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What is (risk) appropriate regulation of gene editing technology?

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Despite the much-hyped expectation that Europe was on course to follow other parts of the world in removing GMO-style regulatory requirements from gene edited (GE) crops, with EU elections looming and no agreement in sight the bloc now risks slipping back towards precautionary inertia. Summarising their recent peer-reviewed paper exploring risk-appropriate regulation for gene editing, agricultural economists Graham Brookes and Stuart Smyth warn that we must learn the lessons from past experience of divergent international regulation of agricultural innovations. The impact of over-precautionary EU regulation of gene editing will not only disadvantage European agriculture, but will also compromise global efforts to address urgent climate, biodiversity and food security challenges, they argue.

It now seems almost inevitable that the EU Commission's proposals to introduce more enabling and risk-proportionate regulation of gene editing techniques in plant breeding will be shunted into the next legislative term after MEPs (and some member states) called for mandatory labelling requirements, and voted to ban the use of patents in GE plants. Yet again, the EU's mis-application of the precautionary principle could not only set back opportunities for European farmers to embrace more sustainable farming systems, but could also hamper the global adoption and uptake of these faster and more precise methods of crop improvement.

In a recently published paper in the peer reviewed journal *GM Crops and Food*, we examined the scope for newly emerging technologies, based on gene editing, to help address the global challenges of food security, climate change and biodiversity depletion.

Our paper examined the science and evidence behind the most appropriate forms of agricultural production to meet these challenges and the possible role of gene editing technologies in contributing to meeting these targets. It then considered the most risk-appropriate regulatory environment required to best facilitate adoption of this technology drawing on the experiences of the impact of regulatory systems for other innovations used in agricultural and food production.

A review of the findings of the literature exploring the impacts of regulation on investment and innovation are fairly consistent. The contribution of regulatory costs (eg, the generation of safety or environmental impact data, or clinical/animal trials) to total costs of research and product development can be up to 50% of the total costs of bringing a product to market.

Secondly, the different nature of regulatory systems operating around the world can have a negative impact on innovation through different data requirements, different interpretations of (the same) data and a lack of clarity and transparency on how interpretations and decisions are made. These differences cause delays in the approval process, which negatively impacts potential returns on investment not only in a specific market where a regulatory delay occurs but also can negatively

impact a new innovation being commercialised in any market. The differences in the nature of regulatory systems also generate uncertainty, which further discourages innovation.

The lack of global 'harmonisation' of regulations across a range of subjects including GMOs, novel foods and health claims is widely perceived as contributing to slowing down the process of bringing products to market in different regions and countries. In particular, the regulatory approval systems in the EU (notably GMOs, but also for novel foods, health claims, food additives and enzymes) are widely perceived to take longer and have a higher degree of regulatory uncertainty than regulatory approval systems in other countries/regions of the world.

Much of the 'blame' for the negative impact on innovation of the EU's various regulatory approval systems can be attributed to the EU's systems being significantly influenced by application of the precautionary principle. This affects the process of risk analysis and management by implying that regulatory approval systems should ensure that risks are avoided even when there is incomplete scientific evidence as to their magnitude or potential effects. This approach allows regulators to make subjective assumptions about the risks associated with new technologies possibly being infinite whilst possible benefits are uncertain (Bertioli and Miller 2023). As a result, evidence standards and limits can lack clarity, the role of science and evidence becomes unclear, and the whole regulatory process lacks transparency. In such a system, evidence of a product's safety and benefits can be ignored in favour of a 'best not', total avoidance of risk approach. Inevitably, such a system adds cost, delays and uncertainty to new product or technology development and penalises innovation.

Moving back to the subject of regulation of the newly emerging GE technologies, what does constitute a risk-appropriate regulatory system? Given that the technologies are relatively new and there is incomplete evidence of potential impact magnitude or effects, a precautionary approach might be considered, as was practised in some countries and regions of the world in the 1990s when GMOs were first regulated. The science and evidence do not, however, support implementing a 'best not' largely risk avoidance regulatory system for GE technology for the following reasons:

- The evidence to date regarding the benefits from biotechnology and its commercialisation are consistent, with exceptionally robust supporting data. This evidence will be required where countries are yet to formalise appropriate regulation of gene-editing technologies and has already been drawn on by regulators in Argentina, Australia, Brazil, Canada, Japan and the USA. All of these countries have independently concluded that if no foreign DNA is present in the commercialised product from the application of gene-editing technologies, then no additional risk assessment is required, such as is required for genetically modified crop traits (Entine et al. 2021). This regulatory confirmation will provide all firms, from the large multinational firms to the small and medium-sized enterprises, with the greater certainty required to make new agricultural trait and product development investments, knowing that the developed products will be less susceptible to delays from regulations that are founded on a strict version of a precautionary principle;
- The review of the impacts of GMO regulatory systems over the last 25 years shows that regulatory systems where a precautionary principle dominates have created investment uncertainty, increased the cost of bringing products to market, reduced the returns on investment, caused disruption to agricultural commodity trade, added cost to supply chains and discouraged investment;
- The science and evidence show that the best way to address the urgent global food security, climate and environmental challenges that we face is to embrace (not reject) the

adoption of new innovations and technology like plant and animal genetics, digital agriculture and precision farming.

In looking at the potential of GE technologies to contribute to addressing the challenges of food security, climate change and biodiversity protection, an important differentiating factor between GE and GM technologies as applicable to crops has an additional potential to affect development and adoption. This relates to how long the research and development process takes. New variety development containing traits developed using GMO technology commonly take at least 12 years before a trait is ready for commercialisation, and that assumes timely regulatory approval processes. GE technology has the potential to reduce this to 8-9 years and have a significantly lower overall cost of $12-18 million for a single or stacked trait (Kalaitzandonakes et al 2022). These features on their own lower the barriers to entry into the market for products using GE technology and offer the potential for a larger number of (smaller and/or public sector) players to bring GE innovations to the market than has been possible with GM technology. This hypothesis relating to the significant economies in development scale between GE and GM technologies was also highlighted by Bullock, Wilson and Neadeau (2021).

The economies of research and development scale that GE technology offers and the nature of the urgent issues facing the world re-enforce the importance of regulatory approval systems for GE technology being appropriate to the risks involved. If the regulation of this technology around the world fails to use science and evidence to appropriately reflect risks involved and is instead overly precautionary in nature, GE technology will not fulfil much of its promise. Lassoued et al. (2019) estimate that if a GE crop is regulated as equivalent to a GM crop, commercialisation would take an additional 9 years and cost US$14.5 million more.

Evidence to date of the impact of regulatory systems in place for assessing and approving GE technology application in agriculture is currently in an early phase. Argentina was one of the first countries to introduce a specific regulation to approve applications that use GE technology in its agricultural sector back in 2015. The regulation set out specific scientific criteria to be applied on a case-by-case basis to applications for approval to determine if they should be considered 'as GMOs' for the purpose of assessment or considered as conventional technology and not subject to the more onerous, costly and time-consuming process inherent in GM technology approval. Whelan, Gutti and Lema (2020) examined the experiences relating to products derived from GE breeding techniques coming to market in Argentina over the first four years of its operation. Their findings largely confirmed the conclusions drawn by Bullock et al (2021) in that GE products have followed a much faster development rate than GM-derived innovations. This rapid rate of adoption was driven by a wider range of developers, led by small and medium-sized enterprises and public research institutions. Lastly, the product profiles are more diversified in terms of traits than under GM technology.

The paper concludes that if the Global Bio-diversity Framework is to successfully achieve its targeted objectives by 2030 and for sustainable agricultural production systems to be meaningfully developed and widely adopted, it is of fundamental importance that empirically-based regulations be globally enacted. From a practical perspective this means establishing regulatory systems in which risks are appropriately assessed according to clearly defined scientific criteria and evidence and do not default to an overly precautionary approach in which evidence standards and limits lack clarity, the role of science and evidence becomes unclear, and the whole regulatory process lacks transparency.

Deviations from empirically-based regulations and widely accepted scientific standards will delay and stifle the adoption of crucial technologies targeted at contributing to preserving biodiversity and achieving improved agricultural sustainable development.

The longer enabling technologies are delayed and stifled, the longer the continuation of negatively impactful practices will last, increasing the overall adverse impacts. Therefore the solution to meaningful changes lies in shorter peak adoption periods, not longer. For this to happen, all regulations need to be risk-appropriate and evidence-based.

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