

IP and innovation in agriculture

Innovation in the agricultural sector involves the development of healthier, safer and more nutritious food for human and animal consumption (e.g. through the development of genetically modified seeds and crops), new breeding techniques, and fuel for industrial use. Innovation is the main driver of productivity growth in the agricultural field. Since the budgetary constraints of public institutions pose challenges for agricultural innovation, different types of intellectual property (IP) rights can help address many of these challenges (for example, by providing incentives to invest in innovation and facilitating the transfer of technology). In addition to plant variety rights, patents, trademarks, geographical indications and copyrights can also create value in agricultural innovation. Nonetheless, concerns have been raised regarding the large number of IP rights over agricultural inventions concerning genetic resources and traditional knowledge, and also with regard to the proliferation of terminator technologies and the rise of litigation costs.

What is innovation in agriculture?

Innovation in the agricultural sector involves the development of healthier, safer and more nutritious food for human and animal consumption, new breeding techniques, and fuel for industrial use. Agricultural innovation has the potential to increase the productivity and adaptability of crops, diversify the variety of agricultural crops, enhance the nutritional value of food, feed increasing farm animal populations, and provide fuel for a growing range of industrial uses without depleting available land, water and biodiversity resources (Adi, 2006; OECD, 2013).

One of the most remarkable advances in agricultural innovation concerns the transfer of beneficial traits into many agricultural crops that would otherwise be afflicted with problems such as disease, drought intolerance and pests. By incorporating resistance to these problems into seed varieties, crops can provide higher yields while also being less dependent on chemicals and fertilizers, which is specifically beneficial for farmers in developing countries who do not have access to, or cannot afford, chemical products (Boyd et al., 2005). It has been argued that this part of agricultural innovation can make an important contribution towards combating poverty, malnutrition, food insecurity and diseases.

Many innovations in the agricultural sector are “process innovations” that relate to production techniques (e.g. adoption of improved seeds, irrigation and waste management technologies, and the development by farmers of practices adapted to their situation). “Product innovations” include improved seeds and animal breeds, agricultural machines, irrigation systems, buildings, and food with new functional attributes. Marketing and organisational innovations along the supply chain are also increasingly important (OECD, 2013).

Agricultural innovation involves a wide range of actors, including governments, researchers, private businesses, farmers, advisors, non-governmental organizations (NGOs), consumers, etc., who guide, support, create, transfer or adopt innovation, and who advise and inform farmers and the public about innovations (OECD, 2013; World Bank, Managing Intellectual Property to Foster Agricultural Development).

In agriculture as in other sectors, innovation is the main driver of productivity growth. It leads to a better allocation of resources and higher productivity, resulting in higher income. Innovation can also improve the environmental performance of the farm and help farmers deal with production and income uncertainties (OECD, 2013). Since agricultural production is a major component of developing countries’ economies, an increase in production can also directly enhance economic development prospects (Boyd et al., 2005).

In most countries, agricultural research and development (R&D) remains mainly funded by public expenditures. In recent years, the public research mandate in agriculture has been broadened to include environmental, food and other issues, particularly in developed countries, thus reducing funds available for productivity-oriented research. In addition, more attention is now given to innovation along the food chain and to non-technological innovations (e.g. institutional or marketing

innovations) (OECD, 2013; World Bank, Managing Intellectual Property to Foster Agricultural Development).

Budget constraints, conflicting information on research priorities, and long-time lags between research, adoption and results pose challenges to agricultural innovation (OECD, 2013). By providing incentives to invest in innovation and facilitating the transfer of technology, the IP system can help address many of these challenges.

How is IP related to agricultural innovation?

Types of IP contributions to innovation in agriculture

Over the last few decades, agricultural innovation has increasingly relied on IP protection. While investment in innovation is a main driver of economic growth, governments face budgetary constraints in funding innovative projects, including agricultural R&D. IP protection can encourage private investment in innovation and help to ensure continuous research. Thus, IP rights have increasingly received attention as a source of support for agricultural development, including foreign direct investment (FDI), technology transfer, trade, access to genetic resources and protection of traditional knowledge. IP rights have also altered opportunities for financing and encouraging innovations in crop breeding and related areas, and have transformed the structure of incentives and costs related to public and private innovation in the agricultural field (Wright and Pardey, 2006).

The strengthening of IP protection in recent decades has been associated with an increase in private sector investment in agriculture-related research and development, and a surge in innovation leading to improved plant varieties, agricultural chemicals and production technologies. In part due to the incentives provided by IP rights, many of these innovations have moved rapidly into commercial use or have been the subject of new collaboration via pooling, as was the case with the development of a nutritionally enriched strain of rice known as Golden Rice (Kolady and Lesser, 2007; OECD, 2013).

IP protection for agricultural innovations has also helped to increase circulation of knowledge through transfers of techniques (e.g. patents and licenses, disclosure of know-how), and transfers of designs, trademarks and other IP protected assets (OECD, 2010).

Relevant types of IP for agriculture

Article 27 of the World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) provides that patents shall be available (with a few exceptions) in all fields of technology for inventions that are new, non-obvious and industrially applicable. An exception to this rule concerns plant varieties, which may be excluded and protected via a sui generis system, such as the one provided under the convention of the International Union for the Protection of New Varieties of Plants (UPOV).

Under the UPOV system, plant varieties can be protected if they are new, distinct (distinguishable from all other varieties known at the date of application for protection), uniform (sufficiently uniform to be distinguished from other varieties, taking into account the method of reproduction of the species) and stable (the variety can be reproduced unchanged). The holders of a plant variety's right have a legal monopoly over the commercialization of that variety for a prescribed length of time, allowing for the recovery of the cost of breeding commercially valuable new plant varieties. In general, the holder controls the sale, reproduction, import and export of new varieties of plants. Exceptions may be made, however, for both research and the use of seed saved by a farmer for replanting (Binenbaum et al., 2003). Plant variety protection is now proliferating worldwide, although some countries still offer plant patents as well (Wright and Pardey, 2006).

In addition to plant variety rights, patents can play a key role in protecting plant varieties and other types of inventions in the agricultural field, such as genetically modified seeds and crops. Other

forms of protection, such as trademarks and geographical indications, can also create value in agricultural innovation by allowing rights owners to indicate the source of their products and recoup their investments in developing those goods. Likewise, copyright laws can be used to protect information in agricultural research journals, databases and software code. Utility models for the protection of minor inventions, and sometimes trade secrets, are also relevant to agricultural development (World Bank, Managing Intellectual Property to Foster Agricultural Development).

Intellectual property rights, particularly patents, have also made possible the growing investment in plant genomics research. Scientists are using advanced genomics as a means of identifying, mapping and understanding the expression of crop genes, and their link to agriculturally important traits (Adi, 2006).

Issues regarding IP in agriculture

Breeding is a cumulative science, and seeds and other agricultural matters are increasingly the subjects of property rights. The number and diversity of innovations utilized in modern cultivar development, and incorporated in the germplasm, can be large. The spread of IP protection over such innovations has meant that germplasm is often covered by a large number of IP rights, including key process technologies required to bring about genetic transformations embodied in the seeds (Binenbaum et al., 2003; Wright and Pardey, 2006). In this sense, financing and managing access to the necessary inputs and processes can become challenging, especially for smaller firms (Wright and Pardey, 2006).

Concerns have been raised regarding the increasingly fragmented ownership of IP with respect to research inputs in agriculture (technologies and materials such as genes), which may hamper access to knowledge and the innovation process (Blakeney, 2011; OECD, 2013; see [Proliferation of patents](#) [1]).

Ownership of genetic resources and traditional knowledge is also an area of debate. R&D in crop improvement, for example, depends on the wealth of genetic material held in farmers' fields, and national and international gene banks. Both the conservation of genetic resources and access to them are critical for addressing global food security issues, including drought tolerance, yield improvements, and resistance to diseases and pests. Maintaining a balance between the preservation of genetic resources and ensuring widespread access depends on finding solutions that can work within a complicated cross-section of national, international and institutional policies (Adi, 2006; World Bank, Managing Intellectual Property to Foster Agricultural Development). For example, in 2006 the research centers of the Consultative Group on International Agricultural Research (CGIAR) that maintained ex situ collections of plant genetic resources signed agreements with the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture, which placed the collections they hold under such a treaty, and adopted a "Standard Material Transfer Agreement". Exchanges of genetic resources involving the CGIAR centers are now governed by this agreement, which includes IP rights obligations. Mechanisms for equitable benefit sharing between innovators and resource countries are also important (see [IP to address social challenges](#) [2]).

Another area of discussion relates to the proliferation of terminator technology, a technique for genetically altering a plant so that the seeds it produces are sterile. Many companies are working on their own genetic seed sterility patent claims and a new generation of terminator patents has been engineered to respond to external chemical inducers mixed with the company's patented agrochemicals. This means that seeds' genetic traits can be turned on or off simply by applying certain chemical inducers (Adi, 2006).

Finally, IP infringement litigation can be very costly, especially in cases concerning agricultural innovations, where complex issues frequently arise. This can hamper future innovation, since the threat of litigation can deter the innovative efforts of medium- and small-sized firms (see [IP litigation and enforcement](#) [3]).

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