27. Summary of some key issues raised and implications for the policy agenda in OECD countries

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Productivity growth has been a major feature of global agriculture. In an analysis of productivity in more than 90 countries, Coelli and Rao (2005) conclude that the mean rate of growth in total factor productivity (TFP) averaged 1.02% *per annum* over the period 1980-2000, which is quite high considering that the group included a number of developing countries in which agricultural productivity growth was lagging during this period. This estimate also compares favourably with the average rate of growth in TFP of 0.96% *per annum* for the economy as a whole in 23 OECD countries over the period 1975-90 (Maudos *et al.,* 1999). Increased productivity has enabled the populations of OECD countries to have access to an expanding supply of food and agricultural raw materials. The real (inflation-adjusted) price of food has declined globally and the share of the average consumer's disposable income spent of food has fallen substantially. The increase in productivity has been made possible by a continuous supply of new technology and an improvement in knowledge and skills of farmers and others engaged in the food system. To a large extent we have come to consider rapid productivity growth in agriculture as the norm and we may have become unduly complacent about the system for research and development (R&D) and knowledge transfer that underpins this.

Recent experiences of two periods of rapidly increasing global food prices have raised questions about the ability of the food system to continue along the path of rapid gains in efficiency and providing an ample supply of food and agricultural raw materials at reasonable prices. The OECD meeting provided an opportunity to take stock of the current situation and future prospects in the Agricultural Knowledge System (AKS) in a range of countries, and the implications for future policy.

The challenge of adapting AKS to future needs in food and agriculture

The agricultural sector in OECD countries and globally is likely to face major challenges in the years ahead due to pressures on both the supply- and demand-sides of the food balance equation. The United Nations projects that by 2050 the World's population be over 9 billion, compared to roughly 7 billion currently, an increase of roughly one-third (UN, 2010). At same time, average income is likely to continue to increase. The combination of population and income growth will likely contribute to a significant increase in the demand for food. It is estimated that in order to maintain a global average food availability of 3 130 kcal per person per day by 2050 an additional billion tonnes of cereals and 200 million tonnes of meat would need to be produced annually (compared to levels in 2005/07) (Bruinsma, 2009). At the same time, the

demand for agricultural raw materials will also continue to increase. The land-based industries are now being seen as a source of energy and part of the solution to the challenge of transitioning to a low-carbon economy. Growing demand for bioenergy and biomaterials will place additional pressure on agriculture and the natural resources upon which it is based.

Agriculture is likely to face increasing supply pressures. Higher output will require more intensive use of agricultural land and will generate increased demand for water, at the same time as the demand for water for non-agricultural purposes will be increasing. Climate change is also likely to have implications for agricultural output, if not for average productivity then for its variance due to an increased incidence of extreme weather events and greater climatic variability.

In the meeting, evidence of a general slowdown in the rate of productivity growth in agriculture was presented. There has been a tendency to under invest in agricultural R&D, as indicated by the very high estimated rates of return associated with such investment. At the same time, existing AKS may suffer from being locked into old paradigms based on a linear approach to productivity growth, i.e., one in which a set of providers generates new technologies which are then expected to be adopted by users. In contrast, in order to make the most effective use of the resources for R&D a more interactive approach is likely to be needed in which feedback from users guides the development of new technologies and serves to align research with emerging needs. A major challenge for AKS is in transforming **Knowledge** Systems into **Innovation** Systems. As one participant observed "R&D turns money into knowledge; innovation turns knowledge into value". Achieving this outcome is not simply a question of developing a set of new technologies but also of developing the institutional framework within which such technologies can be deployed efficiently.

A major challenge for AKS will be securing sufficient financial resources to support R&D at the level that will be needed in the future. Public funding, in particular, is likely to be increasingly difficult to obtain. Urban constituencies and key interest groups may not be aware of the benefits of agricultural R&D, much of which can require a long-term funding commitment to come to fruition. It is becoming increasingly challenging politically to secure the resources to maintain the necessary continuity of R&D effort. One approach that is being used is "levy funding", i.e. applying an R&D charge on the value of agricultural output rather than providing financing through general taxation. This approach can have the advantage that the costs of research are borne by its primary beneficiaries – the producers who use the research to improve their profitability, and consumers who may bear part of the costs through higher product prices in the short-term, but can expect to gain in the long-term from increased efficiency in food production. This approach is particularly relevant where the private benefits from research are high and the payoff to beneficiaries is rapid and highly visible. Support for the approach among farmers or local funders is less likely where there are large public or non-local benefits or the advantages are not immediately apparent. Systems which rely primarily on local funding for research that has significant non-local benefits may be particularly prone to "market failure" in the sense that the provision of funds for R&D will be significantly less than justified by its overall public benefits.

There are other barriers to generating adequate support for funding agricultural research. One of these is incomplete information. Farmers (and consumers or taxpayers) may have limited awareness and understanding of what innovations will be needed to address future challenges in the food system, in particular those associated with climate

change. They may also be unwilling to support investment in research that aids future adaptation by agriculture to the effects of climate change because of the high uncertainty associated with that type of research.

The implication is that it will be challenging to secure the necessary funds to support the level of R&D in agriculture that will be necessary to meet the major challenges that the sector will face in the future. In the light of this, there may have to be changes to AKS in three broad areas:

- Improved effectiveness in the supply and diffusion of new technology within existing structures.
- Changes in institutional design and operations.
- A change in the balance between public and private sector activities.

Improving the effectiveness of existing AKS

Shared experiences at the meeting revealed a range of new approaches and innovations that are being introduced to increase the effectiveness of existing AKS. Just a few examples are provided here. They include increased private sector involvement to leverage public resources (e.g. in Australia and New Zealand) through such mechanisms as the provision of matching funds for agricultural R&D; the reorientation of public resources for R&D to areas with particularly strong public good elements; and system rationalisation, for example, the creation of centres of excellence to concentrate available R&D competency, and the expansion of international collaboration to exploit synergies. Some emerging economies (e.g. Brazil, China and India) are managing to maintain a high profile for agricultural R&D and have made significant advances in exploiting new production and information technologies in order to improve productivity. However, major resource challenges persist for the AKS in many developing countries, particularly those in sub-Saharan Africa, because of the lack of financial and human capital (particularly that needed to support an effective research base).

Changing institutional design/operation

A second approach to increasing the effectiveness of AKS is to modify the way these are designed or how they operate. One important area is strengthening the role of farmers and the private sector in the development and implementation of new technologies. Several cases were identified where this has been important. For example, the development of no-till crop production methods involved considerable farmer participation and the same could apply to the adaptation of crop and livestock production systems to climate change. Similarly, the food industry could play an important role in the future development of energy-saving technologies and the production of energy from "waste" products. Rather than the current linear structure that tends to characterize many AKS, the challenge is to create learning and innovation networks in which there is continuous interaction between farmers, the food and agricultural industry, and research and extension professionals in the development and application of new technologies.

Networking can play a vital role in leveraging scarce resources that support innovation in the food and agricultural system. The expanded use of public-private and international research partnerships can be used to economize on resources and increase system effectiveness. A range of other methods, for example, greater use of performance evaluation in AKS, competitive grants for research and diffusion activities, and the

development of research/higher education clusters (centres of excellence) can help to make more efficient use of available AKS resources, and create stronger networks by strengthening the link between research and its application. However, as one participant observed "we don't have the luxury of constantly stopping and sitting back to do strategic thinking and to reorient our activities… we need to adopt a continuous and on-going process of adaptation and reorientation".

Altering the balance between public and private sector activities

With increasing demands upon scarce public resources in many countries, it is inevitable that the balance between public and private activities in AKS will have to change in the future. If the private sector is to play a larger role in AKS incentives must exist for it to generate, develop, and diffuse new technologies. In other words there must profit opportunities. One of the key issues for the private sector is the protection of Intellectual Property Rights (IPRs) since the ability to control the deployment and use of new technologies is essential if these are to yield a return to private investment in R&D.

The protection of IPRs can be a controversial issue, particularly in the provision of essentials to human existence, such as food. The public may not understand the benefits of private sector involvement in improving the ability of the sector to meet food needs. Emotive arguments can be involved if access to food is viewed to be a right. The principle of generating private returns from new technologies that enhance the supply of food may be viewed to be morally unacceptable if some individuals do not have enough to eat. In addition to ethical considerations, extended periods of protection of IPRs for innovations that have a large public good element may be difficult to justify. Nevertheless, the incentive for innovation by the private sector can be reduced substantially if some measure of protection for IPRs is not provided.

Some new technologies may be viewed to be risky, for example on health or environmental grounds. The assessment of risk can be challenging and controversial. Most countries provide regulatory oversight for the diffusion of new technologies that may involve an element of risk. An important issue is how much regulation is needed and what criteria to apply so that the public is adequately protected but the process of innovation is not retarded.

In terms of meeting the needs for new technologies, institutional inertia may be a significant barrier to progress in AKS. Current structures may not be well-suited to supporting the enablers of change ("innovation brokers") in the food and agricultural system. These enablers can involve a wide range of actors, including, farmers and their organisations, food processors and retailers, non-governmental organisations, educational institutions and public agencies. The range of potential contributors to the process of innovation suggests that broad sectoral involvement (not just by farmers) may be critical, but the challenge is how to secure this. Existing sectoral networks can act as either a facilitator or a barrier to change, and new networks may need to be created, particularly if an effective two-way flow of information between the developers and users of new technologies is to be fostered. Often it is simpler and cheaper for an AKS to focus on the development of standard technology packages but "one size fits all" approaches may not work. On the other hand, it can be challenging to develop customised alternatives without these being prohibitively expensive. What is clear is that the creation of effective innovation systems may require a range of difficult issues to be addressed, for example, improving the quality of human capital and the physical infrastructure that allow the benefits of new innovations to be realised by farmers and food consumers.

Policy coherence, innovation and AKS

The development and application of new technologies in agriculture and the food system in OECD countries takes place within the context of a set of existing agricultural policies that are broader in scope than those that focus explicitly on AKS. Despite some reduction in the overall level of financial support for agriculture, in many OECD countries the traditional emphasis on providing price and income support for farmers remains important. The provisional estimate for total transfers to OECD agriculture for 2009 was USD 252 billion, equivalent to 22% of the farm-level value of output. An estimated 46% of the total was provided through market price support. In contrast, public expenditure for agricultural research and development was roughly 3% of the value of total transfers. There are questions about whether even this relatively modest public investment in R&D can be maintained given budgetary pressures and in the light of resource pressures what the focus of the R&D effort should be in the future.

In recent years, some OECD countries have tended broaden the focus of policies for agriculture to address a wide range of issues and objectives, such as environmental quality and the protection of natural resources or rural development. These will continue to be important, but there are questions as to whether the growing pressure on agriculture to meet the growing demand for food, fibre and energy and to supply food at reasonable prices requires some rebalancing of emphasis to increase the priority on productivity enhancement and resilience in the sector, particularly in the face of projected changes in global climate. A key issue is whether it will be possible to reconcile the pressure for agriculture to perform a broad range of functions with the need for higher productivity and environmental sustainability. There will be a need for policy coherence for the sector, so that the policies employed do not work at cross-purposes in seeking to achieve multiple goals. Coherence will be needed both nationally and internationally, particularly in an economic environment in which public resources are likely to be increasingly constrained. It will be a considerable challenge to meet the needs for funding AKS given the many demands on public resources. The sentiment expressed by one of the participants in the conference seems to sum up the feelings of many: "We can't afford to wait to change things in AKS… time is running out… we need to act now!"

Notes

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