there were an estimated 790 million people hungry and

[2] The annual growth rate of world population was 2.1% in the late 1960s; had fallen to 1.3% during the late 1990s; and is projected by the UN (1999) to fall further to 1% by 2015, to 0.7% by 2030, and to just 0.3% by 2050.

lacking adequate access to food, of whom 31% were in East and South-East Asia, 31% and in South Asia, with 25% in Sub-Saharan Africa, 7.6% in Latin America and the Caribbean, and 5% in North Africa and Near East (Pinstrup-Andersen and Cohen, 1999). This 790 million represents 18% of the population of developing countries, and although it has remained high, a sign of progress is illustrated by the fact that incidence of under-nourishment stood at 960 million in 1970, comprising 37% of the population of developing countries at the time.

2.6 As a result of increases in agricultural productivity, average per capita consumption of food has increased by 17% in the past 30 years to 2760 kcal. This is over a period when world population grew from 3.69 to 6 billion. The greatest increases have been in developing countries - on average 28%, though starting from a considerably lower base than industrialised countries. Nonetheless, 33 countries still have per capita food consumption under 2200 kcal, most of which are in Sub-Saharan Africa (FAO, 2000).

2.7 Predictions suggest a combination of increased production and more imports will mean per capita consumption will increase to about 3000 kcal per day by 2015. However, food insecurity and malnutrition will still persist. Under current scenarios, net cereal imports will have to double to 192 million tonnes, and meat to increase by eight fold to 6.6 million tonnes. But by 2020, a developing country person will still only consume half of the cereal and a third of the meat compared with a person in an industrialised country (Pinstrup-Andersen et al, 1999). And by this time, there will still be more than 500 million people suffering from chronic under-nourishment (FAO, 2000).

2.8 It is important to note that there is also food poverty in industrialised countries (Lang et al, 1999; FAO, 2000). In the USA, both the largest producer of food in the world and the largest exporter, 11 million people are food insecure and hungry, and a further 23 million are food insecure but without hunger (hovering close to the edge of hunger). Of these, 4 million children are hungry, and another 9.6 million are hungry for at least one month each year. Some $25 billion is spent by federal and state organisations to provide extra food for these people (Eisinger, 1998).

2.9 It is a sad irony that some 14% of people in industrialised countries are obese, and that five of the ten leading causes of death in the USA are diet-related (coronary heart disease, some cancers, stroke, diabetes mellitus, and atherosclerosis) (Lang et al, 1999). According to the WHO (1998), it is also true that in some developing countries, the obese now outnumber the thin (eg in Brazil, Chile, Colombia, Costa Rica, Cuba, Mexico, Peru and Tunisia).

2.10 Another important issue for food consumption is where people will be living. During the period to 2020, the urban population in developing countries is expected to double to 3.4 billion, whilst the rural population will only grow by about 300 million to 3 billion. The numbers of urban people will, for the first time, have exceeded those in rural areas. Such a change has an important effect on food consumption: as rural people move to urban areas, and as urban people's

disposable incomes increase, so they tend to go through a nutritional shift - particularly from rice to wheat, and from coarse grains to wheat and rice. They also tend to eat more livestock products, processed foods, and fruit and vegetables.

2.11 This livestock consumption revolution will also have a significant effect on the world food system. Demand for meat is expected to double by 2020 in developing countries, resulting in a doubling of demand for cereals for feed (mostly from maize). Almost all the increase (85%) in food demand will occur in developing countries. However, this may still not make a significant impact on persistent hunger amongst the poor. Unfortunately, domestic cereal production in developing countries is not expected to keep pace with growing demand.

2.12 Farmers in developing countries will have to both i) increase food production in rural areas to feed existing hungry people; and ii) produce surpluses in rural areas to feed the greatly expanding numbers of urban people (Pinstrup-Andersen et al, 1999; FAO, 2000; NRC, 2000; Smil, 2000).

Growth and Shifts in Food Demand

2.13 Food demand will both grow and shift in the next two decades. There are three driving forces:

i) increasing numbers of people - as total population will continue to increase until at least the latter part of the 21st century, the absolute demand for food will also increase;

ii) increasing incomes mean people will have increasing purchasing power (even though many people will remain on no more than $1/day);

iii) increasing urbanisation - people will be more urbanised, and therefore more likely to adopt new diets, particularly consuming more meat.

2.14 It is predicted that these driving forces will result in a substantial increase in demand for cereals and meat products (Table 2). China is forecast to account for 25% of the global increase in demand for cereals and 40% of the increase in demand for livestock products. Even though the population of India is expected to catch and overtake that of China by 2035, their demand for cereal and meat products is predicted to be lower, mainly because economic growth is expected to be slower. But if the Indian economy does grow quickly, then there will be a consequent much greater increase in demand for food.

Table 2. Changes in demand for cereals and meat to 2020

Location	Increase in cereal demand, 1995 to 2020 (million tonnes)	Increase in total meat demand, 1995 to 2020 (million tonnes
World	690	115
Industrialised countries	110	18

Developing countries	580	97
of which		
China	172	47
India	87	5
Rest of Asia	98	15
Sub-Saharan and North Africa	143	12
Latin America	81	19

Source: IFPRI, 2000

Note: A focus on cereals and meat does not tell the whole story. There is a large consumption of vegetables and `secondary' staples, such as roots and tubers, often missed by these data

2.15 Food consumption disparities are expected to persist. Currently, annual demand in industrialised countries is 550kg cereal and 78kg meat per person. By contrast, in developing countries it is only 260kg cereal and 30 kg meat per person. These gaps in consumption are expected to remain.

2.16 This is partly because of the nutrition transition (Popkin, 1998), and the moulding of taste by global corporate interests (Lang et al, 1999). This generally implies both a transition from domestic `traditional' foods prepared from raw products to refined and industrially-processed foods (often including international exotics), and the replacement of domestic products by cheaper imports. In India, for example, 78 million tonnes of milk are produced annually, mostly by the 800,000 women dairy farmers who are members of some 60,000 dairy cooperatives. Milk sales have long helped sustain the livelihoods of small farmers. Yet in the second half of 1999, India imported 16,700 tonnes of milk and cream from the Netherlands, with the import price substantially lower than the cost of smallholders' production (Sharma, 2000).

The Livestock Consumption Revolution

2.17 One of the most important changes to the world food system will come from a large increase in demand for livestock products. This will arise again from changing incomes, growing urbanisation, and the nutrition transition (Popkin, 1998). Meat demand is expected to double by 2020 in developing countries to 190 million tonnes, and increase by 25% in industrialised countries to 122 million tonnes (Table 3). Worldwide the demand for poultry will grow by 85%, pigmeat by 45% and beef by 50% (Delgado et al, 1999).

2.18 This will help to drive a total and per capita increase in demand for cereals, with demand for rice growing at 1.23% per year to 2020, wheat by 1.58% per year, other grains by 2.1% per year, and maize by 2.4%. Some 64% of maize demand will be for livestock feed alone.

2.19 But it takes 7 kg of feed to produce 1 kg of feedlot beef, 4 kg to produce 1kg of pork, and 2 kg to produce 1 kg of poultry (Rosegrant et al, 1999). Pinstrup-Anderson et al (2000), therefore, predict that developing countries' net cereal imports will have to double to reach 192 million tonnes by 2020, including an increase in East Asia from 31 to 71 million tonnes per year, and in South Asia from 0.3 to 21 million tonnes.

Table 3. Predicted changes in demand for cereals for human and livestock feed (1995-2020)

Location	1995 (million tonnes)	2020 (million tonnes)
Developing countries		
Food	608	1013
Feed	212	445
Industrialised countries		
Food	160	170
Feed	420	490

Source: IFPRI (2000)

2.20 In the past, traditional livestock in developing countries have been efficient parts of mixed production systems, often consuming foods and by-products that would not be consumed by humans. But increasingly farmers are finding it easier and cheaper to feed animals with cheap cereals. Livestock fed a diet of grain and silage produce 1 MJ of meat for every 3 MJ of grain eaten. Once again, the central problem is this: as we eat more meat, so cereals are increasingly diverted for livestock feed, and those in food poverty do not benefit (cf White, 2000; Seidl, 2000).

Who Needs More Food the Most?

2.21 With these gloomy predictions about increasing numbers of people, growing demand for cereals and meat, and stubbornly persistent hunger and poverty, an important question relates to who needs an increase in food the most (Maxwell and Frankenberger, 1992; Hoddinott, 2000).

2.22 First, there remains a persistent yield gap between the top and bottom country performers. The yields for wheat and rice, for example, in the bottom decile of developing countries are less than one-fifth of the yields of the best performers in the top decile (Table 4). Were the data available, similar patterns are likely to be found within countries.

2.23 There is increasing agreement that more attention needs to be paid to maternal and child nutrition. Low birth weight is now known to be a key factor in child malnutrition and premature death. This is, in turn, caused by a mother's poor nutrition before conception and during pregnancy (ACC/SCN, 2000). Foetal under-nutrition is also a contributing factor in increasing incidence of chronic diseases in later life. Some 30 million infants are born each year in developing countries with impaired growth (6% of children in SE Asia and Latin America, and 11-15% in Sub-Saharan Africa).

2.24 In the year 2000, 27% of pre-school children (some 182 million) in developing countries had stunted growth (where height is less that two standard deviations for the age), with proportions rising to 50% in East and south central Asia. This number is expected to continue to fall overall in the coming years, but will rise in

Sub-Saharan Africa.

Table 4. Average wheat and rice yields for selected developing country groups growing more than 50,000 ha of the crop

	Average yields in developing countries (t/ha)	Yields of the top decile (t/ha)	Yields of the bottom decile (t/ha)
Wheat	2.13	4.83	0.85
Rice	3.06	6.43	1.12

Source: FAO (2000)

Note: Dowayri et al (1999) state that the theoretical maximum yields for both wheat and rice are approximately 20 t/ha. On experimental stations, yields of 17 t/ha have been reached in sub-tropical climates, and 10 t/ha in the tropics.

2.25 Stunting is more common, however, in school-age children in some locations. In four of ten countries recently surveyed (ACC/SCN, 2000), more than one third of children are stunted. This is due both to poor quantity and quality of food, with deficiencies of key vitamins and minerals affecting many people. For example, two billion people suffer from iron-deficiency anaemia, including 76% of pregnant women in SE Asia, 50% in Africa, 33% in the Americas, and 24% in Europe. Anaemia causes 65,000 maternal deaths per year in Asia. Severe Vitamin A deficiency affects 100-250 million children worldwide (Smith and Haddad, 1999; ACC/SCN, 2000).

2.26 The effect of dietary improvements can be dramatic, and nutritionists have long considered the positive effects of supplementing diets. The effect of the treating of Indonesian children with vitamin A tablets has been shown to reduce child mortality by 30% (Smith and Haddad, 1999). Other micronutrients, such as vitamins B, D folic acid and iron could be added to wheat flour; but rice is more difficult. It cannot easily be used as a fortification vehicle, and poor people often cannot get access to sufficient quality and quantity of foods rich in nutrients.

2.27 But these initiatives will not alone be enough. Smith and Haddad's (1999) review of child malnutrition since 1975 suggested that improved food availability is only one of four factors important in overcoming these problems. These were female education, family health improvements, and status improvements for women relative to men. Women are disadvantaged in agricultural systems. They produce up to 80% of food, but have access to less than 10% of credit and extension advice, and also own very little land. The UN 4th report on the world's nutrition put it this way:

> *"Investing in maternal and childhood nutrition will have both short- and long-term benefits of huge economic and social significance, including reduced health care costs throughout the life cycle, increased educability and intellectual capacity, and increased adult productivity. No economic analysis can fully capture the benefits of such sustained mental, physical and social development"* (ACC/SCN, 2000).

2.28 It is clear that adequate and appropriate food supply is a necessary condition for eliminating hunger and food-poverty. But increased food supply does not automatically mean increased food security for all. What is important is who produces the food, who has access to the technology and knowledge to produce it, and who has the purchasing power to acquire it. The conventional wisdom is that, in order to double food supply, we need to redouble efforts to modernise agriculture. After all, it has been successful in the past. But there are doubts about the capacity of such systems to produce the food where the poor and hungry people live. They need low-cost and readily-available technologies and practices to increase food production.

Key Questions for this Research

2.29 These growing food poverty and food security challenges pose several key questions:

i) How can we best meet the increasing demand for food and feed?

ii) Can ways be found to feed the existing undernourished and hungry people (some 790 million), who are partially or entirely excluded in the current world food system?

iii) What are the best agricultural development options for increasing food production to meet future increases in demand?

iv) Can food production be increased without further damage to natural resources?

2.30 There are three possible choices for agricultural development:

- expand the area of agriculture, by converting new lands to agriculture, but with losses in services from forests, grasslands and other areas of important biodiversity;

- increase per hectare production in agricultural exporting countries (mostly industrialised), so that food can be transferred or sold to those who need it;

- increase total farm productivity in developing countries which are most going to need the food.

2.31 In this research, we explore the options offered by a more sustainable agriculture, and draw some tentative conclusions about the value of alternative approaches to modern agricultural development. This is not to say that modern agriculture cannot successfully increase food production. Manifestly, any farmer or agricultural system with access to sufficient inputs, knowledge and skills, and so can produce large amounts of food. Most farmers in developing countries are not

in such a position.

2.32 The central questions, therefore, focus on i) the extent to which farmers can improve food production with cheap, low-cost, locally-available technologies and inputs, and ii) whether they can do this without causing further environmental damage.

2.33 The success of modern agriculture in recent decades has often masked significant externalities[3], affecting both natural capital and human health, as well as agriculture itself. Environmental and health problems associated with agriculture have been increasingly well-documented (cf Balfour, 1943; Carson, 1963; Conway and Pretty, 1991; EEA, 1996, 1998), but it is only recently that the scale of the costs has come to be appreciated.

2.34 There have been several recent studies on the external costs of modern agriculture in Germany, Netherlands, UK and the USA (Steiner et al, 1995; Pimentel et al, 1995; Evans, 1995; Waibel and Fleischer, 1998; Pretty et al, 2000). In the UK, these have recently been put at £2.34 billion per year, or roughly £208 per hectare of arable and grassland (Pretty et al, 2000).

2.35 In China, the 500,000 ha of wetlands that have been reclaimed for crop production since 1950 has meant the loss of flood water storage capacity of some 50 billion m^3 - a major reason for the $20 billion flood damage caused in 1998 (Cai et al, 1999; Norse et al, 2000). In many agricultural systems, over-intensive use of the land has resulted in sharp declines in soil organic matter and/or increases in soil erosion, some of which in turn threatens the viability of agriculture itself. In South Asia, for example, 25% of land is affected by water erosion, 18% by wind erosion, and 15% by salinisation and waterlogging (FAO, 2000).

2.36 Modern rice cultivation has proven to be costly. IRRI researchers investigated the health status of Filipino rice farmers exposed to pesticides, and found statistically significant increased eye, skin, lung and neurological disorders (Rola and Pingali, 1993; Pingali and Roger, 1995). The health costs of these pesticide problems were calculated, and compared the economics of various pest control strategies. The so-called `complete protection' strategy, with nine pesticide sprays per season, returned less per hectare than the other two control strategies, and cost the most in terms of ill-health. Any expected positive production benefits of applying pesticides were overwhelmed by the health costs.

Sustainable Agriculture

2.37 The aim of the SAFE-World research project was to audit recent worldwide

[3] An externality is any action that affects the welfare of or opportunities available to an individual or group without direct payment or compensation, and may be positive or negative. The types of externalities encountered in the agricultural sector have four features: i) their costs are often neglected; ii) they often occur with a time lag; iii) they often damage groups whose interests are not represented; iv) the identity of the producer of the externality is not always known (Pretty et al, 2000).

progress towards sustainable agriculture, and assess the extent to which such projects/initiatives, if spread on a much larger scale, could feed a growing world population that is already substantially food insecure.

2.38 There are three key conceptual bases for sustainable agriculture in this research project (see Chapter 1 and Annex A):

i) an assets-based understanding of both inputs needed for agriculture and the effect of agriculture in these assets - agricultural systems at all levels rely for their success on the value of services flowing from the total stock of natural, social, human, physical and financial capital;

ii) the many functions of agriculture - unlike other economic sectors, agriculture is inherently multifunctional. It jointly produces more than food, fibre or oil, having a profound positive and/or negative impact on aspects of local, national and global economies and ecosystems. A fundamental principle of sustainable systems is that they seek to maintain or accumulate natural, social and human capital assets, whilst unsustainable ones tends to deplete them;

iii) the nine types of improvements for progressing towards more sustainable agriculture. Transitions in agriculture are often conceived of as requiring sudden shifts in both practices and attitudes, but not all farmers are able or willing to take such a leap. However, all can take small steps, and small steps added together can bring about big transformations. Drawing on the assets-based model and on empirical evidence from the field, a typology of nine improvements has been developed to demonstrate where adjustments towards sustainability can be made.

2.39 A more sustainable farming seeks to make the best use of nature's goods and services whilst not damaging the environment (Altieri, 1995, 1999; Thrupp, 1996; Conway, 1997; Pretty, 1995, 1998, 2000; Drinkwater, 1998; Tilman, 1998; Hinchliffe et al, 1999; FiBL, 2000; Petersen et al, 2000; Zhu et al, 2000; Wolfe, 2000; Pretty and Hine, 2000). It does this by integrating natural and regenerative processes, such as nutrient cycling, nitrogen fixation, soil regeneration and natural enemies of pests, into food production processes. It also minimises the use of non-renewable inputs (pesticides and fertilizers) that damage the environment or harm the health of farmers and consumers. It makes better use of the knowledge and skills of farmers, so improving their self-reliance. And it seeks to make productive use of social capital - people's capacities to work together to solve common management problems, such as pest, watershed, irrigation, forest and credit management.

2.40 Sustainable agriculture technologies and practices must be locally-adapted. They emerge from new configurations of social capital (relations of trust embodied in new social organisations, and new horizontal and vertical partnerships between institutions) and human capital (leadership, ingenuity, management skills and knowledge, capacity to experiment and innovate). Agricultural systems with high

social and human capital are able to innovate in the face of uncertainty.

2.41 Sustainable agriculture jointly produces food and other goods for farm families and markets, and also contributes to a range of public goods, such as clean water, wildlife, carbon sequestration in soils, flood protection, landscape quality. It delivers many unique non-food functions that cannot be produced by other sectors (eg on-farm biodiversity, groundwater recharge, urban to rural migration, social cohesion).