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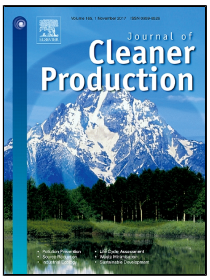

Degrowth, organic agriculture and GMOs: A reply to Gomiero (2017, JCLEPRO)

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Highlights

- Agriculture is a blind spot in degrowth debate, as Gomiero rightly points out.
- Gomiero's analysis of organic vs. biotech-based agriculture is biased against GMOs.
- CRISPR/Cas genome editing relativises many anti-GM arguments.
- GMOs are not necessarily incompatible with degrowth-compatible organic agriculture.

Degrowth, organic agriculture and GMOs: A reply to Gomiero (2017, JCLEPRO)

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Abstract

This paper is a critical response to Gomiero's (2017, JCLEPRO) analysis of the links between degrowth and agriculture. It is argued that Gomiero's contribution is timely and important, and he makes a number of important points, especially regarding the naivety of some degrowth proposals that amount to romanticising organic agriculture. However, Gomiero's criticism of GM crops, which he contrasts with organic agriculture, is partly outdated and partly misguided. This reply thus presents a different interpretation of the potential of modern green biotechnology, including its possible compatibility with organic agriculture.

Keywords: Agriculture; CRISPR/Cas genome editing; Degrowth; Food production; Genetic engineering

1 Introduction

Agriculture is arguably one of the most environmentally impactful human activities, both presently and historically (Pereira et al., 2012); at the same time, it is essential for human survival. Food production and food consumption are of profound physiological, economic and cultural importance (Harlan, 1992; Pollan, 2013). Thus, any broad societal transformation would require an accompanying transformation of agriculture. It is therefore a rather surprising finding, made recently by Gomiero (2017), that the degrowth literature largely lacks a thorough investigation of the role of agriculture in the societal transformation towards sustainability and justice that the degrowth movement envisages. Gomiero's (2017) review and analysis of the relationship between degrowth and agriculture is therefore very timely and highly welcome.

In fact, as pointed out by Gomiero (2017), the degrowth literature's casual treatment of issues related to food production and consumption is rather naïve – it involves calls for 'a more frugal lifestyle, based on local production and food self-sufficiency, and of short food chains' (p. 8), mostly in combination with a rather generic support of organic agriculture. Throughout his paper, Gomiero (2017) points out two main limitations and oversimplifications of this view:

First, he stresses that 'turning European society into self-sufficient, no-inputs family farms [that seems to be the vision of many degrowth scholars and activists – BB] may not even be feasible,[1] because of a simple biophysical constraint: the lack of land to meet the food demand of its large population' (p. 9); he goes on by providing a simple calculation for Germany, which shows that it would be hardly possible to support its population in a scenario of food production autarky – even if we ignore issues such as food waste (Alexander et al., 2017) and the need to hold and feed livestock as a source of manure (main natural fertilizer in organic agriculture). Accordingly, the view of organic agriculture that can be read from degrowth publications appears heavily romanticising and unrealistic – both with regard to the current state of organic farming, which is often heavily mechanised and based on large-scale operations; and also regarding the potential of small-scale, low-input, self-subsistent agriculture to feed a population.

Second, Gomiero links agriculture to the 'old' question of population, on which he provides a more-faceted view than many contributions from the degrowth literature, e.g. by pointing out that self-sufficient, convivial agrarian societies are heavily dependent on a large labour force and thus have strong incentives for high fertility (contrary to modern industrialised societies that have already completed the demographic transition). Just as is the case with organic agriculture, the population question is much more complex than it seems prima facie – a point clearly made by Gomiero. Here, old and new approaches (e.g. Boserup, 1965; Dasgupta and Dasgupta, 2017) are relevant and needed that go beyond the extremist neo-Malthusian (Ehrlich, 1968) vs. Cornucopian (Simon, 1981) divide.

Other important issues stressed by Gomiero, which up to now have received less attention in the degrowth literature, are the importance of inefficiencies in the food production and consumption system, resulting in severe wastage of biomass and energy (Alexander et al., 2017), which cannot be easily solved just by switching the mode of production to organic; and the related emphasis on nexus thinking that would put the analysis of agriculture into a broader context, and which could derive fruitful and fertile inspiration from the literature on multifunctional landscapes and ecosystem service trade-offs (Cord et al., 2017). Both issues have particularly high relevance in the context of agricultural production within planetary boundaries (see also Fischer et al., 2017).

[1] The author introduces a very useful distinction between feasibility (compatibility with external environmental constraints), viability (compatibility with internal, i.e. social and technological constraints) and desirability (compatibility with societal preferences) to guide his analysis. He attributes the distinction to Giampietro et al. (2013).

These are all important issues and Gomiero makes numerous relevant points; however, his comparative analysis of organic agriculture vs. what he calls 'biotech-based agriculture' from the perspective of degrowth is incomplete at the least. In fact, it is partly inconsistent and many of its arguments are either misguided or outdated. The present paper aims at adding to Gomiero's analysis by offering a different view on the 'organic vs. biotech' comparison, based on recent developments in genetics and a more relaxed, flexible approach.

2 The distinction: organic and biotech-based agriculture

The most basic shortcoming in Gomiero's analysis is his definition of the two agricultural types whose compatibility with degrowth he chose to analyse. On the one hand, we have organic agriculture, which can be characterised in a more or less consistent way by a complex of criteria, particularly rejection of GMOs, synthetic fertilisers and pesticides. On the other hand, we have biotech-based agriculture, which is explicitly defined by one criterion only – the application and use of GM technology. Implicitly, a number of other characteristics are attached to this type of agriculture – that it is large-scale, industrialised, operating on oligopolistic or monopolistic markets. As will be argued in more detail below, there is no prima facie reason to identify biotechnology with industrial agriculture – as argued e.g. by Ronald and Adamchak (2008), whom Gomiero cites repeatedly. The implicit identification of biotech-based agriculture with all that is usually considered 'bad' from the degrowth perspective pre-determines the result of the analysis. This is the more surprising because Gomiero's presentation and discussion of organic agriculture is much more multi-faceted and realistic (see section 1 above). He refuses the temptation to romanticise organic agriculture, but he succumbs to the corresponding temptation to identify GMOs with a demonised version of industrial agriculture; it would have helped his analysis to treat both sides equally.

3 The criteria: appropriate technology and conviviality

Another, probably less serious problem regards the treatment of the two criteria Gomiero chose for his analysis – Schumacher's appropriate technology and Illich's conviviality. For the purposes of this reply it is less relevant whether the choice of these two criteria has been a good idea in the first place – however, once chosen, they pose certain demands that Gomiero's analysis does not seem to fulfil adequately. As he explicitly states himself, Schumacher's appropriate technology criterion has been developed with the contexts of the global South in mind – and should be applied accordingly. Meanwhile, Illich's conviviality is mainly applicable to the global North (Gomiero, 2017, p. 28). However, in developing his argument, the author does not stick to this geographical delimitation – especially when discussing biotech-based

agriculture's supposed incompatibility with conviviality, he very often uses examples from the global South; conversely, to contrast biotech-based agriculture with the criterion of appropriate technology, he uses examples from the North, particularly criticising that GM crops have not increased yield or decreased herbicide use in the US – implicitly ignoring that (i) the US agriculture is arguably at the global efficiency frontier, so further yield increases are very difficult to achieve;[2] (ii) benefits of GM crops go beyond yield increases (Brookes and Barfoot, 2012), including e.g. lower costs due to reduced need for fuel (Roundup Ready crops) or pesticides (Bt crops); (iii) what are the most relevant effects has to be differentiated between GM crops (e.g. it is not surprising that Roundup Ready crops lead to increases in spraying, as it can be done more easily and frequently), rather than being attributed to GM as such.

At times, the 'coarse' application of the criteria, together with the above-mentioned problematic definition of the two analysed modes of agriculture, create the impression that Gomiero is not willing to take GM crops seriously by analysing them in an unbiased way. In what follows, a more up-to-date, relaxed and flexible perspective on biotech in the broad context of degrowth will be developed, mainly by responding to specific statements made by Gomiero in his paper; thus, the criteria of appropriate technology and conviviality will not be used explicitly but only insofar as the criticised arguments chosen by Gomiero are related to these criteria.

4 Towards an up-to-date and flexible perspective on biotech

In his analysis of biotech-based agriculture, Gomiero makes numerous arguments about GMOs that are misguided or at least debatable. For instance, on page 21 he starts the argument by introducing the two main GM crop types to date, Bt and Roundup Ready – but the criticism that follows, namely that an increase in the use of herbicides after introduction of GM crops were observed, is related to the latter only; thus, Roundup Ready becomes an implicit 'representative' for GM crops in general (see also last section). The next critical point raised, similarly common in GM critiques, is that the cultivation of Bt maize has led to the emergence of secondary pests – which, as was pointed out by Ronald and Adamchak (2008), has to do with cultivation, not breeding. Moving away from monocultures would prevent or at least alleviate the problem of secondary pests and resistances. There is no logically necessary relationship between growing GM crops and growing crops in monocultures. On page 22 Gomiero states that '[y]ield may be volatile due to the uneven expression of GM genes in plants' – which is true for the expression of any agronomically relevant gene in any crop plant, no matter the origins of the gene in

[2] A point actually made by Gomiero himself in a different context (Gomiero, 2016), where he cites Grassini et al.'s (2013) analysis of global yield plateaus for selected crops.

question; also, the following observation that the introduction of GM crops has not led to yield increases in the US, can be easily explained by the fact that US agriculture is already highly efficient (see last section). Moreover, this particular argument is an example of the problem raised in section 3, as it is used in the discussion of Schumacher's global-South specific appropriate technology criterion.

Repeatedly, Gomiero criticises GM crops by linking them to industrialised agriculture and effectively criticising the latter (see section 2 above). However, there is no reason why GM crops could not be combined with other cultivation methods, including organic agriculture (Ronald and Adamchak, 2008). Of course, this does not hold for those GM crops that are controlled by multinational companies such as Monsanto (now Bayer). The question of property rights, especially patents, is highly important indeed. But especially in recent years, breakthroughs in biotechnology have taken place in public institutions, not Monsanto labs. Note that the argument developed here is about the possibility for GM to be used differently; it acknowledges that current use of GM crop is dominated by very few applications (notably the already mentioned Roundup Ready and Bt crops) controlled by a handful of multinational corporations.

The main limitation of Gomiero's analysis is his focus on older GM techniques, as indicated by an explicit reference to transgenesis and 'gene guns' (p. 20), as well as the examples chosen to illustrate his arguments. Thus, he ignores important recent developments of genome editing (Baltes et al., 2017), particularly the breakthrough innovation in CRISPR/Cas genome editing technique, first introduced in 2012 by Jinek et al. (2012) and sweeping GM research (Fig. 1) and increasingly also applications (Brinegar et al., 2017).

The differences between CRISPR/Cas on the one hand and the older GM techniques, which Gomiero based his analysis on, on the other hand, are manifold. To start with, CRISPR/Cas is considered highly precise, as it allows for introduction of genes or for their removal/silencing at a precisely specified location; moreover, it is relatively easy-to-use and very cheap (Ledford, 2015). Its potential for application in agriculture and crop breeding is very broad (Baltes et al., 2017); in fact, the first two CRISPR/Cas-generated crops that were approved for cultivation in the US involved cisgenesis (Waltz, 2016a). This is important because the precision, relative simplicity and low cost of CRISPR/Cas genome editing makes it a viable alternative for conventional breeding, i.e. for cisgenic applications. Last but not least, central CRISPR/Cas patents originate with public institutions, and while a legal debate is ongoing regarding who owns what (Contreras and Sherkow, 2017a, 2017b; Horn, 2017; McGuire, 2016), the new

technique has the potential to trigger a diversification of the green biotech market (Bartkowski et al., submitted).

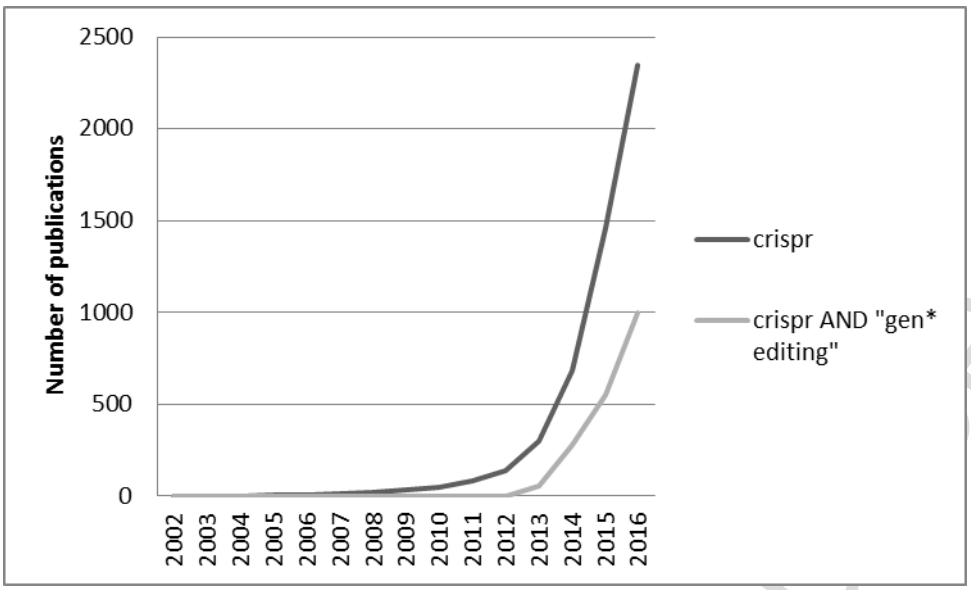

Figure 1 Publications on CRISPR and its application in genome editing (Source: Scopus topic search, querried 2017-09-01)

All this has numerous implications for Gomiero's argument. Most basically, it adds weight to the reservation expressed above about the juxtaposition GM vs. organic agriculture. The turn towards cisgenesis that is implied by the increasing popularity and spread of CRISPR/Cas strengthens the argument originally voiced by Ronald and Adamchak (2008) that organic agriculture and genetic engineering need not be mutually exclusive but may rather be complementary. The general technology used to breed a crop does not predetermine breeding goals – and many breeding goals (e.g. resistance to pests or to environmental stresses) do not presuppose a particular method of cultivation. It is entirely imaginable to have organically cultivated GM crops. In fact, this may be interpreted as the proper response to Gomiero's statement that 'focusing on GM as the solution of complex problems may hide their real nature' (p. 22) – the same is true for focusing on GM as the main obstacle to the solution.

Of course, CRISPR/Cas genome editing does not alleviate all problems related to the two criteria used by Gomiero in his analysis. For instance, even though CRISPR/Cas is *relatively* simple and easy-to-use, it is still much too advanced a technology for individual use by farmers. However, as rightly pointed out by Gomiero, the same holds for modern conventional breeding. Thus, CRISPR/Cas genome editing can be argued to score less negatively than conventional GM technology with regard to the criteria of appropriate technology and do-it-yourself (DOI) conviviality; this is especially the case since hardly any modern, efficient crop varieties fulfil these criteria fully. Regarding conviviality, the problems of ownership (p. 23) remain because

CRISPR/Cas is a patented technology – though, as has been stressed above, since the patent holders are public institutions, this problem is arguably less serious than it would be if the patent rights belonged to private firms (see also Kvakkestad and Vatn, 2011).

With respect to the 'tools able to limit growth' interpretation of conviviality, there is no prima facie reason to expect that, for instance, the first CRISPR/Cas-generated crop plant allowed for cultivation – non-browning mushrooms (Waltz, 2016b) – would necessarily contribute to growth dynamics. Of course, they create other problems – namely that they are not distinguishable from products of natural selection or conventional breeding, since CRISPR/Cas does not leave traces in the modified organism – but those are of a different nature and pertain mainly to the ethics of naturalness and to governance (Pirscher et al., forthcoming). Here, Gomiero's dictum that 'GM crop governance should be transparent and participatory' is particularly relevant.

5 Conclusions

Indeed, '[a] sound and comprehensive analysis of how agriculture and the food system should change to meet the call for degrowth has not yet been produced' (p. 29). Thus, Gomiero's paper is an important contribution both to the degrowth debate and to the broader debates about possible futures of agriculture and food production. However, one would wish that he applied the following desideratum to both agricultural technology complexes in his analysis:

> The point I wish to make here is that it is not that simple to identify a production technique in absolute terms: tradeoffs need to always be considered. (Gomiero, 2017, p. 26)

The vision offered in this reply is more relaxed towards green biotechnology; in fact, it is close to what Hausknost et al. (2017), in their analysis of bioeconomy narratives, call the 'planned transition' interpretation, in which degrowth's core notion of sufficiency is combined with a widespread use of modern technologies to achieve sustainability. This should not be understood as a plea in favour of the application of GM crops in agriculture. It is a plea for an unbiased stance towards this option.

GM crops cannot be expected to solve global problems of widespread malnutrition and obesity, food security, fossil fuel substitution etc. But they have the potential to contribute to the solution of these problems, also within a degrowth context. Whether this potential outweighs the uncertainties and ethical challenges related to modifying genomes has to be clarified in an open societal debate. Prejudging GM crops does not help this debate.

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