

REPORT OF THE FAO EXPERT MEETING ON HOW TO FEED THE WORLD IN 2050

Rome, 24-26 June 2009

INTRODUCTION

In the first half of this century, global demand for food, feed and fibre is projected to increase by some 70 percent while, increasingly, crops may also be used for bioenergy and other industrial purposes. New and traditional demand for agricultural produce will thus put growing pressure on already scarce agricultural resources. And while agriculture will be forced to compete for land and water with sprawling urban settlements, it will also be required to serve on other major fronts: adapting to and contributing to the mitigation of climate change, helping preserve natural habitats, and maintaining biodiversity. At the same time, fewer people will be living in rural areas and even fewer will be farmers. They will need new technologies to grow more from less land, with fewer hands.

This scenario raises a number of important questions. For instance, will we be able to produce enough food at affordable prices or will rising food prices drive more of the world's population into poverty and hunger? How much spare capacity in terms of land and water do we have to feed the world in 2050? What are the new technologies that can help us use scarce resources more efficiently, increase and stabilize crop and livestock yields?

Are we investing enough in research and development for breakthroughs to be available in time? Will new technologies be available to the people who will need them most - the poor? How much do we need to invest in order to help agriculture adapt to climate change, and how much can agriculture contribute to mitigating increasing greenhouse gas emissions?

Finally, do we have the right policies to help ensure that the world's future needs are met? Are the governments of the low-income countries adequate to enable their poor and hungry improve their livelihoods and feed themselves? Are trade policies and ODA international cooperation sufficient and properly focused to feed the world better over the coming decades? What are priority areas for policy action and where are the present and future hot-spots where policy action is needed most urgently? What can be done to ensure food security in sub-Saharan Africa, the continent facing the highest population growth rates, the severest impacts from climate change and the heaviest burden of HIV/AIDS?

To consider these and associated questions, FAO convened a three-day meeting of Experts in Rome under the Chairmanship of Hartwig de Haen, former Assistant Director-General with responsibility for the Economic and Social Development Department. 17 papers were commissioned from a broad range of experts and were presented by the authors. A further three presentations were made without supporting papers. Rich discussion followed each presentation.

The meeting was opened by Hafez Ghanem, current Assistant Director-General of the Economic and social development department. It was organized in six sessions matching the structure proposed for the High-Level Expert Forum to be held in Rome on 12-13 October 2009. These are:

1. Global agriculture towards 2050: the outlook for food and agriculture in a dynamically changing economic and demographic environment.
2. Feeding the world in 2050 (1): available resources (land, water, genetics), limits and challenges from climate change and new demands (bioenergy).
3. Feeding the world in 2050 (2): the technological challenge.
4. Feeding the world in 2050 (3): investment needs, sources and the need for a new financial architecture in agriculture.
5. Feeding the world in 2050 (4): the policy challenge – investment, trade, support and more.
6. Feeding the world in 2050 (5): special session on Africa.

The technical papers prepared for the Experts Meeting have been posted on the website at <http://www.fao.org/wsfs/forum2050/wsfs-forum/en/> and will be published as a Proceedings document in due course. A synthesis document will be prepared as a basic background document for the High-Level Experts Forum in October.

A list of participants is attached as Annex 1

The agenda is attached as Annex 2

MAIN MESSAGES AND POLICY PRIORITIES

A key message emerging from the discussions was that it should be possible to produce enough food in 2050 at a global level to feed a world population that has increased to more than nine billion. But this assumed certain conditions are met, and recognized that there are considerable uncertainties, including those related to the impact of climate change and the demand for biofuels on global food supply.

The key condition for meeting the production target participants identified was that there should be increased investment to sustain productivity growth: investment in R&D, technology, infrastructure and institutions, and also in environmental services and sustainable resource management.

The meeting agreed that it was essential not simply to focus on supply issues, but also on the demand side, and the question of access of the world's poor and hungry to the food they need to live active and healthy lives. Furthermore, it would be dangerous to focus exclusively on the aggregate and ignore regional disparities.

Participants agreed that there was a need to improve countries' ability to adapt and respond to new pressures and uncertainties: there was a likelihood of more frequent commodity price spikes in the years ahead, increased volatility in commodity markets, and increased incidence of extreme weather incidents linked to climate change. International trade would be particularly important with several regions forecast to remain in food deficit in 2050.

The policy priorities that emerged from the discussions were:

- increase investment in agriculture;
 - research and development, infrastructure and institutions;
 - also in up- and downstream sectors of primary agriculture, and in complementary sectors such as education and health;
- improve access to food;
 - promote equitable growth in incomes (both farm and non-farm);
 - improve risk management at household and national levels;
 - put in place safety nets for vulnerable groups;
- ensure well-functioning national markets and institutions as well as promoting international trade liberalisation;
 - improve farmers' access to input and output markets while facilitating the transition out of agriculture for those who leave the sector;
 - support the development of value chains benefiting smallholders
 - reduce subsidies for biofuels;
 - reduce trade barriers and
 - improve regulatory frameworks for new technologies, including GMOs;
- improve natural resource management;
 - best practices, sustainability guidelines, payments for environmental services;
- build political will to address challenges that transcend the traditional decision-making horizons of producers, consumers and policy-makers.

THE DISCUSSIONS

Session 1: Global agriculture to 2050: how will the world's food and agriculture sector develop in a dynamically changing economic and resource environment?

Presentations:

1. Macroeconomic environment, commodity markets: a longer term outlook. Dominique van der Mensbrugge, Israel Osorio-Rodarte, Andrew Burns, John Baffes, The World Bank.
2. Poverty, growth and inequality over the next 50 year. Evan Hillebrand, University of Kentucky, USA.
3. Agrimonde: scenarios and challenges for feeding the world in 2050. Bruno Dorin, Patrick Caron, Bernard Hubert, CIRAD/INRA.

1. The opening paper noted that the recent commodity boom was the longest and broadest of the post World War II period. Although most prices have declined sharply since their mid-2008 peak, they are still considerably higher than in 2003, when the boom began. Apart from strong and sustained economic growth, the recent boom was fuelled by numerous other factors, including low past investment in extractive commodities, a weak dollar, fiscal expansion in many countries, and possibly investment fund activity. In addition, the diversion of some food commodities to the production of biofuels, adverse weather conditions, global stock declines to historical lows and government policies, including export bans and prohibitive taxes, accelerated the price increases that eventually led to the 2008 rally.

Discussing the macroeconomic environment, the paper noted that over the next 50 years, population expansion would slow down considerably, with an increase of some 50 percent over 2000, but coming off a high base, this still represents a rise of three billion people. There was expected to be nearly no increase in the high-income countries, compared to a 120 percent increase in the least developed countries, many of which have already been having significant difficulty in feeding their growing populations for both natural and man-made reasons.

At the same time, high-income countries have both stable populations and food demand and robust agriculture. This combination could lead to increased reliance of the least developed countries on food imports, with other regions lying somewhere in between – some with surpluses, such as many Latin American countries, and others with potentially growing deficits, as some in Asia. The bottom line is that global agricultural production has to increase at an average rate of 0.8 percent per annum simply to accommodate population growth, and in the least developed countries it would have to grow at an average rate of 1.8 percent over the 50-year period. The authors noted that over the last few decades, which saw a huge increase in world population and stagnant or falling agricultural prices, the growth of supplies was supported by sizeable improvements in agricultural productivity growth – but that this rapid growth has slowed somewhat recently.

On the question of climate change, the paper said that the net impact it was likely to have on agriculture was still being debated, at least at the global level. Some regions, notably the higher latitudes, could benefit from longer growing periods, largely offsetting the damage in regions of the lower latitudes. There was also some uncertainty regarding the impact of carbon fertilization.

Turning to biofuels, the authors noted that the trade-off between food and biofuel feedstock was quite limited in the case of cane-based ethanol. By contrast, ethanol based on grains has a direct effect on the prices of grains as well as of several important competing crops. The expansion of biodiesel has a strong and direct implication for vegetable oil prices and the feedstock and food demand are in direct competition. A large biodiesel expansion would push vegetable prices higher. Hence the expansion of biofuels based on grains and oilseeds is a potentially exacerbating factor for higher food prices and could compromise access to food for the poorest on the planet.

In conclusion the authors said that at a minimum the price spike of 2007/2008 shook global complacency as regards agriculture after an extended period of neglect. Experts were long aware about the fall in agricultural productivity growth and expenditures on research and development, but in a crowded field of international economic policy issues, the warning signs had so far been largely ignored.

Declining population growth and food saturation will temper food demand growth in the future, and there is sufficient land that will allow for some expansion, if managed appropriately and sustainably. It will require investment in infrastructure, which could be onerous, particularly in the poorer parts of the world. The ability to raise productivity is a concern, particularly in an environment with growing climate stress. It will require resources to enhance research and development as well as infrastructure and services, with an emphasis on regions where productivity lags far behind.

2. The starting point for Hillebrand's paper was the fact that global poverty has fallen dramatically over the last two centuries, and the fall has accelerated in recent decades, raising hopes that it could be eliminated within the next 50 years. He noted that if the non-OECD countries merely match the levels of economic growth achieved over the last 25 years, the global poverty ratio will fall from about 21 percent in 2005 to less than 12 percent in 2050, and the number of people living in absolute poverty will decline a further 250 million. If countries matched the levels of economic growth achieved during the height of the globalization boom of 2003-2007, absolute poverty would be wiped out far before then.

However Hillebrand also noted that progress over the last 25 years had not been uniform, and while dramatic improvement was recorded in China and several other large countries such as Indonesia, India, Pakistan, Brazil, Mexico and South Africa, Sub-Saharan Africa as whole saw a huge increase in the number of people living in absolute poverty and only a small decrease in the poverty ratio.

The paper examined two alternative scenarios for the next 40 years: the Market First scenario assumed rapid technological change in the OECD countries, a strong tendency toward convergence in the non-OECD countries based on globalization, pro-growth policies and institutional change. The Trend Growth scenario assumed less technological change, less globalization, and less improvement in economic policies in the slow-growth regions.

Under the Market First scenario, by 2050 the global poverty rate would have been reduced to only 2.5 percent. World food demand in this high-growth, medium-population-growth scenario increases by about 1.3 percent annually to 2050. World supply rises somewhat less because substantial improvements in technology and transportation infrastructure are assumed to cut crop losses sharply. Calories available per person rise everywhere and particularly so in Sub-Saharan Africa.

By contrast, under the Trend Growth scenario, most countries are assumed to continue on the same trajectory they have been on for the last 25 years. For some, notably China and India, this is a very good trajectory. But for Latin America, Africa and the Middle East, it is less so, and by 2050 the rate of extreme poverty in Sub-Saharan Africa is three times what it was estimated to be under the Market First scenario. The Trend Growth calculations assume that the regions that have been lagging do not transition onto a high growth path, which results in much higher poverty levels.

Hillebrand concluded by remarking that even more depressing scenarios had been considered, though not empirically explored, and he noted that resource constraints, if not met by technological solutions, would surely make the poverty estimates in the paper worse. A breakdown in the world market system, or even a gradual turning away from the system that has done so much to reduce global poverty over the last two centuries, would be disastrous.

3. The third paper of the opening session also looked at contrasting scenarios for feeding the world in 2050. The Agrimonde GO scenario focused on feeding the planet by making global economic growth a priority, while the Agrimonde 1 scenario looked at feeding the planet by preserving ecosystems.

Under Agrimonde GO, the world is preoccupied above all with the problem of employing and feeding a growing population. Huge investments in research and infrastructure, especially in developing countries, coupled with free trade, make it possible to meet steep increases in food demand. Economic growth is very intense, surpassing previous averages in several regions – mainly Sub-Saharan Africa and the former Soviet Union – owing to a combination of trade liberalization, extensive economic cooperation and the rapid diffusion of new technologies. In addition, investments in education and health are huge in all regions.

Under this scenario, the global availability of food calories per day and per capita, would increase by 818 calories between 2000 and 2050, with the steepest increases experienced in Asia, sub-Saharan Africa and Latin America.

Under the Agrimonde 1 scenario, global economic growth between 2000 and 2050 is driven by the growth of developing economies. Apart from the spread of ecological intensification practices, an infrastructure of regional planning and supply chains development has been put in place in these economies: transport, storage and industrial processing capacities, as well as services in health, education and training.

Owing to the upsurge of opportunities for wealth creation in rural areas, the rural exodus in developing countries has slowed down. Urbanization nevertheless continues and sometimes encroaches on the best agricultural lands. The acceleration of climate change at the beginning of the century has been a decisive incentive for technological change in agriculture. Ecological intensification technologies make it possible to minimize the environmental impact of agricultural practices, primarily on water, biodiversity and the soil.

Under this scenario, the Agrimonde authors predict that by 2050 diets in the various regions of the world will have converged as regards calorie intake, with a mean availability of about 3,000 kcal per person per day.

Session 2 - The resource base to 2050: will there be enough land, water and genetic potential to meet future food and biofuel demands?

Presentations

4. World food and agriculture to 1030/3050. Highlights and views from mid-2009. Nikos Alexandratos.
5. World agriculture in a dynamically changing environment: IFPRI's long-term outlook for food and agriculture under additional demand and constraints. Siwa Msangi and Mark Rosegrant, IFPRI.
6. The resource outlook to 2050. By how much do land, water use and crop yields need to increase by 2050? Jelle Bruinsma.
7. How do climate change and bioenergy alter the long-term outlook for food, agriculture and resource availability. Gunther Fischer, IIASA.

4. The first paper in the second session examined the possible evolution of world food and agriculture to 2050 in terms of the key variables – production, consumption and trade of the main commodity groups and the implications for food and nutrition in the developing countries.

The starting point for the analysis was FAO's projections of food and agriculture to 2015, 2030 and 2050, with base year 1999-2001, and published in 2006. These projections did not include biofuels. They indicated that all major commodity sectors of world agriculture would grow in the future at lower rates than in the past. The slowdown reflected the lower population growth and the gradual attainment of medium-high levels of per capita consumption in a growing number of countries. The slowdown would contribute to easing the rate at which pressures are mounting on resources and the broader environment from the expansion and intensification of agriculture. However, getting from here to there still involved quantum jumps in the production of several commodities. Moreover the mounting pressure will be increasingly concentrated in countries with low food consumption levels, high population growth rates and often poor agricultural resource endowments. The result could well be enhanced risk of persistent food insecurity for a long time to come in a number of countries in the midst of a world with adequate food supplies and the potential to produce more. Indeed, the analysis of four years ago had indicated that the target of halving the numbers undernourished by 2015 was unlikely to be attained. This prospect was becoming even more likely in the light of developments in recent years when, according to recent FAO estimates, the process of decline in the numbers undernourished, slow and inadequate in itself, was actually reversed.

The author noted that the last few years have witnessed upheavals that must be taken into account in passing judgement as to how relevant the views of the future reflected in the projections of four years ago are today. In the first place, there has been the intrusion of the energy markets into those for agricultural produce via the links of the high energy prices and the boost this gave to the demand for crops as biofuel feedstocks, helped by government policies favouring such use of crops. It is now widely accepted that this was a key factor explaining the food price surges up to mid-2008. Secondly, the overall economic outlook is being severely affected by the ongoing economic crisis, though the issue of how important this may prove for the

longer term is moot. He used two criteria to run a reality check of the projections: (a) actual developments over the period 2000-2008, and (b) the latest medium term projections of the *OECD/FAO Agricultural Outlook 2009-2018*, both with and without biofuels. He concluded that on both criteria the projections without biofuels of four years ago for broad commodity and country group aggregates were still broadly valid.

The advent of biofuels represented a new element in the long term outlook and needed to be integrated into the standard projections of food and feed. The projected slowdown in the growth of world agriculture might be significantly mitigated or even reversed if the use of crop biomass for biofuels were to be further increased and consolidated. Existing biofuels projections for the medium term indicated that the demand from this source for food crops might be contained. However, much depended on developments in the energy markets. The assumption was often made that second generation biofuels would be coming on stream in about two decades. This might ease the food-biofuels competition but would not eliminate it, since biomass production for second generation biofuels would still compete for the common land and water resources.

If the biofuels sector were to expand significantly, the implications for agriculture, development and food security could be significant: it could give a boost to the development prospects of countries with abundant land and climate resources that are suitable for the feedstock crops. Several countries in Latin America, South-East Asia and sub-Saharan Africa, including some of the most needy and food-insecure ones, could benefit. Whether and to what extent this may happen is very uncertain, but the issue deserves serious analysis and evaluation. Of particular interest would be the possible adverse effects on the food security of the poor and the food-insecure if food prices were to rise because of resource diversion towards the production of feedstock crops for biofuels, and also the environmental implications of cultivated land expansion into pasturelands and forested areas.

5. The second paper, from IFPRI, explored the nature of several key drivers of change in food systems, and examined a number of possible entry points for policy interventions, in order to determine their effect on food prices and other market-driven outcomes. The authors said that the sharp increases in food prices that have occurred in global and national markets over the last several years have sharpened the awareness of policy-makers and agricultural economic analysts to the stresses facing the global food systems and the ecosystems that support them. The rapid increases in prices of key food commodities such as maize, wheat, rice and soybeans among others has mirrored the increase in prices of energy products and strengthen the recognition that energy and agricultural markets are becoming more closely linked.

The authors said that while many see the reversal of historically declining real prices of agricultural commodities as an opportunity for agricultural producers in both developed and developing countries, others remain concerned about the implications of high food prices and increased volatility in food markets on the welfare and well-being of vulnerable populations. IFPRI's projections indicated that world grain prices were likely to increase further by between 30 and 50 percent before 2050, and meat prices by an additional 20-30 percent beyond current high levels.

The paper said that the challenges and increased stresses that face global food production and distribution systems are particularly acute and pressing for sub-Saharan Africa, where high and persistent levels of food insecurity already exist, with roughly a third of the population having insufficient access to food and 43 percent living below the international poverty line. The constraints that lie in the way of Africa benefiting from higher producer prices of agricultural commodities on the world market are myriad, and include the fact that most of sub-Saharan Africa's agricultural production relies on rainfed cultivation and receives lower input levels of improved seed technology and fertilizer applications than other regions.

The paper said that the main socio-economic factors that drive increasing food demand are population increases, rising incomes and increasing urbanization. The combination of these latter two factors is also changing the nature of diets. Rapidly rising incomes in the developing world have led to an increase in demand for meat products, which in turn puts additional pressure on land resources for pasture and coarse grain markets for feed, including maize.

The authors stated that increases in population and income increase pressure on natural resources to meet domestic, agricultural and industrial demand. Climate change and increasing demand for water resources will impact growing conditions, significantly impacting food production in the future. Developing countries are likely to have a 9-21 percent decline in potential overall agricultural productivity due to global warming. Already yield growth rates for major grains have been declining in recent decades and have dropped by roughly 50 percent from the highs of the 1960s and 1970s. One of the causes of this decline was undoubtedly a fall the growth of public agricultural research and development spending, down by 51 percent in real terms in the two decades since the 1980s.

Turning to policy responses, the authors said that on the demand side, policies governing the use of food-based feedstocks for biofuel production could be altered to promote use of non-food feedstocks. On the supply side the urgent need was to boost cereals output by raising yields through policies that accelerate the improvement of crop technologies, including investing in irrigation systems.

The paper concluded by arguing that certain policies should be avoided when countries are faced with high food prices, in particular export bans, import subsidies and restoration of production subsidies. Instead policy-makers should focus on eliminating trade barriers, revitalising agricultural growth by expanding aid for rural infrastructure, services, research and technology, and ensuring safety nets are in place to shield the most vulnerable.

6. The Bruinsma paper focused on the additional demands on natural resources to meet the crop production levels in 2030 and 2050 projected by FAO in 2006. It concluded that growth in agricultural production will continue to slow down as a consequence of the slowdown in population growth and of the fact that an ever increasing share of world population is reaching medium to high levels of food consumption. Nevertheless, agricultural production would still need to increase by 70 percent overall and nearly 100 percent in developing countries by 2050 to meet the demand associated with a 40 percent increase in world population, in the process raising average food availability to 3,130 kcal per person per day. This translates into an additional billion tonnes of cereals and 200 million tonnes of meat to be produced annually by 2050.

The paper estimated that 90 percent of the growth in crop production would come from higher yields and increased cropping intensity, with the remainder coming from land expansion. Arable land would expand by some 70 million ha overall (less than 5 percent), with an expansion of 120 million ha in developing countries being offset by a decline of some 50 million ha in developed countries. Most of the expansion would take place in sub-Saharan Africa and Latin America.

Discussing the feasibility of the projected increases in land, water use and yields that are needed, the author noted that the Agro-Ecological Zone study shows that there are still ample land resources globally with some potential for crop production. The availability of fresh water resources shows a similar picture with supplies more than sufficient globally, but very unevenly distributed, with an increasing number of countries or regions within countries reaching alarming levels of water scarcity.

The potential to raise crop yields even with existing technology seemed to be considerable. Provided the appropriate socio-economic incentives are in place, there are still ample bridgeable gaps in yields, especially in developing countries.

Despite this potential, the paper concludes that all is not well. The fact that the world as a whole produces or could produce enough food for all is small consolation to the persons and countries (or regions within countries) that continue to suffer from undernourishment. The projected increases in yields, land and irrigation expansion will not come about solely as a result of market forces but will also require huge public intervention and investments, particularly in agricultural research and in preventing and mitigating environmental damage. In the problem countries, public intervention will continue to be required on the one hand to develop agriculture and to adapt agriculture to local circumstances, and on the other hand to establish social safety nets.

7. Gunther Fischer presented the main themes of IIASA's Biofuels and Food Security Study, which included a review of world-wide biofuels development and policy support; assessment of the agro-ecological potential of first and second generation biofuel feedstocks; scenarios of first and second generation targets to 2020 and 2030; and impacts of biofuel expansion on food prices, agricultural value added, land use, and greenhouse gas emissions.

Analysing the likely positive, neutral and negative effects of global environmental change of agro-ecosystems, Fischer noted that global warming was likely to remove cool temperature limitations in some areas, particularly in higher latitudes, allowing longer growing seasons and faster growing periods. However it was also likely to result in temperatures exceeding thresholds for some crops, increases in crop water requirements and increased incidence of plant pests and disease, particularly in tropical regions. Changes in the composition of the atmosphere could result in crop yield increases as a result of CO₂ fertilization and improvements in the efficiency of water use, but also increases in pollution. Further impacts could include changes in rainfall patterns, in soil moisture and surface runoff; increased occurrence of extreme weather events; and increased climate variability.

The study showed that the impacts of climate change on crop production are geographically very unevenly distributed, so that aggregate global figures reveal little. It predicted that autonomous adaptation, by shifting planting dates, changing cultivars, moist-conservation tillage, use of irrigation where economical, and switching crops, would offset some of the effects of gradual warming. The aggregate impacts of projected climate change on the global food system were thus relatively small, and the global balance of food demand and supply was not likely to be challenged until the middle of the century.

However the study also indicated that while atmospheric changes, and in particular CO₂ fertilization, may initially increase the productivity of current agricultural land in the temperate latitudes, climate change, if not halted, would have a clearly negative impact in the second half of this century. It noted that changes in the frequencies of extreme events such as droughts, heat waves or severe storms would be more troublesome in the short term than gradual changes in average condition. It warned however that the impact of climate change on increasing the demand for irrigation water could be as large as the changes predicted due to socio-economic developments in the period to 2080.

Summarizing the study and associated scenarios, Fischer said that the conclusion was that there would be strong increases in global demand for agriculture products – up about 70 percent in 2050 compared to 2000. There was expected to be increasing integration of agriculture, forestry and energy sectors through land competition for biomass production. There was limited availability of additional high quality land, and uncertainty regarding the viability of using marginal land. Finally there was growing risk of yield damage due to extreme weather episodes, and widespread negative climate change impacts could be expected after the middle of the century.

Session 3 – The investment challenge to 2050: how much, where to invest, what priorities and what sources?

Presentations:

8. Investment requirements under new demands on world agriculture: feeding the world with bioenergy and climate change. Siwa Msangi and Mark Rosegrant, IFPRI.
9. Capital requirements for developing countries' agriculture to 2050. Josef Schmidhuber, FAO.
10. Drivers of investment in large-scale farming: evidence and implications. Klaus Deininger, Derek Bylerlee. World Bank.
11. International investments in agricultural production in developing countries: win-win or neocolonialism. David Hallam, FAO

8. The Msangi-Rosegrant paper stated that the results of the authors' analysis revealed a significant level of investment needed for key regions such as sub-Saharan Africa and South Asia, which hold most of the world's poor and undernourished and which will be hard hit by climate change. The role of irrigation was particularly important for those regions, like Africa, which depend heavily on rainfed agricultural production, and the need for roads also becomes important as a means of increasing market access.

The paper warned that reduced investment in crop and energy technology over time could lead to a longer term slowdown in the expansion of supply, eventually leading to higher prices as demand begins to grow faster. It noted that agricultural research dedicated to improving the productivity of staple crops had declined over the years as the United States and other developed regions shifted their research focus to reflect consumer preferences for processed, organic and humane products. This had slowed the diffusion of more relevant yield enhancing technology on developing countries. Better technology diffusion⁰ and more public money dedicated to developing country research programmes were critical to meeting growing food needs.

The message for policy-makers was that a combination of policy interventions was needed, to accelerate yield growth, increase commitments towards Research and Development from both private and public sources, and improve extension services and marketing and distribution infrastructure.

9. Schmidhuber's paper analysed the capital requirements for agriculture in developing countries to 2050, and concluded that there was an average annual requirement of some USD 210 billion gross, and USD 83 billion net, excluding the depreciation and replacement costs, at constant 2009 dollars. This resulted cumulatively in a gross investment requirement over the next 44 years of nearly USD 9.2 trillion to deliver the production increases projected by FAO. The author noted that a striking feature of the outlook was that the annual net additions to the capital stock showed a noticeable decline over time, resulting in a slowdown in the annual net requirement. The analysis suggested that overall growth would be characterized by a growing substitution of labour with capital and moderate total factor productivity growth. There would be marked regional differences, however. In Latin America growth would be capital and productivity based, with negative labour contributions, while in Sub-Saharan Africa, it would be heavily labour and only moderately capital based, with limited efficiency gains.

The analysis of expected revenues, capital stocks and land available per labourer suggested that many people in sub-Saharan Africa would remain dependent on labour-intensive, capital-saving forms of small-scale agriculture, in which many farmers will have too few resources and revenues to share. The paper said that the available capital stock per worker was identified as an important explanatory variable for inter-regional differences in performance. A farmer in Latin America has on average 10 times more capital available than his counterpart in sub-Saharan Africa. Latin American farmers also enjoy better infrastructure, research institutions, roads and electricity.

The paper said the regional disparities and the outlook for Africa posed questions as to alternative income sources that might be tapped. Emerging options included opportunities arising from higher energy prices and production of bioenergy feedstocks; income opportunities from the provision of environmental services; and a greater export orientation.

10. Derek Byerlee gave a presentation of preliminary findings of a World Bank study looking at the drivers of international investment in large-scale corporate farming. There was no accompanying paper. The study had set out to discover what was really happening on the ground; whether the policy, legal and institutional environment was adequate; were these sound investments; and what social and environmental impact were they having. He said such investments involved opportunities and risks. On the positive side there was the prospect of using abundant land in remote regions, of developing exports, of moving into new industries such as biofuels, of generating employment and transferring technology. But the risks included lack of attention to existing land users, undermining governance, short-term interests and negative environmental impact.

The study's initial findings were that the trend to large investment in farms in developing countries was not new, and it took many forms. It appeared that there were more proposals than approved deals, and that many investments were speculative. Analysis had identified elements of a conducive policy framework for such investments that started from a clear definition of land rights and policies for transfer and joint ventures. There needed to be land available with potential for development, and clear process for the acquisition or transfer of public and private land with appropriate compensation. Investors needed transparency in the supply and approval procedure, and institutional roles needed to be clear and coordinated. And finally there needed to be sensible environmental and social safeguards.

For the future, Byerlee said the interest in land acquisition was likely to continue, with some governments very active and with deep pockets. Developing countries needed to develop the capacity to manage the process better, and there was considerable interest mainly from the investor side, in the development of a Code of Conduct.

11. David Hallam's paper also looked at the recent resurgence of interest in international investment in agricultural land. He noted that purchases and leasing of agricultural land in Africa by investors in various Gulf States for food production in support of their food security strategy had perhaps attracted most attention, but were in fact just one of a variety of actual or planned investment flows. The paper noted that complex and controversial issues – economic, political, institutional, legal and ethical – were raised in relation to food security, poverty reduction, rural development, technology and access to resources, especially land, in the country offering the land.

Hallam said that investor motivation varied, but included portfolio diversification and biofuel production as well as food security, reflecting a fear arising from the recent high food prices and policy-induced shocks that dependence on world markets for food supplies has become more risky. Investors seek enhanced food security for themselves by acquiring land and water resources in countries where they are more abundant. He noted that many investors sought to buy land, since titled ownership of assets was seen as most secure, but there were many arguments against this from the point of view of the host country. Acquisition of land does not necessarily provide immunity to sovereign risk, and can provoke political and economic conflict, the paper said. Other forms of investment such as contract farming and out-grower schemes can offer just as much security of supply.

Turning to the benefits of these investments, Hallam said the financial benefits to host countries might be small, but there was a potential for providing developmental benefits through technology transfer, employment creation, infrastructural provisions, production increases, and export earnings. But he warned that there were additional political and ethical concerns where the host country was food insecure. While there was a presumption that investments would increase aggregate food supplies, this did not imply that domestic food availability would increase, notably where food produced was repatriated to the investing country.

The paper said that if the general developmental benefits of international investments were to be realised, then appropriate policy, institutional and legislative frameworks needed to be in place to guarantee them. Apart from the financial terms and conditions, provisions may be needed covering local sourcing of inputs, including labour, social and environmental standards, property rights and stakeholder involvement, food security concerns, distribution of food produced between export and local markets, and distribution of revenues. Trade policy was also involved where investors wanted to repatriate food produced and some countries had offered trade policy exceptions such as agreements not to impose export controls even in times of domestic food crisis. The case for an international code of conduct which highlighted the need for transparency, stakeholder involvement and sustainability, and emphasised concerns for domestic food security and rural development, needed to be explored.

Session 4: The investment challenge and the technology challenge to 2050

Presentations:

12. Foreign Direct Investment and other forms of TNC participation in agricultural production: trends and implications. Hafiz Mirza and Anne Mirous, UNCTAD
13. Investment in developing countries' food and agriculture: assessing agricultural capital stocks and their impact on productivity. Gustavo Anriquez, FAO, Hartwig de Haen, Oleg Mivyeveskiy and Stephan von Cramon-Tauadel, University of Gottingen.
14. Can technology deliver on the yield challenge to 2050? R.A. Fischer, Derek Byerlee, G.O. Edmeades.
15. Setting meaningful investment targets in agricultural research and development: challenges, opportunities and fiscal realities. Nienke Beintema, Howard Elliott, IFPRI.

12. Hafiz Mirza presented UNCTAD analysis of the involvement of trans-national companies in investing in developing countries, demonstrating how companies are active at all points in the global value

chain, from input supply, seed propagation, production on the farm, basic processing, trading and logistics, processing and retailing. There was particular interest in making direct investment in land, either through outright ownership, the preferred option, or long-term leases. Generally it was the policy of the host country that determined the form of land tenure. But at the same time there was a discernible trend to short, medium and long-term contract farming arrangements.

UNCTAD's figures showed that while the trend of overall FDI to agriculture, forestry and fishing was fairly flat, there had been a significant increase in the food and beverage sector (including tobacco) in the last few years. The main products targeted by trans-nationals included corn, cotton, dairy products, floriculture and fruits, meat and oil crops, rice, soybeans, sugarcane, vegetables and wheat. Most of the investing companies were based in United States and Europe, but also some North African and Middle Eastern countries, China and South Africa.

13. Stephan Cramon and colleagues reported that the fixed capital stock (ACS) in primary agriculture has been growing at global level over the last three decades, although for most of this period at a declining rate. At the same time there seemed to be a shift in the relative share of capital formation between different regions and country groups. The paper clarified that the productive capacity of the food and agriculture sector entailed not only the physical assets at farm level, but also the working capital in the form of fertilizer, seeds and pesticides used in the production process, public rural infrastructure, capacities in science, technology and extension services, productive capacities in up and downstream sectors throughout the agricultural commodity chain, as well as human and social capital.

The paper noted that annual rates of growth in the stock of improved agricultural land have been declining at global level over the period. This could reflect, at least in part, a reduction in the willingness to invest in improving the productivity of the existing stock of land. The authors noted that ACS had grown the least in countries with the highest prevalence and depth of hunger. In several of the least developed countries, in particular in Sub-Saharan Africa and South Asia, the growth of the population active in agriculture had outstripped the rate of ACS growth. This development was particularly worrying because it severely limited these countries' ability to increase labour productivity in rural areas and hence to reduce poverty and undernourishment. By contrast, countries making the most progress towards reaching the World Food Summit target of halving the number of undernourished citizens by 2015 have realized relatively high rates of growth of ACS per worker in agriculture.

At the same time they found a direct correlation between government expenditure on agriculture and capital formation in a sample of developing countries. This correlation confirmed the decisive role of public expenditure in creating an enabling environment in terms of infrastructure and sustainable access to natural resources. Public expenditure on agriculture could be an important ingredient in an investment climate conducive to agricultural development and the reduction of hunger. This finding should be a strong signal for governments in developing countries to change priorities in budget allocations so as to avoid, or at least reduce, any existing discrimination towards agriculture

The authors remarked that a common feature of countries that had been successful in reducing hunger and poverty was that they not only had higher overall rates of economic growth than the less successful countries, but that they achieved this higher growth through a relatively higher growth in agriculture. Other features were an absence of conflict, good governance, functioning markets, public investment in rural infrastructure and a greater degree of integration in world markets than the less successful countries. Such success stories could be found in all regions.

14. Tony Fischer and colleagues started from the premise that given land and water scarcity, climate change and rising energy prices on the supply side, and growing markets for food, feed and fuel on the demand side, global grain markets will be tighter in the future than over the past 40 years. Given that area expansion will at best be small, agricultural growth will be more reliant than ever on raising crop and animal yields. However the growth rate of cereal yields has been falling since the Green Revolution years.

Changes in global yields were important for global food security. In a globalizing world, many countries will increasingly depend on trade to provision their food needs, which should encourage production in the lowest cost regions, barring significant trade barriers. However there are many situations where trade will be

inadequate to assure food supplies. India and China, for example, would have little choice but to produce most of their staple foods, especially rice, given relatively small world markets in relation to their huge domestic markets. In Africa too, poor infrastructure, landlocked location and lack of foreign exchange necessitated that much of the food be produced near where it is to be consumed. The high population growth in some of the more densely populated African countries places an additional urgency on accelerating domestic production.

The paper analyzed the gap between yields achieved in research stations and on the farm, in several crops and different regions. It concluded that despite impressive gains in yields over the past 50 years in most of the world, large and economically exploitable yield gaps remained in many places, especially in the developing world and nowhere more so than in sub-Saharan Africa where food supply is most precarious. The authors stated that in the short to medium terms there were many technologies that are in their early stage of adoption that promised a win-win combination of enhancing productivity and sustainably managing natural resources. These included conservation farming approaches based on no tillage and the GM technology revolution – both still only used on less than 10 percent of the world's cropland.

However yield gains could not be achieved by technology alone, but also required complementary changes in policies and institutions. Innovations were required in risk management, market development, rural finance, organizing farmers, and provision of advisory services. Overall the authors said they were optimistic of the world's ability to feed itself in 2050, but the history of agriculture in the 20th century teaches us that investment in R&D will be the most important determinant. Resilience, flexibility and policies that favour R&D investment in staple food research and efficient input use will be the pillars on which future food security depends.

15. Beintema and Elliott reported that global public spending on agricultural R&D, including government, non-profit and higher education sectors, totalled some USD 25 billion in 2005 dollars in 2000, the latest date for which comparable global data are available. This was a considerable increase on the USD 16 billion reported in 1981, but growth was not even across regions. Spending in the Asia-Pacific region more than doubled, while in contrast spending in sub-Saharan Africa only grew on average by 0.6 percent annually. More worrisome is that spending for sub-Saharan Africa as a whole actually contracted slightly during the 1990s, with more than half the countries for which data is available spending less in 2000 than they were in 1991.

The authors found that the government sector is still the largest contributor to public agricultural research, accounting on average for 81 percent of total funding, although in sub-Saharan Africa some 35 percent of funding was received from donor loans and grants. They noted that the Comprehensive Africa Agriculture Development Programme committed countries to double the current annual spending on agriculture research within 10 years, which would mean an average 10 percent annual increase – substantially higher than the average 1 percent seen in the 1990s.

The authors stated that in order to reverse the general under-investment, meet various political targets and prepare for emerging challenges in the coming decades, more investment was clearly needed. But they warned that this presumed that there was sufficient research capacity to address the targets, or the commitment to invest what is needed in developing that capacity. The rate at which research capacity can grow is linked to the strength of the higher education system, which itself requires retooling.

Regarding the focus of new investment in R&D, the paper said the options lie in areas where new knowledge, science and technology are needed to meet pre-stated goals of environmental sustainability, economically sustainable development, hunger and poverty reduction, and improving nutrition and human health. It noted that there were some areas where the challenges were likely to grow with climate change, population growth and increasing resource scarcity. It also urged greater involvement of women and called for policies that encourage the increased participation of women, not only to secure gender balance, but also to tap substantial additional human resources for agricultural R&D.

Session 5: Feeding the world in 2050: the global policy challenge**Presentations:**

16. Evolving structure of world agricultural trade and requirements for new world trade rules. Alexander Sarris, FAO
17. Farm support policies that minimize global distortionary effects. Aziz Elbehri and Alexander Sarris, FAO

16. Alexander Sarris said that the recent world food crisis of 2007-2008 had alerted the world and policy-makers to the fact that global agricultural productivity growth has been slowing down, and highlighted the fact that current national agricultural trade policies and the current world trade rules as agreed in the WTO Agreement on Agriculture, may not be adequate to prevent such crises in the future. At the same time, changes in climate may be the precursors of more potential food crises, with significant negative impacts on many poor across the world. This necessitated a reconsideration of the factors that drive long-term agricultural trade and the needs of future global agricultural trade rules.

The paper defined the causes of the recent food price spike as being growing world demand for basic food commodities; demand for cereals for biofuel production; the rise in petroleum prices; slowing rates of increase in farm productivity; the gradual decline in global food commodity stocks; commodity speculation, and macroeconomic factors such as US dollar depreciation. It also pointed to a tendency towards hoarding and panic buying and the imposition of policies affecting the normal flow of commodities.

The medium-term outlook for agricultural commodities is that while the growth rate of world demand would slow in the next 10 years, demand for income sensitive products will grow faster. Growth in food demand will be faster in developing countries for all types of products and supply is expected to keep up, with moderate increases in productivity. Nevertheless new demands especially for biofuels are likely to keep prices firm in the medium term. The overall conclusion is that global food commodity markets are likely to stay volatile in the next few years until stocks are replenished, petroleum prices stabilize and the global financial crisis works itself out.

Looking at the effects of price volatility, Sarris said that price instability can undermine the perceived legitimacy of the global market as a place in which countries can buy food supplies on a regular basis and make use of trade to supplement domestic production. The WTO rules were currently unbalanced in that they spring into action when prices are low but do little to constrain government action when prices rise. So export subsidies are constrained and tariffs are bound, but export taxes are not limited and export embargoes hardly mentioned. The ability of the world trade system to respond in times of price volatility is likely to be tested severely in the future, and some creative institutional arrangements may be needed.

In his conclusion Sarris noted that many developing countries and especially LDC countries in Africa, have become more food import dependent without becoming more productive in their own agricultural producing sectors, or without expanding other export sectors to be able to pay for that import dependency. This implies that they may have become more exposed to international market instability and hence more vulnerable. Given population growth patterns and income projections, the largest challenge in the coming decades seems to be to ensure a global trading system that balances the objective of an orderly and dependable market for food with the objective of growth of many currently developing and least developed countries.

Sarris took the opportunity of his presentation to discuss components of a possible International Grain Clearing Arrangement to guarantee the performance of medium and long-term grain contracts between countries or private entities, and also a proposal to ensure food imports in low income net grain importing countries through a dedicated Food Import Financing Facility.

17. Aziz Elbehri noted that in OECD countries, farm support policies stimulate domestic production, but also create distortions in world markets, inducing disincentives in developing countries' agricultural production in the long run. He noted that OECD farm policies were changing and perhaps reducing their degree of market distortion. At the same time developing countries were not affected uniformly by OECD policies as a result of differentiated selective trade preference between countries. A key challenge was how

to shape and design support to farmers in both developed and developing countries without hurting the farmers in the developing world and at the same time promoting global food security.

The paper discussed a range of policies which might be non-distorting. It noted that farm policies in developed countries have progressed towards decoupled payments, and said this should be further encouraged. It suggested that agricultural insurance in OECD countries should deal only with extreme and unpredictable agricultural risks that cause market failures. It urged decoupled policies to maintain agricultural production reserves in high income countries through policies such as set-aside, as an alternative to expensive physical commodity reserves.

In developing countries there should be promotion of public and private sector investment strategies with an emphasis on public goods type investments such as infrastructure and technology. There should also be a focus on the input side, developing the infrastructure for supply of inputs such as seed and fertilizer, and promoting input subsidies. Trade policies should be used selectively to support and complement domestic investment programmes. Risk reduction and risk coping policies in developing countries should be promoted and carbon offsets in developed countries should be used to promote carbon reducing but at the same time productivity enhancing agricultural technologies and investments in developing countries.

The paper said the largest trade distortions were created by market access restrictions imposed by OECD countries on agricultural imports and these restrictions should be lowered significantly, particularly as regards the least developed countries. Such restrictions, in the form of tariff barriers, standards, phytosanitary restrictions etc. significantly impacted developing country trade. The author also urged flexibility for developing countries and especially LDCs in the Doha Round, and suggested that OECD countries might offer compensatory financing for developing country producers, perhaps by putting a percentage of farm subsidies into a global development fund. The paper also urged the promotion of a Food Import Financing Facility to insure LIFDCs against sudden and adverse movements in the food import bills, and urged the promotion of a market-based and more automatic compensation scheme for negative agricultural earnings variations for commodity-dependent low income countries.

Session 6: Africa's special role, problems and needs: what development model for Africa?

Presentations:

18. Challenges and opportunities for African agriculture and food security. Hans P. Binswanger-Mkhize, Tschwane University.
19. Can the smallholder model deliver poverty reduction and food security for a rapidly growing population in Africa? Steve Wiggins, ODI.
20. African agriculture in 50 years: smallholders in a rapidly changing world? Paul Collier and Stefan Dercon, Oxford University.

18. Binswanger opened his paper and presentation with an upbeat assessment of future prospects for Africa, stating that after decades of decline of per capita food production, we are now in a period of new optimism about the prospects for Africa and African agriculture. Economic growth was near 4 percent, agricultural growth about 1 percent, armed conflicts were down and democracy had advanced significantly. The paper analyzed the causes of Africa's failure to grow as rapidly as the rest of the developing world in past decades, which had left a terrible legacy of poverty and hunger.

The paper said that the higher food prices of recent years meant African agriculture was likely to become more profitable. It noted that the resumption of overall economic growth and agricultural growth had not been caused by significant investments in infrastructure, any closing of the agriculture technology gap or the provision of better services to smallholders. Private input and output markets had not developed as fast as expected and farmers continued to be severely penalized by inadequate competition in these markets and by higher input prices and lower farm-gate prices than in other regions of the world. Binswanger also noted that growth had resumed despite continued high population growth, the AIDS crisis and the onset of measurable climate change. Indeed, he stated that higher world prices combined with rapid demand growth associated with population growth, urbanization and income growth opened the greatest opportunities for African farmers in domestic and regional markets

Examining the impact of climate change, the paper said that depending on whether carbon fertilization benefits materialized, the aggregate negative impact of climate change on potential African agricultural output up to the 2080-2100 period was estimated to be between 15 and 30 percent. Since the specific nature and severity of changes were not known, it was not possible to plan specific measures for mitigating the effects, instead what was required was a strengthening of the capacity of African agriculture and food systems to adapt to climate change, through improved technology generation and adoption systems, more and better irrigation and drainage, better markets and greater ability to import food in bad years or on a year-round basis, greater preparedness for extreme weather events and better safety nets.

Examining the demographic question, the paper said rapid population growth was not only a drag on growth, but also generated huge unemployment problems among youth. Agricultural development should be seen as an opportunity to generate much more employment for rural youth and thereby stem urbanization. But it added that while the demographic transition had barely begun in Sub-Saharan Africa, faster economic growth, high female education, and a resumption of family programmes could significantly accelerate it, thereby creating a population dividend for future economic and agricultural growth.

Binswanger concluded with a four point agenda for action: countries should avoid backsliding on economy-wide and agricultural policies and further reduce disprotection where still practiced; barriers to intra-regional trade in food and other agricultural commodities should be reduced and institutions supporting regional trade, quality and phytosanitary controls and other regional agricultural public goods and services should be properly financed; domestic and regional funding should be increased for agricultural science, science education and research; domestic markets should be assisted to deepen and sharp improvements in smallholder services should be fostered.

19. The Wiggins paper and presentation examined the debate about which agricultural model was most likely to secure agricultural growth in Sub-Saharan Africa – smallholders or commercial farming. Wiggins stated that the empirical record of performance of both small and large farms in Africa was uneven and incomplete, which made analysis difficult, and there were significant regional variations in performance. He noted that there was broad understanding that the combination of creating a favourable investment climate, spending on public goods, fostering of economic institutions, the presence of demand at the farm gate, and conservation of natural resources were necessary. He also noted that agricultural supply chains were changing, with ever more demanding conditions being imposed on would-be suppliers that could marginalise small farms.

Wiggins conceded that the disappointing record of African agricultural development in many but not all countries over the last 30 years or more years, not surprisingly invited doubts about the ability of the predominantly smallholder structure of farming across the continent to deliver agricultural development. The essential conditions for smallholder development included a favourable investment climate for farming, and the creation of a level playing field in which farmers could buy inputs, access finance and sell their produce on something like neutral terms in which they were not exorbitantly taxed by domestic policy, albeit implicitly, or having to compete with subsidized food imports, or exporting to markets where prices had been depressed by the policies of OECD countries.

A second key condition was investment in public goods that support agriculture, most notably agricultural research and extension, rural roads, education, health care and in some cases irrigation and power supplies. The third key condition was the development of economic institutions to allocate and protect property rights, to facilitate trading, to reduce risk and allow collective action. And, of course, there was a need for the existence of demand that was transmitted effectively to the farm gate.

Since not all small farmers would be able to participate in growth to the same degree, the options for policy-makers came down to the three Dorwood choices: Stepping up, Stepping out, or Hanging in. The uppermost quartile would be those stepping up, while those stepping out would need to be helped to move into the non-farm economy, while those hanging in would require safety net support. The final conclusion was that smallholder development could help deliver food security in Africa. More food availability was likely to tend to push down food prices, while increased incomes for the poor were likely to mean greater access to food. But this would not be sufficient. A substantial part of the problem of child malnutrition in areas such as West

Africa came from disease, not food supply. For better nutrition, the continent needed to do as much to ensure access to clean water, sanitation and primary health measures, as to grow more food.

20. In the final presentation, Paul Collier opened with an alternative vision of a successful Africa in fifty years time, characterized by a vast reduction in the number of people engaged in agriculture, a massive increase in the urban and coastal populations, a vast reduction in the size of the population living in rural areas relatively far from urban areas and the coasts, a considerable increase in labour productivity in agriculture, and a considerable increase in overall agricultural production. This contrasted with the current character of much of African agriculture: a vast and only slowly changing number of poor smallholders contributing most of agricultural output, with low yields, limited commercialization, few signs of rapid productivity growth, and population-land ratios that are not declining.

Collier noted that climate change strongly reinforced the need for African agriculture to adapt. If it was to be successful despite overall deteriorating agro-climatic conditions, new crops or varieties would need to be grown, often using different technologies. Furthermore the geographical distribution of agricultural activity would have to change. Collier asked whether the current model favoured by donors and most agricultural economists was likely to achieve the needed transformation. Its approach was to stimulate growth in smallholder agriculture by a variety of interventions from technology to market development. Collier and his co-author questioned this model, arguing that the perceived wisdom of the likely success of this strategy was based on weaker evidence than is commonly suggested. They believed that without considering more radical strategies, Africa's agricultural growth prospects might be weak. The alternative was not to return to the discredited 1950s and 1960s models of mechanized agriculture, but to consider more flexible organizational models in which not all bets were placed on a single unquestioned model of production.

The paper argued that much of the focus on smallholders might actually be hindering large-scale poverty reductions, and current policy ignored one key necessity for labour productivity growth: successful migration out of agriculture and rural areas. Collier identified three key areas where larger farms would benefit from economies of scale, which together suggested that the current model was flawed. These were skills and technology, finance and access to capital, and the organization and logistics of trading, marketing and storage. What was needed was a switch in the form of organization from informal and personalized to formal and institutionalized. The benefit of size was that it facilitated commercialization. The innovations of recent decades had made the rapid adoption of technology, access to finance, and high-speed logistics more important, and in the process given commercial agriculture a substantial advantage over the smallholder mode of production.

Collier argued that the reason there were few large commercial farms in Africa was not that they would be unable to compete with smallholdings, but primarily that commercial organizations can no longer gain access to land, and secondly that the business environment in Africa has in recent decades been more difficult than in competing locations that offered similar agronomic conditions. Difficulties in access to land and doing business have been due to cultural and political biases, rather than to an economic process. Collier said Governments were wary of the emergence of a large class of rural landless workers, and the Western NGOs were hostile to the entire notion of commercial agriculture. The belief of the authors was not that commercial agriculture would always prove to be superior to smallholder agriculture, but that if these impediments were lifted it would probably make a substantial contribution to African agricultural growth.

In conclusion the paper noted that in recent decades Brazilian agriculture had commercialized and become highly successful in global markets, propelled by intensive use of technology, finance and international logistics. Each of these elements were ill-suited to tiny, self-employed enterprises in which the head had no wealth other than land and little education. While there was a strong poverty-based case for trying to assist smallholder farmers, the agenda for African agricultural growth should surely be to introduce commercial agriculture on a competitive basis. The approach of consciously excluding commercial agriculture *a priori*, which has been pursued for the past four decades, had come at a cost. It would be better to let commercial agriculture compete in factor markets with smallholders, while cooperating with them in output markets.

CONCLUSIONS

Crisis-proofing the world food system

Following the formal presentations, the Chair invited participants to make proposals for concrete policy actions that could address the issues identified during the meeting and ensure that the world can indeed provide food security to all its citizens by the year 2050.

The Chair asked participants to focus on what needed to be done, who should do it, and how policy should differ from in the past. Following is a distillation of contributions.

1. Investment

All participants agreed on the need for significant new and increased investment to secure the needed agricultural development, and in particular growth in yields, in productivity and production. The established correlation between spending on Research and Development and yield growth meant that R&D was an important focus of investment, particularly in developing countries. The CGIAR system needed revitalising. There was also a need for investment in improving market access both upstream and downstream, in rural infrastructure, in extension services, in risk management and rural finance, and in institutions and capacity development. Countries need to create an investment climate that would attract the private sector to participate. There was general agreement on the need for a code of conduct to manage the trend towards large international investments in farming in developing countries.

2. Access

The question of access to food was as important as supply, so that simply producing enough food on aggregate was not a solution to feeding the world's expanded population in 2050. There were other ingredients to resolving problems of undernourishment such as clean water, sanitation and education, particularly of women. It was recognized that while this meeting had focused on supply-side issues and broad global developments, the gender dimension was critical to the issue of increasing agricultural production and productivity and improving access to food.

3. Trade

There was agreement that the world commodity trading scene was likely to remain volatile and that price spikes could become more frequent. There was a problem of loss of confidence in the market by some importers to be addressed. Proposals were made for a clearing house system and a financing mechanism for poor countries. There was agreement that trade liberalisation and completion of the Doha Round were vital, and that efforts should be made to reduce the distortionary effects of farm support policies in OECD countries. Participants supported the proposal for a link between farm support in the OECD and a fund to assist developing countries farmers. Many agreed that efforts should be made to dissuade countries from imposing export bans, perhaps by bringing such moves under the WTO rules.

4. Africa

While some participants debated the traditional smallholder model for African agricultural development, with proposals for removing barriers to larger commercial farming and improving opportunities for the poorest subsistence farmers outside agriculture as well as within it, others maintained that smallholders, if given the adequate conducive socio-economic environment, would still have an important role in Africa's future.

5. Climate Change, bioenergy and technology

The new challenges of climate change and the demand for bioenergy feedstock meant new solutions should be considered. Since the exact effect of climate change could not be known, the important thing was to enhance the capacity of countries to respond. There was agreement that the suite of tools needed to meet the challenge would include the use of GMOs. In developing countries the argument for using GMOs was that by increasing and stabilizing yields they could be life-saving, rather than simply cost-cutting, which was the driver in developed countries. There was a need to help developing countries put in place regulatory processes that would facilitate the roll-out of GM crops.

6. Institutions

Many participants called for an institutional revolution to ensure that farmers and others receive the support and incentives they need at all stages in the value chain. Historical fiscal discrimination against agriculture should be ended.

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FAO EXPERT MEETING ON HOW TO FEED THE WORLD IN 2050, 24-26 JUNE 2009, FAO HEADQUARTERS, ROME (MEXICO ROOM)**AGENDA****WEDNESDAY, 24 June 2009**

09.30 – 10.00	Welcome Address (Hafez Ghanem)
10.00 – 13.00	Session 1: Global agriculture to 2050: How will the world’s food and agriculture sector develop in a dynamically changing economic and resource environment?
	<ul style="list-style-type: none"> ▪ The macroeconomic environment, commodity markets: A longer term outlook. (Presenters: Dominique van der Mensbrugghe, John Baffes; World Bank) ▪ Poverty, growth and inequality over the next 50 years. (Presenter: Evan Hillebrand, University of Kentucky) ▪ Agrimonde: Scenarios and challenges for feeding the world in 2050 (Presenters: Bruno Dorin, Patrick Caron, Bernard Hubert, CIRAD/INRA)
14.30 – 17.30	Session 2: The resource base to 2050: Will there be enough land, water and genetic potential to meet future food and biofuel demands?
	<ul style="list-style-type: none"> ▪ World food and agriculture to 2030/2050. Highlights and views from mid-2009 (Presenter: Nikos Alexandratos, FAO) ▪ World agriculture in a dynamically-changing environment: IFPRI’s long-term outlook for food and agriculture under additional demand and constraints (Presenter: Siwa Msangi, IFPRI) ▪ The resource outlook to 2050. By how much do land, water use and crop yields need to increase by 2050? (Presenter: Jelle Bruinsma, FAO) ▪ How do climate change and bioenergy alter the long-term outlook for food, agriculture and resource availability (Presenter: Günther Fischer, IIASA)

THURSDAY, 25 June 2009

09.00 – 12.30	Session 3: The investment challenge to 2050: How much, where to invest, what priorities and what sources?
	<ul style="list-style-type: none"> ▪ Investment requirements under new demands on world agriculture: Feeding the world with bioenergy and climate change (Presenter: Siwa Msangi, IFPRI) ▪ Capital requirements for developing countries' agriculture to 2050. (Presenter: Josef Schmidhuber, FAO) ▪ Drivers of investment in large-scale farming: Evidence and implications (Presenter: Derek Byerlee, The World Bank) ▪ Investment in developing countries' food and agriculture: Assessing agricultural capital stocks and their impact on productivity (Presenter: Stephan Cramon, University of Goettingen)
14.00 – 17.30	Session 4: The investment challenge and the technology challenge to 2050
	<ul style="list-style-type: none"> ▪ International investments in agricultural production in developing countries. Win-win or neo-colonialism? (Presenter: David Hallam, FAO) ▪ Foreign direct investment and other forms of TNC participation in agricultural production: Trends and implications. (Presenter: Hafiz Mirza, UNCTAD) ▪ How can technology deliver for food crop yields (Presenter: Tony Fischer, CSIRO) ▪ Setting meaningful investment targets in agricultural development: Challenges, opportunities, and fiscal realities (Presenters: Nienke Beintema, Howard Elliott, IFPRI)

FRIDAY, 26 June 2009

09.00 – 12.30	<p>Session 5: Feeding the world in 2050: The global policy challenge</p>
	<ul style="list-style-type: none"> ▪ Presentation 5.1: World agricultural trade challenges to 2050 and requirements for evolving structure of world trade rules compatible with food security for developing countries (Presenter: Alexander Sarris, FAO) ▪ Presentation 5.2: The role of non-distorting support policies for long-term agricultural development (Presenter: Aziz Elbehri, FAO)
	<p><i>Lunch</i></p>
14.00 – 17.30	<p>Session 6: Africa’s special role, problems and needs: What development model for Africa?</p>
	<ul style="list-style-type: none"> ▪ Presentation 6.1: How can Africa master its multiple challenges of high population growth, climate change and HIV/AIDS (Presenter: Hans Binswanger-Mkhize, Tshwane University of Technology) ▪ Presentation 6.2: Can the smallholder model deliver poverty reduction and food security for a rapidly growing population in Africa? (Presenter: Steve Wiggins, ODI) ▪ Presentation 6.3: African agriculture in 50 years: Smallholders in a rapidly changing world? (Presenter: Paul Collier, Oxford University)
	<p>Concluding discussion, outlook and summary of the chair</p>