African Centre for Biodiversity submission to the South African Competition Commission on Bayer-Monsanto merger

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On 7 April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity (ACB). This name change was agreed to by consultation within the ACB, to reflect the expanded scope of our work over the past few years. All ACB publications prior to this date will remain under our old name of African Centre for Biosafety and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture systems in Africa and to our belief in peoples' rights to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and to define their own food and agriculture systems.

www.acbio.org.za
PO Box 29170, Melville 2109, Johannesburg

Contact persons:
Mariam Mayet Mariam@acbio.org.za
Stephen Greenberg Stephen@acbio.org.za

Design and layout: Adam Rumball, Sharkbuoys Designs, Johannesburg

Abbreviations

ARC	Agricultural Research Council
CGIAR	Consultative Group for International Agricultural Research
GM	genetic modification
GMOs	genetically modified organisms
IP	intellectual property
NPGRC	National Plant Genetic Resource Centre
OPVs	open pollinated varieties
PBRs	plant breeders' rights
PGR	plant growth regulator
PVP	plant variety protection
R&D	research and development
SANSOR	South African National Seed Organisation
UPOV	International Convention for the Protection of New Varieties of Plants

Executive summary

The African Centre for Biodiversity (ACB) is making this submission because of serious public interest concerns about the proposed merger between Bayer and Monsanto. This merger is occurring in the context of other related mergers in agricultural input supply, between ChemChina-Syngenta and Dow-Du Pont.

We are experiencing increasing concentration in agricultural input supply with significant negative implications for South African farmers and consumers. We recognise this concentration is part of an ongoing process, globally and nationally. Competition law and policy have been ineffective in preventing this kind of consolidation. The focus of competition law is too narrowly on ongoing competition within segmented markets that are considered in isolation from one another.

We urge the Commission to consider the wider implications of merger, and to recognise a dominant technological platform in operation in biotechnology traits, seed production and agrochemicals. While there may be some intra-platform competition amongst multinational and domestic companies, in reality we are faced with a monopoly or cartel situation, where there is no effective inter-platform competition; that is, there is no effective competition from an alternative set of technologies and production systems.

The submission includes the provision of contextual information to the Commission, in particular information about the central role of intellectual property (IP) protection in agricultural input supply; the structure and main actors in the seed and agrochemical sectors; and an overview of agricultural biotechnology, genetic modification and their relation to these input sectors.

IP on seed is protected in two main ways: plant variety protection/plant breeders' rights, and patents. South Africa uses a plant variety protection approach based on the 1991 version of the International Convention for the Protection of New Varieties of Plants (UPOV), but recognises patents on living organisms granted elsewhere, especially for genetic modification (GM) traits and processes through the Patent Cooperation Treaty to which South Africa is a Party.

Both these forms of IP protection grant the plant breeder's rights/patent holder with exclusive rights to use, although there are some differences in the two forms of protection that are discussed briefly in the submission. The IP regime has permitted Monsanto to construct a dominant technological platform based on its own patented innovations, seed traits and agrochemicals. Of particular importance are its (now expired) patent on glyphosate herbicide sold under its brand name 'Round Up' and thousands of patents on GM traits, sequences and processes. Monsanto has been able to use licensing to control processes of innovation. All major seed companies produce on the basis of licenses from Monsanto, including Du Pont Pioneer, which holds an overwhelming share of maize seed varieties in South Africa.

Even though some of these patents have expired or are set to expire in the next few years, Monsanto has been able to use its monopoly advantage to entrench its control in the market, both through licenses and through bundling its technologies in such a way that farmers are obliged to use the company's proprietary brands.

Significant cross-licensing reinforces the dominance of the technological platform. This should be investigated as a form of collusion or cartel behaviour which entrenches the power of a small number of corporations on this platform and excludes the possibility of competition from alternative platforms – and indeed precludes the possibility of other platforms to exist. It closes down competition in seed breeding and production, and in input supply more generally, because it creates high barriers to entry to access and use technologies.

There is multinational dominance in South Africa's seed and agrochemical sector. Information about market shares is a closely guarded secret and treated as commercially sensitive information, or is gathered by private market research organisations and sold at extortionate rates. Monsanto and Bayer are two of the largest actors. Although there are a number of other competitors in both these markets, they are reliant on licensing of technologies that have been developed and patented outside South Africa, particularly by Monsanto but also by other multinationals. In combination all these multinationals operating in the agricultural input supply sectors contribute to the dominance of the GM trait, GM seed and agrochemical platform. Although there are technologies available on the market outside this platform, they are unable to compete effectively. Most research and development (R&D) spend is under the control of the six largest corporations.

In South Africa Bayer is a small player in the seed sector, though the Commission should note that a merger between Bayer and Monsanto will produce an absolute monopoly on commercially available cotton seed in South Africa. Bayer and Monsanto both produce glyphosate (which came off patent in 2001), although there are a number of other competitors. Bayer also has glufosinate ammonium in herbicides, and significant ownership in fungicides, insecticides and plant growth regulators. A merger will enable Bayer-Monsanto to pool their technological resources and patents to produce new bundled input packages and strengthen their combined position on the technological platform.
In so doing they will further entrench the dominance of this platform as a whole.

Competition and public interest issues

There is a societal imperative in South Africa for the transformation of the economy to be more inclusive and to open spaces for disadvantaged and marginal economic actors to engage in productive activity. It is apparent that further corporate entrenchment in agricultural input supply will work against these objectives.

The dominant platform limits alternatives for farmers, who are locked onto a **technological pathway***, producing a strong dependency on corporate drivers. Farmers are compelled to operate on economies of scale, based on a high-input-high-output model. It is ever more difficult for smallholder farmers to compete. The result is a closing down of competition in agricultural production.

Rising seed prices are a result of stacked GM traits with increasing technological fees and royalties on seed. A Bayer-Monsanto merger will generate more of these stacked seeds at a high price for farmers. There is evidence from Grain SA that maize seed prices are rising faster than grain prices. This indicates capturing of value by integrated seed and agrochemical producers. Seed prices are a significant share of input prices, especially for smallholder farmers. Their customers are more often the rural poor, and this constituency will, therefore, be hit the hardest by rises in seed and input prices in the form of higher food prices.

Concentration of R&D resources in the hands of an ever smaller number of multinationals is already well under way. The 'Big Six' corporations in biotechnology, seed and agrochemicals already account for 75% of private sector R&D expenditure in these sectors. This is far larger than public sector R&D, which has declined over the past 20–25 years. Smallholder farmers and the public sector play a critical role in maintaining agricultural biodiversity. In contrast, the multinationals focus on a few lucrative commercial crops, primarily maize, wheat and soya in South Africa. Other crops, including indigenous crops, fall by the wayside. There is less support from the public sector as budgets are cut, and there is no support from the private sector to maintain and improve indigenous seeds and varieties. Smallholder farmers are under immense pressure to adopt the dominant technological package (including from government input supply programmes) and they also facing very difficult ecological conditions. The result is a decline in seed diversity and diversity of production practices. Commercial farmers are already locked into the dominant platform, generally mono-cropping and they play a limited role in maintaining agricultural biodiversity. This makes the whole food system very vulnerable to shocks and stresses because there is limited diffusion of risk, with all eggs in one basket. The threats and already existing shocks of climate change, drought and pest and disease attacks are more pronounced when the system is too uniform.

Domestic innovation is an essential dimension of wealth creation in a global knowledge economy. However, innovation in agricultural input supply is being driven by the needs of the dominant technological platform. This is an inappropriate model of top-down technological development and dissemination. It does not recognise the critical role farmers play in adapting seeds to specific contexts and in ongoing innovation. The dominant approach is to focus on technical fixes without adequately considering socio-cultural, economic, agro-ecological, and systemic institutional and political dimensions of innovation.

The Commission has a small window of opportunity to gather proprietary information from these corporations while investigating the merger. Information that is needed to make an informed decision even about intra-platform competition includes:

- Royalties and licence fees being extracted from South Africa;
- Patent ownership on genetic traits and technologies, and agrochemicals in use in South Africa's dominant technological platform;
- The extent to which the Monsanto-driven technological platform constitutes a de facto monopoly in the provision of seed and related inputs to farmers in (GM) maize and soya;
- Cross-licencing and patent/technology pooling agreements between the merging companies, and between these corporations and other 'competitors', and the extent to which these agreements can be considered as collusion or cartel behaviour that serves to reinforce the dominant technological platform and exclude alternatives;
- Allocation of R&D expenditure of the merging companies in South Africa, and how much of this is original research;
- Market shares in GM traits, seed varieties, and agrochemicals (particularly glyphosate and other **broad spectrum herbicides***, including glufosinate and paraquat);
- Details on value chain relationships in agrochemicals, especially between manufacturers and distributors, especially to look for exclusive supply arrangements; and
- Terms of supply between agrochemical producers and distributors.

Smallholder farmers are likely to be unaware that the merger is even being proposed, or what the implications of the mergers will be on them. If these processes were to be conducted democratically, smallholder farmers would be given at least an opportunity to be informed and to make their own contributions on their experiences with accessing seed and agrochemicals, their actual needs and their own proposed solutions.

We urge the Commission to consider the wider implications of these mergers beyond a narrow view of competition in segmented product markets. These include the entrenchment of the dominant technological platform in agricultural inputs, broader impacts on the agro-food system, agricultural biodiversity, input prices for farmers and knock-on effects on food prices, domestic innovation, and implications for just economic transformation and widening the base of productive activity.

Note: Definitions of selected concepts marked with * are provided in the Glossary in Appendix 1.

Introduction

This is a submission to the South African Competition Commission on the proposed merger of Bayer and Monsanto, in the context of rapid concentration in the commercial seed and agrochemical sectors globally and in South Africa. This includes two related mergers concurrently under consideration: those between China National Chemical Corporation (ChemChina) and Syngenta, and Dow and DuPont. The submission offers some background information on IP protection in the agricultural input sector; royalties, licencing, and cross-licencing; commercial value chains on seed and agrochemicals in South Africa, with main actors and an overview of market shares; and an overview of the structure of the genetically modified (GM) seed market and its relation with agrochemicals and ownership of GM varieties. It closes with consideration of key competition and public interest issues.

Overview of intellectual property on living organisms

Plant breeders' rights and patents

In the era of a knowledge economy, the leveraging of proprietary knowledge is becoming the main source of wealth creation, and in this context the creation, quantification and protection of **intellectual property*** (IP) is a key strategy for successful businesses globally.[1]

There are different approaches to the protection of IP rights in seed: primarily plant variety protection (PVP)/plant breeders' rights (PBRs), and **patents***. Globally, the International Convention for the Protection of New Varieties of Plants (UPOV) was adopted – mainly in European countries at the start – in 1961. The Convention was revised in 1972, 1978 and 1991. It established a system of IP protection on plant varieties, with monopoly rights to use for a period of time ranging up to 25 year, depending on the plant species and variety. UPOV "establishes the terms of ownership rights over propagating materials and protects the rights holders of protected varieties, prevents unlawful usage, and ensures that royalties can be claimed".[2] During the period of monopoly rights, the rights holder is entitled to license out the protected variety for a fee to allow other plant breeders or seed producers to use or develop it. At the end of the period of exclusive rights, the variety becomes freely available for others to use and develop without requiring a licence. South Africa became a Party to UPOV 1978 with the passing of the Plant Breeders' Rights (PBR) Act in 1976 and is in line with the 1991 version of UPOV. This law is currently under review, and the new Bill proposes to strengthen the IP rights of breeders in the number of ways.[3]

A different way of protecting IP rights in seed was opened up following a decision by the United States courts in the case of *Diamond v Chakrabarty* to allow patents on **genetically modified organisms*** (GMOs).[4] This concept of patents on life was eventually codified in the IP regime of the Trade Related Aspect of Intellectual Property Rights (TRIPS) under the auspices of the World Trade Organisation (WTO). Article 27(3) of TRIPS allows the patenting of micro-organisms (e.g. fungi, viruses and planktons) and non-biological and microbiological processes. All 153 members of the WTO, including South Africa, are required to change their respective patent laws to incorporate this provision.

1. Stephan, H., Power, M., Hervey, A. and Fonseca, R.S. 2006. *The scramble for Africa in the 21st century: A view from the South*. Renaissance Press, Cape Town.
2. African Centre for Biodiversity 2016. "Integration of small-scale farmers into formal seed production in South Africa: A scoping report". ACB, Johannesburg, p.11.
3. See Plant Breeders' Rights Bill 11B of 2015 and African Centre for Biodiversity 2017. "Briefing on Plant Breeder's Rights Bill", http://acbio.org.za/wp-content/uploads/2017/01/ACB-comments-PBR-Bill.pdf
4. US Supreme Court 1980. "Diamond vs Chakrabarty 447 US 303 (1980)", https://supreme.justia.com/cases/federal/us/447/303/case.html

The key differences between PVP/PBRs and patents[5] are:

- Patents cover both processes and products, whereas PVP/PBRs only cover products. This has significant implications because it means if an effective method of gene transfer is patented, for example, no other person may use that method without permission and they will be forced to look for alternative, likely less effective ways of doing the same thing. This may prevent others from using best practice to advance knowledge in society.
- Patents confer stronger rights on the holder. For example, a patent holder may prevent anyone from using the patented product or process if they wish. In contrast, breeders with PBRs are generally not permitted to prevent other breeders from using the protected varieties to create new varieties (the 'breeders' exemption'). Therefore patents can be considered to have a limiting effect on innovation.

South Africa is a Party to the Patent Cooperation Treaty (PCT), an international patent law treaty, concluded in 1970. It provides a unified procedure for filing patent applications to protect inventions in each of its contracting states. A patent application filed under the PCT is called an international application, or PCT application. South Africa's patent office in terms of its Patent Act routinely grants patents without patent examinations. While in South Africa patents are not granted for any variety of animal or plant, or any essentially biological process for the production of animals or plants (not being a microbiological process or the product of such a process), patents are granted on gene constructs and traits used in the development of GMOs.

Patent law provides the 'inventor' of an original product, concept or discovery an exclusive period of market access to make a return on the investment, in exchange for disclosure. The extension of this IP regime to living organisms led to significant private sector interest in research and development (R&D) in agricultural biotechnology. Patents have been granted in the genetically modified (GM) seed sector for a range of breeding aspects, including tissue culture methods, gene introduction methods, the composition of the DNA construct and its effect on genes, selectable markers, associated regulatory sequences and novel promoters to methods of gene introduction.[6] Internationally, patents were also granted on new chemical formulations for agrochemicals, going back many decades. This IP regime facilitated a rapid process of concentration in agricultural inputs, with mergers between biotechnology, seed and agrochemical companies that previously were distinct entities. This history is well documented.[7]

Patents and the related **licensing*** agreements have assisted agricultural biotechnology companies to establish their market dominance, not just on the patented product but also on complementary products through extensive licensing agreements. Monsanto has been at the forefront of the use of patents in agricultural inputs, most significantly for glyphosate – the world's most widely-used herbicide; and for thousands of patents on biotechnology and GM-related technologies. Monsanto currently has over 7,000 granted and unexpired patents worldwide, including GM varieties, chemicals, processes and machines.[8] These patents have allowed Monsanto to entrench its power in GM seed and agrochemicals markets, by selectively excluding

5. Public Citizen 2008. "The differences between plant variety protection and patent protection on plants", https://www.citizen.org/documents/differences-between-plant-variety-protection-and-patents-on-plants.pdf
6. Dunwell, J.M. 2005. "Review: intellectual property aspects of plant transformation", P*lant Biotechnology Journal 3*, pp.371–384.
7. See for example ETC Group 2015. "Breaking bad: Big ag mega-mergers in play. Dow + DuPont in the pocket? Next: Demonsanto?", *ETC Group Communique* #114; Clapp, J. 2017. "Bigger is not always better: Drivers and implications of the recent agribusiness megamergers", Global Food Politics Group, University of Waterloo, Waterloo, Ontario.
8. Julia Maret, patent agent, Monsanto 2014 https://gmoanswers.com/ask/how-many-patents-does-monsanto-have-does-it-really-have-11000-patents

or deterring others from using critical research tools and methods,[9] or alternatively by licensing selected patents (especially on traits, varieties and agrochemicals) for others to use.

Monsanto owned the now-expired '605 patent' related to the insertion of synthetic gene (a cauliflower mosaic virus) promoter, a protein sequence and a 'stop' signal that confers tolerance to its herbicide, glyphosate, under its brand name **Roundup Ready***. It also owns a variety of other patents (the McPherson patents) related to insect resistant traits,[10] which, in relation to insect resistant GM crops are commonly referred to as **Bt crops*** (Bt maize or Bt cotton). Monsanto used the '605 patent to develop its range of glyphosate **herbicide tolerant*** soybeans and cotton (Roundup Ready soybeans and cotton), which was sold to be used in conjunction with its complementary herbicide, Roundup. It used the McPherson patents to develop insect resistant and herbicide tolerant **stacked traits*** in GM cotton seed (Bt x herbicide tolerant).

In 1996 Monsanto started licensing this biotechnology to other seed companies. The licensing agreements allowed seed growers to use the biotechnology in their own **germplasm*** to produce Bt and herbicide tolerant seed (also commonly known as Roundup Ready and Bollgard/Roundup Ready seeds), with some restrictions. These restrictions included that seed companies could not sell seed containing this technology to growers, unless the grower signed a licensing agreement and agreed to only use the seed for a single commercial crop (known as an exclusivity provision). The seed could not be saved and replanted, or used for research purposes. Growers would also need to pay a technology fee and, as a condition of purchase, agree to only use Monsanto's Roundup herbicide with its seeds.[11]

Legal challenges to the specification of which particular brand had to be used have generally failed. However, in one case the court did highlight that tying the use of the specific branded herbicide to use of Monsanto's seed was unlawful and a misuse of the patent system.[12] Monsanto argued that Roundup was the only glyphosate herbicide with regulatory approval at the time. However the court noted that the agreement did not state that the seeds could be used only with an approved herbicide, but stipulated which specific herbicide was to be used. This was deemed anti-competitive because it could discourage other competitors from even seeking regulatory approval for their own products.[13]

Some of the patents granted restrict the freedom of new companies to operate because of the increasing number of rights (and therefore fees) vested in a single product. An example of this is found with 'golden rice' in which 40 separate organisations hold 72 patents over various aspects of the production of the seed.[14] This situation is known as a 'patent thicket' with the associated **royalty stacking***.

Royalties and licensing

Royalties on seed are fees paid on the purchase price by the end user of the seed. They are normally linked to sales volume and range between 1–5% due to the low profit margins of the agricultural sector.[15] Royalty stacking – when several different owners of intellectual or tangible property components in one product

9. Jefferson O., Kollhofer, D., Ehrich, T. and Jefferson, R. 2015. "The ownership question of plant gene and genome intellectual properties", *Nature Biotechnology*, 33:11, pp.1138–1143.
10. Justia 2006. "United States Court of Appeals for the Federal Circuit. Monsanto v. Michell Scruggs, Eddie Scrugges, Scruggs Farm & Supplies, LLC, Scruggs Farm Joint Venture, HES Farms, Inc., MES Farms, Inc., and MHS Farms, Inc.", https://cases.justia.com/federal/appellate-courts/cafc/04-1532/04-1532-2011-03-27.pdf.
11. Justia 2006, *op cit*.
12. Justia 2006, *op cit*.
13. Justia 2006, *op cit*.
14. Dunwell 2005, *op cit*.
15. Cahoon, R. 2007. "Licensing agreements in agricultural biotechnology", in Krattiger, A., Mahoney, R. and Nelsen, L. (eds) *Intellectual property management in health and agricultural innovation: A handbook of best practices*. MIHR/PIPRA, Oxford/Davis.

each expect a royalty payment on every sale – can make products increasingly expensive due to the need to pay multiple licence fees.[16]

In South Africa, as in other countries, seed breeders have the right to obtain royalties under the PBR Act on the basis of their registration of a new variety. Farmers saving and re-using protected seed are a threat to this system as they only pay royalties when they purchase the seed the first time. When a farmer buys or plants Monsanto's GM seed, for example, they will sign a technology/stewardship agreement that sets out the terms on which the farmer can use the seed.[17] To ensure that farmers do not save and replant seed of protected varieties, a Cultivar and Technology Agency was established in South Africa in 2016 to collect levies to contribute towards R&D of new varieties.[18] The South African National Seed Organisation (SANSOR), Grain SA, the Agricultural Research Council (ARC) and Agbiz Grain requested the agency to set a statutory breeding and technology levy, over and above the existing industry one, for winter cereals and to collect payment on this at the first point of sale. Payment will be made to seed companies based on their market share, which is yet to be determined.[19] Farmers end up paying twice: once for the seed itself which has R&D costs built into the price; and again on the R&D levy.

Licensing, based on ownership of the technology (the genetic constructs/traits) through a patent, serves as an avenue to recoup the investments required to create, develop and commercialise agricultural biotechnology products and to make ongoing profits. A licensing agreement defines and transfers "certain property rights between two or more parties under a specified sharing of rights and obligations between those parties".[20] Generally licenses are made available to other breeders or to seed producers for a fee. The rights pertain to possession and use, but not ownership of the property.

Licensing encompasses exclusive or non-exclusive use, and distribution (rights to market and sell) and/or production licenses.[21] Companies will often provide incentives to their licensees to, in turn, license the technology to others, particularly in markets where the company has no or minimal presence. Payment for licence fees is often made in milestone payments at crucial development stages.[22]

The trend to stacking of GM traits in a single seed is well under way, with stacks of 8 or more GM traits already on the market. These stacks are designed to respond to increasing insect or weed resistance to individual traits, while also providing corporations with opportunities to extend their exclusive rights by creating (and patenting) 'new' varieties using old technologies. As a major holder of patents on traits, Monsanto has control over what stacks may be created using the technologies under its ownership. According to Diana Moss of the American Antitrust Institute, "there are very few independent, rival transgenic seed platforms comprised of technologies other than Monsanto's. Inter-platform competition is thus limited, giving farmers few choices of traited seeds that do not include Monsanto technologies".[23]

16. US Department of Justice 2014. "Antitrust analysis of portfolio cross-licensing agreements and patent pools", https://www.justice.gov/sites/default/files/atr/legacy/2014/05/30/chapter_3.pdf
17. Genuity 2017. "License & Technology Use", https://www.genuity.com/stewardship/Pages/License-and-Technology.aspx. Accessed 24 February 2017.
18. Purnell, M. 2016. "The implementation of a breeding and technology levy on wheat", http://www.agtag.co.za/view_shared_post/13445
19. Purnell 2016, *op cit*.
20. Cahoon 2007, *op cit*.
21. Nilsson, M. 2007. "The in and out-licensing of plant varieties", in Krattiger, A., Mahoney, R. and Nelsen, L. (eds) *Intellectual property management in health and agricultural innovation: A handbook of best practices*. MIHR/PIPRA, Oxford/Davis.
22. Cahoon 2007, *op cit*.
23. Moss, D. 2010. "Transgenic seed platforms: Competition between a rock and a hard place?", American Antitrust Institute.

Moss defines a seed platform as an integrated set of technologies binding a) innovation involving genetic **transformation*** technologies and genomics; b) genetic traits that are expressed in plant agronomics, including insect resistance and herbicide tolerance; and c) state-of-the-art seeds containing genetic traits, for which seed companies are the major distribution channel for ultimate sales to farmers.[24] We can widen this definition to refer to a technological platform that will include patented agrochemicals alongside seed and biotechnology traits. This is an important concept because it is apparent that there is a single dominant technological platform currently in operation in South Africa in key markets – specifically maize, soya and cotton – consisting of a bundle of GM traits, seed varieties and agrochemicals structured around Monsanto's proprietary technologies, and in which all the other major companies in the seed and agrochemicals sectors in South Africa participate in a subsidiary role. While there may be strong intra-platform competition (i.e. competition within this dominant technological platform), there is no effective inter-platform competition (i.e. competition between the dominant platform and an alternative technological platform based on a different set of technologies and companies).

Cross-licensing: Cartels and legal collusion?

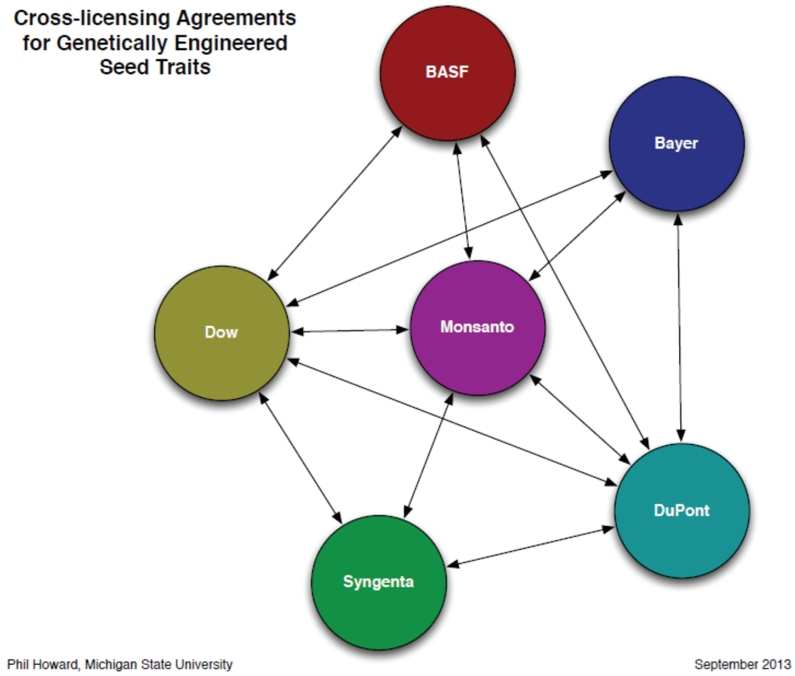
Patent thickets, in which every owner of a proprietary technology expects a royalty on sales, and the existence of multiple forms of property existing simultaneously in one technology (utility and plant patents, plant breeders' rights, trade secrets, trademarks, etc.) encourage the cross-licencing of traits.[25] These cross-licenses are intra-platform (within a set of integrated technologies, controlled by the innovation driver, in this case Monsanto) rather than inter-platform (between different competing technological bases).

Cross-licensing is when two or more companies license their respective patents to each other. Most cross-licenses require royalty payments and are granted on a non-exclusive basis so that the companies can still license their patents to others. Sometimes patent pools are used to ensure affordable access to a range of technologies that companies have put into the 'pool' at an agreed price. Companies that use patent pools and cross-licensing benefit, in that the costs of access to technology are decreased thus lowering the costs of production. These mechanisms can, however, also generate anticompetitive results if companies fix prices, restrict outputs or foreclose on innovative activity.[26] Even if this is not the intent, it is a result of cross-licensing. When the three or four dominant corporations share technologies and reduce the costs just within their own pool, while restricting others from accessing the technology on equal terms, this locks out competitors not involved in the cross-licencing agreement or technology pool, effectively preventing them from being able to compete fairly.

Figure 1 indicates the extent of cross-licensing of traits between the 'Big Six' agricultural biotechnology firms in 2013. The 'Big Six' companies in agricultural biotechnology, seed and agrochemicals have essentially "formed ... a cartel with a web of cross-licensing agreements" that "secure the dominance of [a] few corporate giants".[27] Cross-licensing enables companies to sell their own and their competitor's technologies through the stacking of traits. An example is a 2013 agreement between Monsanto and Dow that provided Monsanto with Dow's Enlist weed control system herbicide tolerate trait for use in field corn, and Dow with Monsanto's third generation corn rootworm technology. This enabled the introduction of next-generation products that build off an existing trait stacking platform for both companies.[28] Monsanto will represent both parties when

24. Moss 2010, *op cit*., p.2.
25. Cahoon 2007, *op cit*.
26. US Department of Justice 2014, *op cit*.
27. Douglas, L. 2016. "Monsanto-Bayer mega-deal a nightmare for America?", CNN http://edition.cnn.com/2016/05/23/opinions/monsanto-bayer-douglas/index.html
28. Dow 2013. "Dow Agrosciences, Monsanto cross-license advanced corn trait technology, designed to provide exceptional new tools for weed and insect management", http://newsroom.dowagro.com/press-release/dow-agrosciences-monsanto-cross-license-advanced-corn-trait-technology-designed-provid

Figure 1: Cross-licencing agreements for GM seed traits



Source: Phil Howard, 2013, Michigan State University

selling licensing rights to third-party seed companies. Prolific cross-licensing of genetic traits make it harder for new and smaller companies to enter the market because they have to pay multiple and often expensive licensing fees. Smaller companies that cannot afford licensing fees often opt to be bought out, thereby producing concentration in germplasm ownership.

Bayer and Monsanto have several existing cross-licensing agreements in place.[29] An example is the 2013 agreement through which the companies agreed that Monsanto would give Bayer a royalty-bearing licence to its Genuity Roundup Ready 2 Yield and related Xtend technology for soybeans in the United States and Canada. Monsanto also agreed to future royalty-bearing licenses for its Intacta RR2 PRO for soybean in Brazil, and possibly other Latin American countries, as well as stacking rights under certain conditions. In return, Bayer gave Monsanto licences to evaluate enabling technologies for corn rootworm control and herbicide tolerance as options for its R&D pipeline. The agreement enabled Bayer to provide additional products for its market and lowered the costs for Monsanto's R&D work.

Other examples of cross-licencing are:

- Monsanto entered into a multi-year supply agreement with Du Pont to provide dicamba herbicide in the United States and Canada.
- Dow AgroSciences and Monsanto reached a non-exclusive global option and licensing agreement covering Dow's Exzact Precision Technology genome editing technology.
- Monsanto and Du Pont agreed that Monsanto would offer DuPont's insecticidal seed treatment, Lumivia (chlorantraniliprole – trade-marked as Rynaxypyr), for use on maize under Monsanto's Acceleron brand in eastern Canada.
- Syngenta and Du Pont had a joint patent published focused on the development of a new herbicide chemistry class.

29. American Agriculturalist 2013. "Bayer, Monsanto cross-license biotech products", http://www.americanagriculturist.com/story-bayer-monsanto-cross-license-biotech-products-13-97224

Bayer, Monsanto, Syngenta, Dow, BASF and DuPont between them account for more than 80% of traits that appear in stacked trait products.[30] If the three mergers are approved, the dominant traits-seeds-agrochemicals technological platform will be further entrenched. This raises barriers to entry for smaller market actors who cannot afford to compete as they do not have access to the necessary technologies or cannot afford to license them. It can also incentivise companies to foreclose their offerings.

Monsanto current holds 96% of cotton traits patented in the United States. This allows it considerable market power regarding the setting of prices and terms through cross-cutting licensing agreements.[31] In the early 2000s it prohibited seed companies from stacking non-Monsanto traits in their cotton seeds. This was challenged in 2007 and Monsanto was forced to revise its terms for a period. The same judgement does not apply to the other seed traits that Monsanto owns. A merger between Bayer and Monsanto could result in the use of licensing restrictions to prevent competitors from stacking their own traits on other seeds with Monsanto or Bayer traits. It could essentially 'foreclose' others' traits, seeds and herbicides by making packages of 'seeds-traits-and-chemicals' that only work as a **technological package***.

The ETC Group refers to this web of cross-licensing as 'non-merger mergers', in that they effectively enable competitors to lock up markets without the regulatory approval required for formal mergers.[32] For example, virtually all seed companies selling GM seeds in South Africa are under licence to Monsanto for the use of traits and processes. Competition is effectively undermined by cross-licensing. In South Africa, seed companies or dealerships, such as Agricol, sell **hybrid*** and GM varieties under license from DuPont Pioneer, which, in turn licenses traits from Monsanto. DuPont Pioneer pays the technology fee to Monsanto, and sells its stacked technology on to recoup that cost and more. The International Seed Federation has found that the trait component of seeds can account for 25% (for maize) and between 40–55% (for soya and cotton) of seed costs; when traits are stacked, the portion of the cost ascribed to technology can amount to about 67% of the overall seed cost.[33]

The **transgenic*** crop market is highly competitive (although within the dominant technological platform), and given the significant costs involved in researching, developing and gaining approval for a single GM product, it makes business sense for companies to acquire or merge with other companies that will help them to broaden their portfolio of traits and technologies.[34] A portfolio of this nature can include gene promoters, **marker genes***, techniques to insert specific genes into plant cells and gene expression technology to increase the viability and efficiency of foreign genes in the host material.

30. American Antitrust Institute 2016. "Consolidation and competition in the US seed and agrochemical company – testimony of Diana L. Moss". American Antitrust Institute.
31. Stucke, M. and Grunes, A. 2016. "An antitrust review of the Bayer-Monsanto merger". Konkurrenz Group, Washington DC.
32. African Centre for Biodiversity 2015. "Heavy hands: Monsanto's control in South Africa", http://acbio.org.za/wp-content/uploads/2015/02/GMO-Monsantos-May2011.pdf
33. African Centre for Biodiversity 2015, *op cit*.
34. Dunwell 2005, *op cit*.

Overview of commercial seed value chain and main actors in South Africa

Seed value chain and main actors

The commercial seed system can be broken down into discrete activities or 'nodes' as follows: germplasm collection and maintenance; research and breeding to improve varieties; registration and regulation; seed production (also called multiplication); seed processing and packaging; and distribution to the end user (the farmer) (Table 1).

Plant breeders hold the power in the South African (and global) commercial seed system. Private sector breeders hold most **genetic resources*** for agriculture in private collections, they have IP rights over most commercial varieties, and they outsource production or license use rights to seed producers. Distributors are essentially service providers to get the seed to the end user. They do not have the same kind of power as food distributors (retailers) do in the food system. Commercial seed is effectively a 'producer-driven' system in that the seed breeders dictate the technologies and processes and are able to allocate activities and have a strong influence over the distribution of value in the system. Prices are essentially set by the breeders.

The first stage of the seed production cycle is the maintenance of the collection of germplasm that constitutes the agricultural biological base. The three main germplasm stores in South Africa are in the ARC system, in National Plant Genetic Resource Centre (NPGRC - the national gene bank), and in privately-owned collections. The NPGRC attempts to gather copies of all available varieties of seed/genetic materials in the country although it does not keep **improved varieties***, and hence does not collect from breeders. It focuses on indigenous crops for food and agriculture, and mainly stores material in a base collection and an active collection, and shares varieties with the regional gene bank in Lusaka. *In situ* seed and genetic resource collections on farms and in local seed banks are another source of germplasm. There is no systematic research conducted on these activities to date, despite their critical importance for maintaining **agricultural biodiversity***. The NPGRC seeks to restore landrace accessions to smallholder farmers, and to promote broader use of **landraces***, but this programme is not well resourced.

These collections provide the material for plant breeding. Local germplasm is usually crossed with germplasm from outside, either from the international public system through the Consultative Group for International Agricultural Research (CGIAR) institutions or from collections owned by private companies. Access to publicly-held germplasm is generally free to use with a small agreement on use, but access to privately held collections is only available on licence and on conditions imposed by the owner of the material. The PBR Act establishes the rules allowing the private ownership of protected varieties and conditions of licencing.

SANSOR tests new varieties based on 'novel, distinct, uniform and stable' (NDUS) criteria and registers them if they pass the test. Breeders apply for PBRs which give them exclusive rights to the variety for a period up to 20 years. Once a variety has been selected for commercialisation, the formal seed system enters into the production stage. There are three stages of seed multiplication in the formal seed system: i) breeders' and pre-basic seed; ii) foundation or basic seed; and iii) certified seed under contract. The breeder or variety developer is responsible for maintaining genetically pure breeders' seed. Foundation or basic seed is produced by breeders or seed companies using the pre-basic seed, and then sold or given to farmers to produce certified seed under contract. This is mainly a process of getting enough bulk to advance the seed to the next stage. This seed is used to produce certified seed, and this stage usually remains within the company that does the breeding. Pre-basic and basic seed are checked by regulatory authorities to make sure it is the same as the breeders' seed (true to type). This used to be a public sector function but certification was transferred to SANSOR in

Table 1: Seed value chain and main actors

Node	Main actors
Germplasm collection and maintenance	Private collections (multinational and domestic companies) Agricultural Research Council (ARC) National Plant Genetic Resources Centre (NPGRC) In-situ conservation (farmers)
Research and breeding, Breeders' and foundation seed production	***Multinational corporations (MNCs) + local subsidiaries:*** Barenbrug Seeds, DLF, DuPont Pioneer (+Pannar), Monsanto, Sakata Seed, Seed Genetics International, Selected Seeds, Syngenta ***Domestic companies:*** Agricol, Agri-Seed Technology, Capstone Seeds, Delta Saad, Hygrotech, Klein Karoo Seed Marketing, Lake Agriculture, Northern Seed Production, Qualita Seeds, Quality Seed, Starke Ayres, United Seeds, Van Rooyen Saad ***Public and university:*** Agricultural Research Council (ARC) Universities
Variety registration and regulation	South African National Seed Organisation (SANSOR)
Seed production/ multiplication	***MNCs + local subsidiaries:*** DLF, DuPont Pioneer (+Pannar), Enza Zaden, Monsanto SA, Prime Seed, Selected Seeds, Syngenta ***Domestic companies:*** Advance Seed, Agricol, Agri-Seed Technology, Delta Saad, Dynamic Seeds, Golden Tropical Seed, Hygrotech, Jermart Seeds, Kaap Agri, Klein Karoo Seed Marketing, Lake Agriculture, MAJ Koegelenberg en Seun, McDonald's Seeds, Northern Seed Production, RE Groundnuts, Quality Seed, Sequoia Seeds, Shalom Agriculture, Southern African Cover Crop Solutions, Southern Hemisphere Seeds (Russell Stone), Starke Ayres, United Seeds, Van Rooyen Saad, Vuna Seeds and Projects, VKB
Processing and packaging • conditioning, sorting and grading • seed treatment packaging	***MNCs + local subsidiaries:*** Barenbrug Seeds, DLF, DuPont Pioneer (+Pannar), Monsanto SA, Prime Seed, Sakata Seed, Seedco SA, Selected Seeds, Syngenta ***Domestic companies:*** Advance Seed, Agricol, Agri-Seed Technology, Agseeds SA, Capstone Seeds, Delta Saad, Golden Peanut and Tree Nut South Africa, Jermart Seeds, Kaap Agri, Klein Karoo Seed Marketing, Lake Agriculture, MAJ Koegelenberg en Seun, Northern Seed Production, RE Groundnuts, Qualita Seeds, Sequoia Seeds, South African Seed Institute (MBFi), Starke Ayres, United Seeds, Van Rooyen Saad, Vita Nova Selection Plant, VKB
Distribution (to farmers/growers)	Wholesale and retail ***MNCs + local subsidiaries:*** Arysta LifeScience, Ball Straathoff (Ballhort), Barenbrug Seeds, DLF, DuPont Pioneer (+Pannar), Monsanto SA, Prime Seed, Sakata Seed, Seed Genetics International, Seedco SA, Selected Seeds, Syngenta ***Domestic companies:*** Advance Seed, Agricol, Agri-Seed Technology, Agseeds SA, Capstone Seeds, Dynamic Seeds, Golden Peanut and Tree Nut South Africa, Hygrotech, Intelichem, Jermart Seeds, Kaap Agri, Klein Karoo Seed Marketing, Lake Agriculture, McDonalds Seeds, Qualita Seeds, RE Groundnuts, Seedcor, Shalom Agriculture, South African Seed Institute (MBFi), Southern Africa Cover Crop Solutions, Southern Hemisphere Seeds (Russell Stone), Starke Ayres, Tsala, United Seeds, Vita Nova Selection Plant, VKB ***Other*** Public and non-government organisations and extension services 'Informal' – farmer sharing

Source: SANSOR membership lists, 2017

1989. The seed is checked for quality based on criteria laid out in the Plant Improvement Act (PIA) of 1976 as amended. The seed is then certified if it passes the tests, which are based on Organization for Economic Cooperation and Development (OECD) and International Seed Trade Association (ISTA) standards. In the third stage, contract farmers produce/multiply the certified seed under controlled and monitored conditions to ensure purity and identity.

The PIA governs the marketing, production and distribution of seed in South Africa, including registration of seed establishments, and prescription of the conditions of sale of seed or plant material for planting, including storage, packaging and labelling standards. Anyone who wants to produce, clean or pack seed for sale must be registered. Some non-commercial varieties may not be required to follow procedures laid out in the Act. Most of the large breeders are registered as seed growers but also contract out seed production to commercial farmers who specialise in seed multiplication. There are a few small government and ARC initiatives to support small-scale, community-based certified seed production, but these are negligible.[35] Small, black-owned seed companies are almost non-existent in South Africa.

After harvesting, seed is conditioned or processed and then packaged for sale to farmers. The first stage is assembly, where the seeds produced in different places are gathered at a central point for cleaning, sorting, grading and packaging. In the commercial system this is in accordance with requirements in the PIA. After grading and sorting seed is usually then treated with herbicides or fungicides for storage and germination (for some crops such as beans and groundnuts, treatment is delayed until the day of planting). Processors aim to delay treatment for as long as possible because this can negatively affect germination. They will only treat enough seed to meet expected demand. Following treatment, seed is packaged. Packaging is important to protect the seed from pests and diseases. Commercial seed establishments must be registered with Department of Agriculture, Forestry and Fisheries (DAFF) to clean and package seed for sale. Samples are taken to check purity, germination and other standards. This is done by a registered laboratory, usually a private company.

The final stage of the seed production process is distribution to the end user, the farmer. Distribution can take the form of direct sales, wholesale/distributors, retail, agents, extension services, or between individuals, groups and networks. A broker or agent buys seeds from producers and sells on their behalf. South Africa has a well-developed private agro-dealer system, built on the back of the former grain co-ops who have retail outlets to supply inputs to farmers. There is no available information on the relationships between the seed and agrochemical companies and the input retailers.[36]

Market shares

In South Africa maize constitutes around 56.4% of the total value of the commercial seed market, soya 5.3%, onions 3.3% and other crops each 3% or less.[37] Du Pont Pioneer and Monsanto dominate the maize and soya seed markets. GM seed is permitted for commercial use for three crops in South Africa at present: maize, soya and cotton. South Africa is the first and only country in the world to permit commercial GM production of its staple crop, maize.

There are no publicly available figures on market shares by company, however Monsanto is understood to be the market leader in maize. The National Varietal List indicates that Du Pont Pioneer holds by far the most varieties, especially of GM seed varieties (Table 2). In 2011

35. African Centre for Biodiversity 2016, *op cit*.
36. Seed value chain information drawn from an earlier report by African Centre for Biosafety 2012. "South Africa's seed systems: Challenges for food sovereignty". ACB/TCOE, Johannesburg/Cape Town.
37. SANSOR South African seed market statistics 2014/15.

Table 2: Ownership of maize, soya and cotton seed varieties in South Africa, 2015

	Maize						Soya		Cotton		
	GM yellow	Non-GM hybrid yellow	OPV yellow	GM white	Non-GM hybrid white	OPV white	GM	Non-GM	GM	Non-GM	Total
Du Pont Pioneer	**104**	**70**	**1**	**83**	**71**	**2**	**26**	**4**	**0**	**0**	**361**
Pioneer Hi-Bred SA	80	45		56	36		16				233
Pannar Seed	24	25	1	27	35	2	10	4			128
Monsanto	**19**	**9**	**0**	**12**	**12**	**1**	**6**	**0**	**11**	**8**	**78**
Monsanto SA	19	6		12	10		1		8		56
Sensako					2	1	5				8
D&PL SA									3	1	4
Mayhco		3								7	10
Bayer Crop Science									**2**	**1**	**3**
Other	29	59	6	11	57	26	51	29		3	271
Total	**152**	**138**	**7**	**106**	**140**	**29**	**83**	**33**	**13**	**12**	**713**

Source: Department of Agriculture, Forestry and Fisheries (DAFF) National Varietal List, June 2015

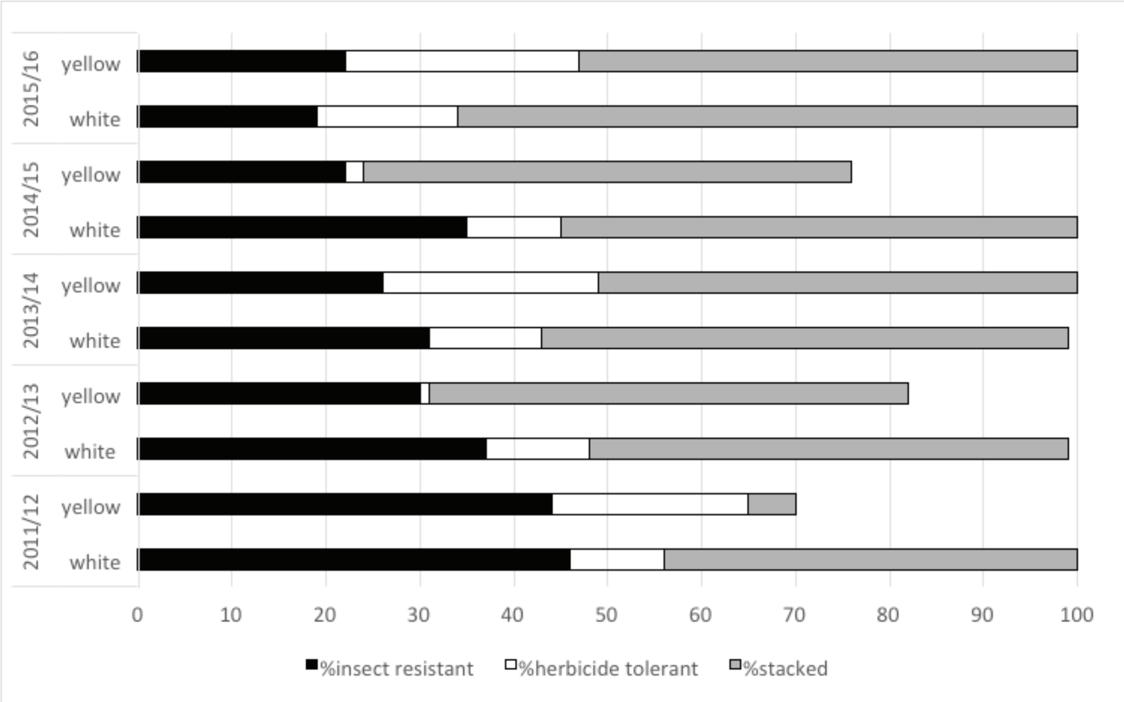
the Commission had allowed the acquisition of Pannar Seed by Pioneer Hi-Bred (owned by Du Pont).[38] This has created a highly concentrated market particularly in maize, with Du Pont Pioneer now owning 78% of GM white maize varieties, 68% of GM yellow maize varieties, as well as 51% of all non-GM maize hybrids (both white and yellow). In soya, Du Pont Pioneer holds 31% of GM varieties. Comparatively speaking, Monsanto owns a relatively smaller share of registered varieties, at 11% of GM white maize, 12.5% of GM yellow maize and 7% of GM soya. However, just about all GM maize and soya varieties in South Africa license patented traits from Monsanto, including those held by Du Pont Pioneer. Given the limited information in the public sphere, the Commission should investigate the dominance of Monsanto's traits as a matter of urgency.

Although there are some hybrid and **open-pollinated varieties*** (OPVs) of maize (Table 1), actual production is completely saturated with GM maize (Figure 2). These non-GM varieties can really be considered a 'reserve' germplasm pool for future GM experimentation. They are available for commercial production but are not being planted. In the public interest section below we indicate that a strong reason for this is that farmers have been channelled and locked into a **technological pathway*** that forces them to adopt the packages of GM seed and agrochemicals that are available through the dominant technological platform if they are to survive economically. GM cultivation of white maize (for human consumption) has been at or around 100% of all plantings since at least 2011. In the same period yellow maize (mainly used for animal feed) planted to GM has been above 70% of total cultivation, increasing to 100% in 2015/16.

Soya is considered South Africa's most important oilseed crop, and is a key ingredient in animal feed. Almost all GM maize is stacked with Monsanto's herbicide tolerant trait. Other companies operating in South Africa license GM traits and technologies from Monsanto.

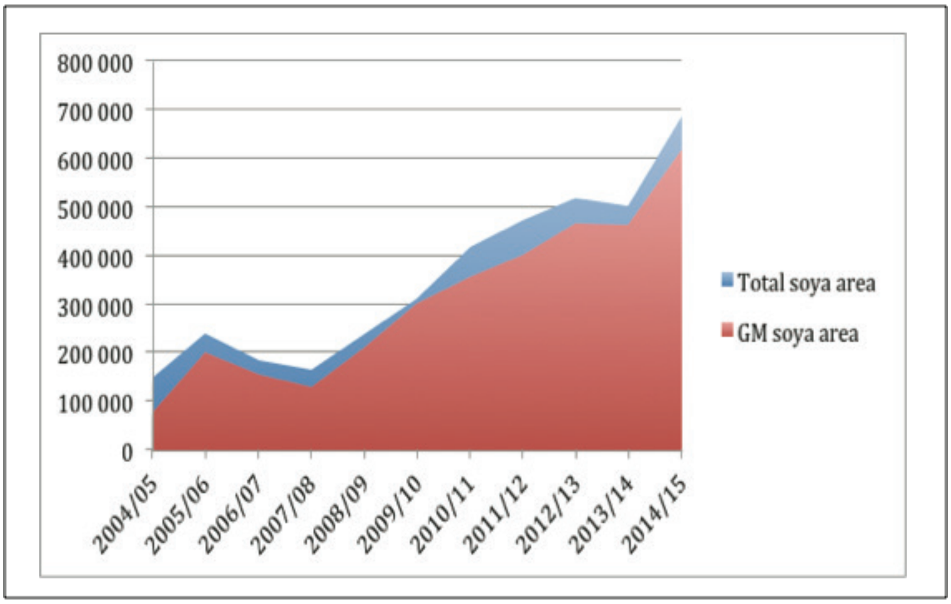
38. Competition Appeal Court 2012. "In the matter between Pioneer Hi-Bred International, Pannar Seed and the Competition Commission and African Centre for Biosafety", CAC Case No 113/CAC/Nov11, CT Case No 81/AM/Dec10. Competition Appeal Court, Pretoria.

Figure 2: Percentage of insect resistant, herbicide tolerant, and stacked maize cultivated in South Africa, 2011/12–2015/16



Source: Global Agriculture Information Network, 2016

Figure 3: South African farm land soya, 2004/05–2014/15 (ha)



Source: Crop Estimates Committee, 2015

GM soya cultivation in South Africa[40]

Soya beans were first introduced into South Africa in 1903 although lack of information about the crop stymied its production for the early part of the twentieth century. Despite government-led efforts to kick-start a domestic soya industry, the area planted under soya beans did not reach 50,000 ha until the early 1990s, and annual production of soya would not regularly surpass 100,000 tons until the year 2000.

In 2001 GM soya beans (NK603—Monsanto's 'Roundup Ready' variety) were approved for commercial cultivation in South Africa, and now account for 90% of all soya bean production. Soya bean production has increased dramatically over the last decade, growing at an average annual rate of 13%, from 2005 to 2015. Despite the recent drought experienced by South Africa, during the 2015/16 cropping season South African farmers planted a record 687,000 ha of soya beans. The major soya producing areas in South Africa are located in Mpumalanga, which accounts for 43% of the country's total production, and the Free State (which accounts for 33%).

Since its approval in South Africa in 2002, the area of GM soya in the country has expanded rapidly; in 2015 GM soya accounted for 618,000 ha of the total area of 687,000 ha under soya. This has coincided with an overall increase in all GM crop cultivation, due to a concerted effort led by the Department of Trade and Industry (DTI) to increase domestic soya production in South Africa.

When compared with maize, sunflower and groundnuts, soya bean is the only major grain crop that has shown significant production increases since 2004, although yields have remained at roughly 1.12 tons/ha over the period (Grain SA, 2015). In 2012 for the first time the area under soya surpassed that of the area under sunflower. Soya is now considered South Africa's most important oilseed crop.

Further expansion of the area under soya is envisaged. The BFAP predicts that the total area under soya in South Africa will rise to over 1 million ha by 2024, and production is expected to exceed 2.1 million tons. If the current rate of GM soya adoption is maintained (as has been the case over the last three seasons), this will mean nearly 1 million ha of GM soya cultivation in South Africa within a decade.

By 2013 GM varieties already constituted 90% of total soya cultivated.[39] Thus, although it appears there is slightly more competition or choice for farmers in soya seed, smaller competitors also license the traits and technologies from Monsanto. This constitutes a de facto monopoly already. As part of the monopoly technological platform based on Monsanto's traits, the introduction of GM soya has led to dramatic increases in the use of glyphosate-based herbicides worldwide, including in South Africa.

With increasing insect resistance and herbicide tolerance, the biotech industry is on a constant cycle of developing and introducing new varieties that can withstand more toxic chemicals. GM maize and soybean varieties tolerant to 2,4-D (owned by Dow) and glufosinate ammonium (owned by Bayer) are currently being developed and released. Glufosinate is being completely phased out in the EU by 2017.

39. Gouse, M. 2014. "Assessing the value of glyphosate in the South African agricultural sector". Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, p.15.
40. African Centre for Biodiversity. 2016. "Genetically modified (GM) soya in South Africa: Status quo report." http://acbio.org.za/wp-content/uploads/2016/07/GM-Soya-Update-ACBio.pdf

Table 4: Agrochemical value chain and main actors

Node	Main actors
Research on new chemicals	***Multinationals:*** Arysta, Adama (ChemChina), BASF, Bayer, Dow, DuPont, FMC Chemicals, Land O'Lakes/Winfield, Monsanto, Sipcam, Sumitomo, Syngenta
Reformulation and production under licence	***Multinationals:*** Adama SA, Platform Speciality Products (incorporating Agriphar Crop Solutions and Arysta LifeScience SA), BASF SA, Bayer Cropscience, Advanced Biological Marketing, Cit Chem SA, Citrashine, Dow Agrosciences, Du Pont, Exportos (Villa Crop Protection/Land o' Lakes), Farm-Af International, FMC Chemicals, Illovo Sugar, Kannar Earth Science, Monsanto SA, Oro Agri SA, Philagro SA, Rotam South Africa, Sipcam SA, Syngenta SA, Total SA, Trical Crop Protection, Villa Crop Protection ***Domestic companies:*** Ag-Chem Africa (Rolfes), Agro-Organics, Avima, Azanchem, Chempac, Cropchem, Enviro Crop Protection, Farmkem, Harvest Chemicals, Hygrotech Seed, ICA International, Inline Trading 112/Nutrico, Insect Science, Kelp Products, Klub M5, MBF International, Medson Manufacturing, Meridian Agritech, Nialcor, Nulandis, Ortus Chemicals, Protek/Pee Bee Agri, SAGL, Scientific Supa-Kill, Siena Bionatec, Zetachem (Omnia)
Distribution	Agriplus Chemical Solutions, Agri-Chemies, Agrison, Baygro Central, Boschem, Coast and Country Agri, Destrimix/Noordchem, Ecoguard Distributors, Farmers Agri-Care, Inteligro, Kombat, Laeveld Agrochem, Loskop Kunsmis, Midchem, Nexus AG, Novon, Octu Chem, Oosvaal Landbou, Provento, PW Landboudienste, Remitto, Sharda Africa, Shiman, Silvix Forestry, The Co-op, Viking Marketing, Wenkem SA, Wilge Chem

Source: CropLife membership lists, 2017

Glufosinate-ammonium is an active ingredient in several non-selective herbicides produced by Bayer CropScience such as Basta, Finale, Rely, and Liberty. Glufosinate-tolerant GM crops were granted commercial approval in 2012 in South Africa. The trait has been licensed out by Bayer to Dupont and a host of field trials of Maize involving this trait have been granted approval in SA as well as for GM cotton.[41]

Monsanto's first generation GM traits are starting to come off patent soon. They were developed in the 1990s, with a 20-year lifespan for patents. The strategy is to produce stacked traits with more than one GM trait packed into the seed. These seeds can then be patented for a further 20 years as 'new' varieties, even though the technologies are old. These stacked traits also respond to rising insect and weed resistance. A merger between Bayer and Monsanto will allow the merged entity to pool their patented technologies together to widen the range of stacks (and new patented varieties) they can create.

Agrochemical value chain and main actors

Table 4 gives an overview of the agrochemicals value chain and main actors. Original R&D on new chemicals is mostly conducted by multinationals outside South Africa. The R&D process is very lengthy and costly. It currently takes over 11 years on average from first synthesis of molecules to sale of product, at an average cost of US$286m per product.[42] Domestic companies and domestic subsidiaries

41. African Centre for Biosafety 2012. "The new generation of GM herbicide tolerant crops: poison cocktail for ailing agriculture", http://acbio.org.za/wp-content/uploads/2015/02/ACB-factsheet_24-D-soybean.pdf
42. Phillips MacDougall 2016. "The cost of new agrochemical product discovery, development and registration in 1995, 2000, 2005-8 and 2010 to 2014. R&D expenditure in 2014 and expectations for 2019". Phillips MacDougall, Midlothian, UK, p.3.

Table 5: Registered active ingredients, 2016

	Herbicides	Insecticides	Fungicides	Plant growth regulators	Total
Monsanto	7	0	0	3	10
Bayer	10	16	32	7	65
Dow	41	15	10	3	69
Du Pont	10	3	9	0	22
Adama/Makhteshim-Agan (ChemChina)	51	23	20	2	96
Syngenta	34	13	22	6	75
BASF	13	8	26	4	51

Source: AVCASA registration lists, 2016

of multinationals who manufacture agrochemicals in South Africa mostly import the active ingredients and reformulate and trial the products under licence for domestic requirements. They are therefore subsidiary operators within the dominant technological platform.

Agrochemical distribution agents are required by law to register with the registrar of the Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947. Agrochemical distribution networks tend to be distinct from the manufacturers although there may be overlaps.

Publicly available information on agrochemical use and market share in South Africa is non-existent. Although there are industry bodies (CropLife International and the Association of Veterinary and Crop Associations of South Africa) these do not provide public information about market shares. Very little academic or civil society research has been done on the agrochemicals sector in South Africa.

Table 5 shows the number of registered active ingredients held by the multinationals involved in the current round of mergers plus BASF. Although Monsanto does not have many registered active ingredients in their name, the company has significant market share in herbicides. Glyphosate, which was developed by Monsanto, is the most used herbicide in South African agriculture. This is part of the dominant technology platform in operation in South Africa. Although glyphosate is extensively used across all agricultural sectors, the main users are maize, wheat and soya, which between them were responsible for 65% of all glyphosate used in South Africa in 2012.[43] Monsanto's glyphosate patent has expired, and the chemical is now registered as an active ingredient by 30 companies in South Africa, including Monsanto and Bayer.[44] However, even though the patent has expired, Monsanto has been able to use its 'first mover' advantage to entrench its position in the glyphosate market. Farmers can technically use any glyphosate-based herbicide with GM seed using Monsanto's herbicide tolerant traits. But if they do so they forfeit their claims for compensation if there are problems with the seed. This effectively ties farmers into using Monsanto's Roundup if they want to use this seed.[45] As indicated above, the overwhelming share of maize and soya planted in South Africa is herbicide tolerant using Monsanto's traits.

Herbicides are the main crop protection chemical used on maize in South Africa, accounting for 68% of expenditure on crop protection in 2012, followed by fungicides (11%), seed treatments (10%), insecticides (8%)

43. Gouse 2014, *op cit*
44. Association of Veterinary and Crop Associations of South Africa (AVCASA) 2016. "Registered herbicides August 2016".
45. African Centre for Biodiversity. 2015. "Heavy hands: Monsanto's control in South Africa", http://acbio.org.za/wp-content/uploads/2015/02/GMO-Monsantos-May2011.pdf

and adjuvants (3%). Over 29% of expenditure on herbicides for maize was on glyphosate in 2012; in turn, 67% of this was on Monsanto's Roundup.[46] For soya, herbicides accounted for 79% of total expenditure on crop protection chemicals, with glyphosate representing 53% of the value of herbicides on soya in 2012.[47] There is a clear correlation between the planting of herbicide tolerant GM crops and increasing use of glyphosate.

Competition and public interest issues

The South African government recently has made bold statements about taking on corporate power and the need for radical economic transformation in this highly unequal and increasingly disaffected society of ours. This points to growing societal pressure for greater inclusion and broader active participation in productive activity, and for a more equitable distribution of resources and opportunities. In the light of the land reform process, smallholder support and rural development policies could be considered within this framework. There are also government commitments to biodiversity and natural resource conservation, especially through the Department of Environmental Affairs. Science and technology policy aims to support and boost domestic innovation.

In this context we have to pose the question: How does increasing concentration of agricultural input supply in the hands of foreign multinational corporations move us as a country towards these goals?

The merger of Bayer and Monsanto, alongside the other current mergers, opens the agro-food system in South Africa to systemic risk. The impacts of these processes of concentration go well beyond narrow concerns about whether there are enough competitors in segmented markets to give farmers choice between one brand of an active ingredient or another, or one variety of genetically modified maize or another.

What this narrow approach to markets misses is the presence of an overwhelmingly dominant technological platform in which all the major companies operate, with no effective alternative available to farmers, especially in the key sectors of maize and soya. This also has broader effects on corporate concentration in the food system as a whole. Multinationals are using their great power and resources to control and channel research and product development onto specific **technological pathways** based on a single technological platform dominated by Monsanto's innovations, patents and traits, which narrows options for farmers and consumers, and makes the system more vulnerable to shocks and stresses.

- This control over and channelling of resources into entrenching a particular system of food production and distribution allows input producers to capture an increasing share of value created in the food system in the form of **seed prices** that rise faster than prices farmers receive for their products.
- These same processes of capture and control of seed systems have already led to a significant reduction in **agricultural biodiversity**, i.e. in the range of crops and varieties readily available for agricultural production; coupled with an intensifying ecological crisis in agriculture in the form of persistent poisons in the soil and water and the accelerating destruction of ecosystems.
- Further concentration of resources, power and wealth entrenches an **inequitable economic system**, where a few giant corporations managed and owned by wealthy elites systematically exclude the majority of the population from anything other than a subordinate relation to the core of economic activity.

46. Gouse 2014, *op cit*., p.11.
47. Gouse 2014, *op cit*., p.16.

Path dependency and narrowing of options for farmers and consumers

As indicated above, agriculture operates within an increasingly technology-oriented regime, which "determines to a large extent what types of innovations are perceived to be needed (e.g. what are considered to be 'good agricultural practices'), and how the science system is supposed to support innovations".[48] The dominant technological platform or innovation regime, structured as it is around large-scale, private corporate R&D, creates path dependencies, sunk investments and institutional logics that are increasingly difficult to change. A technology-oriented regime, linked to a dominant technological platform, removes innovation from farmers and converts them into passive recipients of top-down innovations that favour private corporate interests.

The result over the past forty years in South Africa has been a move to systems of agricultural production and food products that prioritise a relatively small number of industrial crops, in particular maize, wheat and more recently soya. These crops are generally large-scale mono-crops producing uniform and standard outputs amenable to mechanical harvesting and processing, and rooted in economies of scale. This is turn reinforces concentration throughout agro-food value chains as economies of scale for standardised products shape the food system.

For consumers, this R&D paradigm feeds into an agro-food system that generates standardised, comparatively cheap, industrially-processed food. It narrows the range of available choices for consumers, and has resulted in a sharp rise in diet-related non-communicable diseases as people move away from a diversity of whole grains and fresh produce at the centre of the diet to convenient, cheap but less healthy ultra-processed foods.[49]

The technological platform is constructed around GM and hybrid seed, and integrated with particular chemicals that cannot be 'uncoupled' from one another i.e. the technologies come as an indivisible package of traits, seed and chemicals. A merger between Bayer-Monsanto will intensify this as future R&D will be structured to seek ways of taking advantage of new combinations of IP, seed and chemicals that will be available in the enlarged technology pool of a merged entity.

As ETC Group explains: "Once a company has gone through the costs and regulatory manoeuvres to bring a new pesticide to market it makes sense to focus on developing much cheaper plant varieties that either tolerate or need their proprietary toxin. But, it also means that a company has no incentive whatsoever to develop pest or disease tolerant plant varieties needing fewer toxins".[50] Likewise, research into alternative forms of pest management, such as integrated pest management and biological controls, is likely to take a back seat to efforts to maximise returns on sunk investments in existing IP, genetics and toxins. This has significant long-term ecological implications as soil and water systems are poisoned and sterilised. There is widespread recognition that pesticides pose a threat to long-term sustainability in agriculture, and that alternatives must be sought. According to the Food and Agriculture Organisation (FAO) of the United Nations, "the weight of scientific evidence shows the vast majority of pesticides do little or nothing to increase production and most often reduce farm profits and incur major negative side effects on human and environmental health", and they have a

48. Schut, M., Klerkx, L., Sartas, M., Lamers, D., Campbell, M., Ogbonna, I., Kaushik, P., Atta-Krah, K. and Leeuwis, C. 2016. "Innovation platforms: Experiences with their institutional embedding in agricultural research and development", *Experimental Agriculture*, 52:4, p.5.
49. Shisana, O., Labadarios, D., Rehle, T., Simbayi, L., Zuma, K., Dhansay, A., Reddy, P., Parker, W., Hoosain, E., Naidoo, P., Hongoro, C., Mchiza, Z., Steyn, N.P., Dwane, N., Makoae, M., Maluleke, T., Ramlagan, S., Zungu, N., Evans, M.G., Jacobs, L., Faber, M., and SANHANES-1 Team 2013, *South African National Health and Nutrition Examination Survey (SANHANES-1)*. HSRC Press, Cape Town; Ronquest-Ross, L-C., Vink, N. and Sigge, G. 2015. "Food consumption changes in South Africa since 1994". *South African Journal of Science*, 111:9/10, Art. #2014-0354.
50. ETC Group 2015, *op cit*., p.14.

programme aimed explicitly at eliminating or reducing the use of toxic pesticides in agriculture.[51]

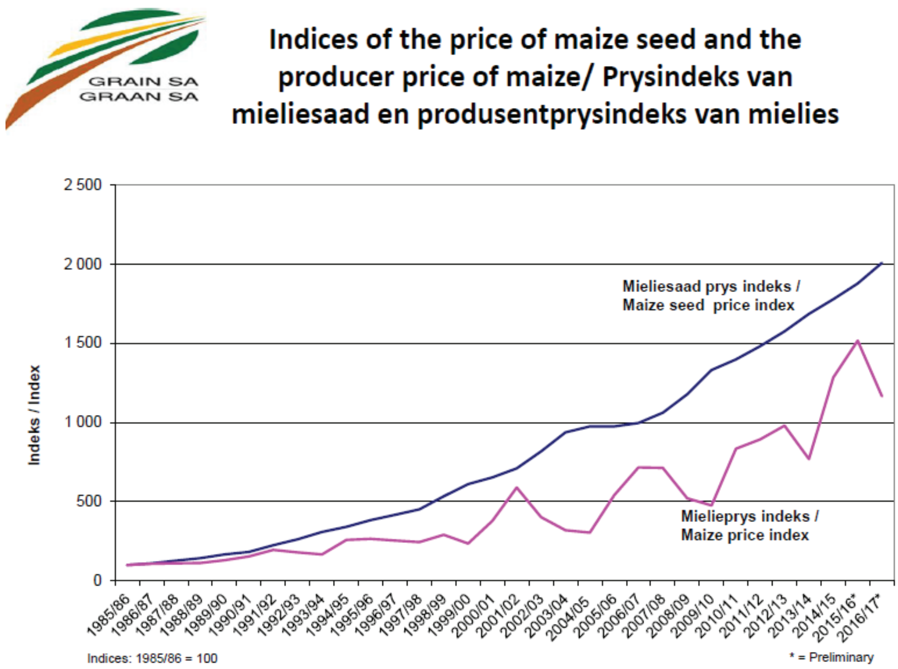
Commercial farmers are increasingly compelled to adopt these technological packages on terms dictated by the proprietary owners of the technologies. There is virtually no choice other than to operate within the confines of the dominant technological platform. The almost universal adoption by commercial farmers of GM maize and soya and their associated chemicals in South Africa is strong evidence of this. The space for non-biotech alternatives closes, and as it does so, farmer dependency on the corporations to provide new technological 'solutions' to pest resistance and stagnating yields increases. Further concentration of ownership in these technologies will only reinforce this. This places the food system on an increasingly unstable and risky footing as all the eggs are placed in one basket. The excess uniformity of this system opens agriculture to vulnerability to external shocks, such as drought or pest invasions (e.g. fall army worm).

As fewer resources are made available for alternative, more context-appropriate seeds and crop protection methods, smaller farmers will simply fall by the wayside, unable to compete at the necessary scale to justify the expense of adopting the predominating technological packages. This works in the opposite direction of government's stated intention to facilitate a wider and more inclusive base of productive activity. It reduces competition in agriculture, with increasing domination by fewer, larger-scale commercial (and increasingly corporate) producers pushing other producers to the margins or out of production completely.

Rising input prices, leading to rising food prices

It is well known that for decades farmers at all scales have faced a 'cost-price' squeeze, with increasing input prices and declining or stable product prices. Taking maize – the dominant crop by far in South Africa – as an example, there is a widening gap between the price of

Figure 4: Maize seed prices to grain prices, 1985/86–2016/17



Source: Grain SA, 2016

51. FAO Integrated Production and Pest Management Programme in Africa, http://www.fao.org/agriculture/ippm/activities/pesticide-risk-reduction/en/

seed and the price of grain (Figure 2). GrainSA notes that the consistent increase in seed prices is becoming a major concern to grain producers.[52] This can be directly translated as an increase in the share of value captured by the seed companies. It is not coincidental that the widening gap in prices has occurred at the same time as consolidation in the seed industry, and the rapid spread of GM seed with all its additional fees and costs. These costs are meant to be recouped in greater yields and higher prices, but this only works for the largest producers. Meanwhile all other producers have to chase behind them, adopting the same technologies, or fall out of the market.

Where the ownership and production of seed is concentrated, oligopolies may form where prices are artificially raised to accrue more profit for seed owners. Cartels are one form of this, where companies collaborate with one another to set prices. Although this is outlawed, it does take place in agro-food value chains, as previous cases before the Competition Commission have revealed (e.g. bread manufacturers, silo owners, fertiliser producers). Where the market is concentrated, major companies can decide not to wage a price war and rather to compete on other grounds, thus keeping prices high.

Trait stacking can also lead to royalty stacking (each trait owner will want their royalties from the sale of the seed) which is liable to inflate seed prices. If farmers are locked onto a technological path that depends on a technological package of GM seed and agrochemicals, they will have to pay these constantly rising costs regardless of the price they ultimately realise for their output. The risk, therefore, is borne by farmers with fewer options available to mitigate that risk through the use of alternative seed and crop protection methods.

In turn, rising agricultural input prices will lead to rising food prices. South Africa's National Agricultural Marketing Council (NAMC) estimates that the price of maize meal increases on average by 0.33% for every 1% increase in the price of maize.[53] For commercial farmers, seed prices were around 10–12% of total input costs in 2012.[54] For smallholder farmers, seed can constitute between 16% (for old hybrids) rising to 43% (for certain GM seed varieties) of total input costs.[55] Rising seed prices may, therefore, have an impact on food prices, with a greater impact on smallholder farmers and their customers, who are mostly the rural poor.

Corporate capture of R&D and shrinking agricultural biodiversity

There is global recognition of the importance of R&D for agricultural growth and productivity.[56] Historically farmers have played the central role in maintaining and improving genetic resources for agriculture through on-farm seed selection, saving and sharing. In South Africa, old cultivars of indigenous crops, such as millets, cassava, plantain, sorghum, cowpea, okra, yams, and sweet lupins have been maintained on-farm, mainly by smallholder farmers.[57]

The public sector historically played a role in R&D on less lucrative crops. Public sector research institutions,such as the ARC have played an important role in improving less commercial varieties, although in recent years

52. GrainSA 2015. "Input research and development", http://www.grainsa.co.za/input-research-and-development/insetnavorsing-en--ontwikkeling
53. GrainSA 2015, *op cit*.
54. Lowane, S. 2011. "Minimum enterprise size – maize and sunflower production", http://www2.senwes.co.za/files/main_productsservices/agriservices/2011/lesings/OL_Landbou-ekonomie_2011_Sipho_Lowane_Minimum_enterprise_size_maize_and_sunflower.pdf
55. Gouse, M. 2014. "Seed technology and production system comparisons – South African subsistence/ smallholder farmers", Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, Pretoria, p.8
56. See for example Beintema, N. and Stads, G-J. 2014. "Taking stock of national agricultural R&D capacity in Africa South of the Sahara. Agricultural Science and Technology Indicators (ASTI) synthesis report". IFPRI
57. National Department of Agriculture 1995. "South Africa country report to the international conference and programme on plant genetic resources", NDA, Pretoria, p.14

they have come under pressure to focus on activities with commercial potential. R&D has only fairly recently been captured by corporations, with the advent of IP rights over seed varieties as a means of capturing value in the chain stimulating commercial efforts. "Higher costs for R&D first for hybrids, and then for genetically engineered traits and plants, encouraged firms to get bigger in order to maintain their competitive edge in R&D, and IP protections provided them with the capacity to recoup those costs by holding exclusive rights to their products for the duration of the patent".[58]

Since the 1990s there was a decline in public sector agricultural R&D expenditure in South Africa. Agricultural budgets were slashed and the parastatal research institutes, who previously were fully funded by government, were corporatised and had to secure part of their funding from contracts with private companies.

The ARC institutes generally have three strands to their work: a small 'public good' strand where they do their own R&D and the collection is open for public use; a sub-licence strand where the institute gets a licence to work on privately owned germplasm and pays royalties to the owner if they develop a product that is sold; and a private client collection, which is the core of their work.[59] The public good strand is very small compared with privately funded activities.

ARC-VOPI (Vegetable and Ornamental Plant Institute) is the only source of seed for some indigenous crops, e.g. amaranth, spider flower, jute, local species of nightshades, local landraces of cowpea and pumpkin, bitter watermelon and amadumbe. Commercial vegetable varieties are all in the hands of the private sector. ARC-GCI (Grain Crops Institute), which deals with maize, sunflowers and soya amongst others, does almost no public good R&D anymore,[60] and at best works in public-private partnerships (PPPs) which might also be seen as the use of public institutions to expand the reach of GM seed.

We have witnessed the abandonment of public sector plant breeding and a shift to subsidising corporate R&D needs.[61] Today most public sector breeders in South Africa have retired or been retrenched and the public institutes have limited resources to maintain breeding programmes. The International Food Policy Research Institute (IFPRI) indicated a 20% decline in the number of PhD-qualified researchers in ARC between 2008 and 2011.[62] Between 2000 and 2011 South Africa had a negative growth rate in public expenditure on agricultural R&D (although in 2011 this was still above the 1% target ratio of agricultural R&D to agricultural GDP agreed by African governments).[63] New students are mostly channelled into biotechnology and genetic modification research. The research institutes have increasingly been drawn into maintaining private germplasm collections on behalf of companies, with only a limited amount of R&D being carried out in the public interest.

Following a 25% cut in government grants to the ARC in 2015–16, Dr Shadrack Moephuli, President and CEO of the ARC said, "reductions in Parliamentary Grant allocations adversely impacted on the ability of the ARC to fulfil its mandate ... Lack of financial resources adversely impacted on the ARC's ability to successfully complete some of the research, technology development and technology transfer projects, again compromising the organisation's ability to fulfil its mandate".[64]

In recent decades the growth of private sector agricultural R&D spending has far outpaced public agricultural R&D, especially after plant breeders' rights and patents allowed

58. Clapp 2017, *op cit*., p.7.
59. Interview, Nokuthula Myeza, Manager, ARC-VOPI in vitro gene bank, 7 Sept 2011.
60. Interview, Dr Willem van Rensburg, ARC-VOPI Plant Breeding division, 7 Sept 2011.
61. ETC Group 2015, *op cit*., p.10.
62. Beintema and Stads 2014, *op cit*., p.9
63. Beintema and Stads 2014, *op cit*., p.15
64. ARC Annual Report 2015–16, p.15

companies exclusive control over genetic material from the 1980s. Three quarters of private sector R&D expenditure on seed and agrochemicals globally is by the six major corporations in these sectors (Monsanto, Bayer, BASF, Dow, DuPont and Syngenta). In 2013 the combined agricultural R&D budgets of the 'Big Six' was 20 times bigger than the Consultative Group for International Agricultural Research (CGIAR)'s total expenditures on crop-oriented research/breeding – including gene bank conservation.[65]

The private sector focuses on a limited number of lucrative crops. As indicated above, maize is by far the dominant seed crop by value, followed a long way behind by soya and then onions, wheat and other crops further back. This produces fragile monocultures that are susceptible to external shocks. Evidence from multiple countries in Europe indicate that concentration of ownership leads to companies reducing the number of varieties they make available even within this narrow range of crops.[66]

Even more importantly, a large amount of agricultural biodiversity beyond these crops is neglected and lost. Crops and varieties that are not lucrative are marginalised. In the past century of industrialisation, around 75% of plant diversity has been eroded, as many farmers have abandoned the use of landraces and local varieties in favour of uniform genetic varieties.[67]

Farmers – especially smallholders – continue to play a crucial role in maintaining and reproducing agricultural biodiversity. This role is explicitly recognised in international agreements, such as the International Treaty on Plant Genetic Resources for Food and Agriculture.[68] Even in South Africa, where smallholder farmers are considered by many to be marginal and irrelevant, recent ACB research with smallholder farmers has shown a high level of reliance on own saved seed and indigenous varieties for their livelihoods and survival.[69] Marginal as they are, these farmers continue to play a crucial role in maintaining biodiversity and in contributing to innovation by selecting for preferred traits and adapting the seed to local conditions.

But this is under pressure in the context of a corporate-driven push for 'modernisation', the adoption of commercial seed varieties and technological packages, including synthetic fertilisers and agrochemicals, and disregard and even criminalisation of longstanding farmer practices in recycling and maintaining a diverse variety of seed. The result is a gradual, and sometimes dramatic, loss in biodiversity. Germplasm needs refreshing from time to time. There will be a general exhaustion of seed over time if the same seed is used in the same place without external contributions to the gene pool. Diseases will build up if not managed carefully. Farmers therefore require support to assist them in refreshing germplasm, and in the selection and enhancement of these diverse varieties. Large corporations driven by quarterly shareholder returns as the measure of success will not invest in these activities. Public sector R&D is being subordinated to corporate interests and, therefore, resources are not channelled towards supporting farmer innovation and variety maintenance and enhancement in the field.

ARC holds germplasm collections stretching back more than 50 years. ARC explicitly states that "if this asset is lost or not maintained properly, all breeding projects of mandated crops will suffer and become entirely

65. ETC Group 2015, *op cit*., p.4
66. See Solberg, S. and Breian, L. 2015. "Commercial cultivars and farmers' access to crop diversity: A case study from the Nordic region", *Agricultural and Food Science*, 24, pp.150–163; Hilbeck, A., Lebrecht, T., Vogel, R., Heinemann, J. and Binimelis, R. 2013. "Farmer's choice of seeds in four EU countries under different levels of GM crop adoption", *Environmental Sciences Europe*, 25:12.
67. Food and Agriculture Organisation 2005. "What's Agrobiodiversity?" in "Building on Gender, Agrobiodiversity and Local Knowledge", FAO, Rome.
68. http://www.fao.org/plant-treaty/en/
69. African Centre for Biodiversity 2017. "Against the odds: Smallholder farmers and agricultural biodiversity in South Africa". ACB, Johannesburg.

dependent on foreign, often non-adapted material".[70]

Maintenance of agricultural biodiversity is crucial in the context of climate change, drought, and the maintenance of cultural and food diversity. Large-scale commercial farmers producing monocrops are not in a position to carry out this ecosystem service*. This maintenance role has fallen to smallholder farmers, marginalised as they are from the mainstream economy and support services. As indicated above, the technology-oriented paradigm results in a lack of diversified R&D, which means increasing uniformity in what is produced and consumed. This is hidden behind an apparent proliferation of choice of varieties within a narrow range of crops.

Entrenching an inequitable economic system

Widening the base and increasing participation in productive activity is a national imperative in responding to the legacy of apartheid, which has produced a concentrated and racially skewed economic structure, where most of the population have been forced into subordinate roles in the economy, based on high levels of exploitation and oppression. South Africans are keenly aware that this underlying structure persists in the present.

The realisation of the goals of widening economic participation and a more equitable distribution of resources and opportunities will require:

- Stabilising and supporting the expansion of smallholder farmers in diversified agricultural production;
- Farmer and small business participation in seed production – this is completely neglected, and there are only a few very small programmes touching not even hundreds of participants; and
- Farmer and small business involvement in crop protection innovation and development – this can include context-specific and cost-effective alternatives, such as integrated pest management and use of biological controls, which are especially appropriate for smallholder production.

In all of these, a strategy is required that goes beyond passive consumption of products generated in a large-scale commercial core, increasingly dominated by multinational businesses.

Enhancing domestic innovation – a key thrust in national science and technology policy – is a key route to wealth creation in a globalised knowledge economy. There is growing recognition of the importance of active farmer participation in agricultural innovation and in the development of technologies. The methods must go beyond a simplistic top-down technical 'fix' that is then transferred to farmers to adopt, to incorporate a multi-dimensional understanding of innovation that includes context-specific socio-cultural, economic, agro-ecological, and systemic institutional and political dimensions of innovation.[71]

It is clear that a merger between Bayer and Monsanto – as well as the other pending corporate mergers in agricultural input supply – works against this agenda of multidimensional, domestic innovation. Already most private sector agricultural R&D in South Africa is based on adaptations of imported technologies under licence from multinational companies.[72] Technology fees and royalties are paid to the patent- or rights-holder. This results both in an extraction of value from South Africa and also closes off possibilities for domestic innovation. IP rights, including plant breeders' rights, restrict farmers from engaging in seed enhancement in the field because by law they are not allowed to save and reuse protected seed without paying royalties. These property rights also restrict cumulative innovation by other smaller seed

70. ARC Annual Report 2015–16, p.19.
71. Schut *et al*. 2016, *op cit*.
72. Kirsten, J. 2011. "More research!", *Farmers' Weekly*, 26 August, p.48.

companies from using protected varieties as a basis for further development.[73] The proposed merger will intensify this because it makes barriers to entry for smaller breeders much higher. These smaller domestic companies are forced to compete with multinational corporations that have billions of dollars at their disposal for R&D conducted elsewhere, and these corporations therefore shape and determine which technologies will be used in South Africa and how.

Conclusion

We recognise the very unequal playing field in which these mergers take place. Corporations with billions of dollars and high level technical and legal expertise at their disposal have whatever time they require in which to prepare their case for the mergers. They hold all the information on costs, market shares etc., which is kept secret from the public on the basis that it is sensitive commercial information. The Commission and public interest organisations are kept in the dark until the last minute and even then, adequate information is not provided in time. The Commission gets a mere two months to make a decision. Corporations involved in these mergers may make promises about the benefits of the merger to society, but there is no mechanism for monitoring whether these benefits actually accrue. Once the deal is settled, they return to their closed systems, hoarding information and knowledge and engaging in opaque activities that no one is able to track effectively. The corporations are not held to their promises, apart from very specific conditions the competition authorities are able to impose (e.g. no job losses for three years). This is a fundamentally broken system that threatens the long-term sustainability of the food system.

We are also concerned about the restricted focus the Commission is required by competition law to adopt. A narrow approach to competition policy that focuses only on whether competition remains in segmented product markets (e.g. a particular class of herbicides, or availability of maize seed varieties produced by other companies on the national list) cannot capture the broad systemic impacts of ongoing corporate concentration and the monopolistic, or at the very least, cartel power of a dominant technological platform. In South Africa one company (Du Pont Pioneer) holds 78% of GM white maize varieties, the staple food crop of the country. Even this company is locked onto the technological platform built on Monsanto's patented biotechnology traits and agrochemical compounds for the same staple food. This situation has developed despite existing competition policy and an active Competition Commission. A merger between Bayer and Monsanto will merely reinforce the stranglehold of this platform.

Instead of considering narrowly whether there is competition in individual segmented markets or intra-platform competition, the Commission may more fruitfully interrogate whether there is inter-platform competition, i.e. competition between different sets of technologies with different actors involved. Pursuing this line of argument, it will become apparent there is an almost complete monopolisation of seed and agrochemical development and supply by a small group of extremely powerful multinationals, who sometimes compete within the platform and at other times collude with one another to share technologies, thereby locking other actors out of the market. Ultimately we must call for a break up of these monopolies and the opening up of opportunities for other actors and technological platforms to engage in economic activity and to provide meaningful choice to farmers and consumers.

The Commission has a small window of opportunity to gather proprietary information from these corporations while investigating the merger. Information that is needed to make an informed decision even about intra-platform competition includes:

73. Lianos, I., Katelevsky, D. and Ivanov, A. 2016. "The global seed market, competition law and intellectual property rights: Untying the Gordian knot", Centre for Law, Economics and Society Working Paper 2/2016, UCL, London.

- Royalties and licence fees being extracted from South Africa;
- Patent ownership on genetic traits and technologies, and agrochemicals in use in South Africa's dominant technological platform;
- The extent to which the Monsanto-driven technological platform constitutes a de facto monopoly in the provision of seed and related inputs to farmers in maize and soya;
- Cross-licencing and patent/technology pooling agreements between the merging companies, and between these corporations and other 'competitors', and the extent to which these agreements can be considered as collusion or cartel behaviour that serves to reinforce the dominant technological platform and exclude alternatives;
- Allocation of R&D expenditure of the merging companies in South Africa, and how much of this is original research;
- Market shares in GM traits, seed varieties, and agrochemicals (particularly glyphosate and other broad spectrum herbicides, including glufosinate and paraquat);
- Details on value chain relationships in agrochemicals, especially between manufacturers and distributors, especially to look for exclusive supply arrangements; and
- Terms of supply between agrochemical producers and distributors.

Smallholder farmers are likely to be unaware that the merger is even being proposed, or what the implications of the mergers will be on them. If these processes were to be conducted democratically, smallholder farmers would be given at least an opportunity to be informed and to make their own contributions on their experiences with accessing seed and agrochemicals, their actual needs and their own proposed solutions.

We urge the Commission to consider the wider implications of these mergers beyond a narrow view of competition in segmented product markets. These include the entrenchment of the dominant technological platform in agricultural inputs, broader impacts on the agro-food system, agricultural biodiversity, input prices for farmers and knock-on effects on food prices, domestic innovation, and implications for just economic transformation and widening the base of productive activity.

The fundamental question is whether further concentration in seed and agrochemical markets will really facilitate South African developmental goals of diversifying the economic base, and including smaller producers in systems of innovation and production with adequate support. This is not only unlikely but definitively works against these goals. The merger will serve to reinforce the dominant platform, extract value from the country through payments for technology, and widen the innovation gap, because technologies are developed externally and brought in to South Africa at high cost for restricted and controlled use.

Appendix 1: Glossary

Agricultural biodiversity

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems (also named agro-ecosystems): the variety and variability of animals, plants and micro-organisms at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes.

Broad spectrum herbicide

Broad spectrum, or non-selective, herbicides are effective in killing a wide range of plants. They are widely used with herbicide-resistant crops because they allow the grower to spray their fields without concern that the crop will be killed along with the weeds.

Bt crops

Bt crops are those that have been genetically modified to produce insecticidal toxins that derive from the bacterial species *Bacillus thuringiensis* (or Bt). The bacteria produce two types of toxins including Cry toxins, of which there are a known 50 different forms with distinct toxic effects that target various insect species. Numerous Cry toxins have been incorporated into genetically modified crops, for example MON810 maize carries the Cry1Ab toxin, while MON89034 maize is a stacked trait, carrying two: Cry2Ab2 and Cry1A.10.

Chimeric DNA

A hybrid DNA molecule generated by joining up DNA from different sources, including DNA from different species that would not naturally mix in nature. Transcription and translation of the chimeric DNA result in a chimeric protein. Also referred to as recombinant DNA. The use of chimeric DNA put together from different sources is to optimise the functioning of the transgene once introduced into a crop. Such elements include promoters, the protein-coding gene that confers the trait of interest, as well as 'stop' signals and signal sequences.

The gene promoter is a regulatory element that is required for 'switching on' the expression of the gene. The cauliflower mosaic virus 35S promoter (CaMV 35S) used in this case derives from a virus. The protein-coding gene encodes the enzyme that functions to confer glyphosate toxicity (the epsps gene, derived from a bacterial species), while the 'stop' signal is required in genes to assure the termination of expression of the protein-coding gene, also derived from a bacterium. A forth element deriving from a plant, is the signal sequence. The synthetic gene is therefore a recombinant or chimeric gene consisting of a composite of genetic elements put together from different sources in the laboratory to optimise its function once introduced into a crop. These elements are patented together, as are the composite parts. Patent 605 covers for example, the chimeric DNA sequence for conferring glyphosate tolerance, as well as any plant cell expressing a chimeric transgene that includes the CaMV 35S promoter. The 247E patent reissued to Monsanto in 2006 covers slightly different aspects of the technology – the transformation process, which is the introduction of genetic material into the cell. 247E covers the transformation of plant cells with the CaMV 35S promoter epsps gene, conferring glyphosate tolerance, as well as the other relevant regulatory elements.

Ecosystem services

The benefits people obtain from functioning ecosystems. These include provisioning services, such as food and water; regulating services, such as flood and disease control; cultural services, such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling that maintain the conditions for life on Earth.

Genetically modified organisms

Genetically modified organisms (GMOs) can be defined as organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination, generated via the use of modern biotechnological techniques.

The process of generating a GMO involves first the generation of DNA sequences that are required to confer the trait of choice in the plant. These DNA sequences are known as **chimeric DNA***, or recombinant DNA, consisting of various genetic elements from different sources that are required for correct functioning of the genes once inserted into the plant. The chimeric DNA is then introduced into the plant, a process called **transformation***. In order to transform a plant, a number of various techniques can be employed to insert DNA into plant cells that are grown in the lab. Biolistics is one technique, whereby the GM gene cassette is attached to tiny gold particles which are then fired at millions of the cultured plant cells. They then enter the cell and some of them manage to insert themselves randomly into the plant cell. Another method employs a plant bacteria that naturally infects plant cells, called *Agrobacterium tumefaciens*. This infectious DNA material from the bacterium is hijacked by scientists, who then insert their completed chimeric DNA sequences into it, and this is then used to infect plant cells. Once this process is complete, cells that have taken up the DNA are selected for. For example, if a **marker gene** is included in the chimeric DNA sequence, such as an antibiotic resistance gene, antibiotics are applied to the plant cell, and then only cells that have taken up the DNA survive. Sometimes, herbicide tolerance genes can also be used as marker genes, thus removing the need to incorporate an antibiotic resistance gene into the chimeric DNA sequence. Those surviving cells are then regenerated into a whole GM plant.

Genetic resources

Genetic resources refer to genetic material of actual or potential value. Examples include material of plant, animal, or microbial origin, such as medicinal plants, agricultural crops and animal breeds.

Germplasm

Germplasm broadly refers to the hereditary material (total content of genes) transmitted to the offspring through germ cells. Germplasm provides the raw material for the breeder to develop various crops. Thus, conservation of germplasm assumes significance in all breeding programmes.

Herbicide tolerant

Herbicide tolerant crops are those genetically modified to tolerate exposure to herbicides, such as glyphosate and 2,4-D.

Hybrid

Hybrids can only be produced by cross-pollinating plant varieties. An F1 hybrid is produced by crossing and backcrossing the pure lines of different varieties over a number of seasons. When you plant an F1 hybrid seed, you get a plant that has the attributes the breeder has bred into the seed, but if you save the seed, the next generation will not breed true: i.e. its characteristics will revert back to one of the original parent lines, which can vary a great deal. It is not viable to save hybrid seeds.

Improved varieties

By conventional definition, an improved variety is that which has been produced by formal breeding. This would include recycled varieties that have not completely lost their desirable attributes and hence perform better than unimproved varieties.

Intellectual property/intellectual property rights

Intellectual property (IP) refers to creations of the intellect; and intellectual property rights refer to the assigning of a monopoly over the use of these creations to designated owners by law.

Landraces

Landraces refer to local varieties of domesticated plant species, which were bred and selected by farmers over time. They are genetically diverse, dynamic, have specific characteristics, and are highly adapted to the environment in which they have evolved. They have a high capacity to tolerate environmental stress and therefore produce very stable yields. Farmers' varieties are always open-pollinated (can be cross- or self-pollinated).

Licensing

Licensing in relation to patents is a contract between the patent holder (licensor) and the licensee whereby permission is given to the licensee to exploit the patent under certain conditions. The license could be exclusive or non-exclusive, and involves payment of royalty fees.

Marker gene

A marker gene is a gene that is included into a GM gene cassette in order to be able to select which cells have taken up the DNA during the genetic modification process. Many marker genes used in GM crops are antibiotic resistance genes. Cells that have taken up the antibiotic resistance marker gene will not die when antibiotics are applied to the cell, allowing only GM cells to survive and be selected for regenerating into a GM plant.

Open-pollinated varieties (OPVs)

Open-pollinated plants are those that require pollination by the wind, insects, or the farmer to set fruit and produce seeds. In some cases, the plant will produce both male and female flowers on the same plant, which means self-pollination can take place. In other cases, cross-pollination is needed. The key benefit of OPVs is that farmers can save seed and the offspring will continue to be viable.

Patent

A patent is a western concept and confers an exclusive monopoly right to an inventor to prevent all others from selling, producing, distributing, licensing or importing a specific invention. This right usually lasts for 20 years, and is enforceable in the country or region where the patent is granted.

Roundup Ready

Roundup Ready (RR) refers to Monsanto's trademarked, genetically modified, herbicide tolerant crops that withstand exposure to their glyphosate-based herbicide, Roundup®. Monsanto's NK603 is an example of a Roundup Ready crop.

Royalty stacking and anti-stacking provisions

Royalty stacking refers to situations in which a single product potentially infringes on many patents, and thus may bear multiple royalty burdens. This may lead to an increase in the price of a product because multiple royalties must be paid. Anti-stacking provisions aim to limit this price inflation through royalty ceilings, variable royalties, or royalty alternatives (for example lump-sum payments and patent pools).

Stacked traits

Gene stacking refers to the process of combining two or more genes of interest into a single plant. A plant with stacked traits therefore has multiple introduced characteristics, such as a combination of both herbicide tolerance and insect resistance. Stacked traits can be generated by introducing multiple genes into one plant, or through breeding of two or more single-trait GM crops together. The growing number of authorised GM events being released provides breeders with an increasing pool of possible combinations to be stacked together. Further, many technology providers tend to cross-license their GM events, and through this activity many new stacks are brought to the market. For example, the eight-gene maize stacked variety SmartStax™ is the result of crossing four different biotech maize lines to combine two herbicide tolerance genes (glufosinate and glyphosate) with six Bt genes. Dow AgroSciences and Monsanto cross-licenced their traits for SmartStax maize. The next generation Smartstax maize agreed between Monsanto and DowAgrosciences also includes the incorporation of 2,4-D herbicides included in Dows Enlist herbicide package. Global GM pipeline trends indicate stacked traits are becoming the dominant form GM crop grown throughout the world.

Technological packages

The marketing of a combination of agro-industrial inputs such as seed and chemicals, to be sold and used together. For example, glyphosate tolerant Roundup Ready crops are sold in a technological package with Roundup herbicide.

Technological pathways

A pathway destined to follow a particular technological route, for example a development pipeline for GM crops that include the generation of GM seeds, along with chemicals to be used in conjunction with such seeds.

Transgenic

Transfer of a gene from one organism into another via genetic engineering techniques.

Transformation

The process of introducing DNA into a cell, such as a plant cell. Such genetic material is designed to permanently integrate into the cell in the production of standard GM crops, such as Roundup Ready products.