Plant ethics and climate change

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Abstract: Plant ethics is a field of philosophy that discusses the moral value of plants, and individual responsibilities towards them. As anthropogenic climate change is likely to have devastating effects on plants, a plant ethics analysis of climate change is crucial to fully understand the extent of people's responsibilities towards plants. However, surprisingly little has been written on this topic. This chapter aims to provide an overview of the main positions in plant ethics as well as an initial exploration of the following three salient questions concerning plant ethics and climate change. First: how stringent are people's responsibilities to preserve plants? Second: do people have responsibilities to plant trees? Third: do people have responsibility to help plant migration? Plant ethics theories struggle to different extent with each of these questions. On all theories, people have great responsibilities to preserve, if not individual plants, at least large forests, and on most theories people have some responsibility to help plant migration. On whether there are responsibilities to plant trees, different plant ethics theories deliver widely different results, from there being no responsibility to plant any tree to there being responsibility to plant as many trees as possible. All three questions are venues for future research in plant ethics.

Keywords: plant ethics, climate ethics, value theory, moral status, prioritization

1. Introduction

Anthropogenic climate change is altering the world on a scale never seen before, impacting for the worse the lives of many individuals. While the environmental damage on humans and sometimes animals are often in the spotlight, the greatest number of individuals affected by climate change is likely to be plants, as they constitute more than 80% of the total biomass on Earth. Several devastating effects of climate change involving plants have already been observed: for example, in the year 2020, 160 million acres of terrain containing uncountable plants were burnt by climate change induced wildfires in Australia and California alone (Binskin, Bennett, & Macintosh, 2020) (GACC, 2020),

(Borchers & al., 2019), (Williams, et al., 2019). Given the large extent to which plants will be affected by climate change and the role that they could play in preventing it, it is crucial to examine people's responsibilities towards plants.

Ethical behaviour towards plants has become a topic of philosophical investigation, prompted by the developments of environmental ethics on the one hand and by the progress in animal ethics on the other (Attfield, 1981) (Hiernaux, 2021). The resulting philosophical field is known as "plant ethics": it explores what individual responsibilities towards plants are, and what the grounds for this responsibility are. Even though the field has only a recent history and is widely underexplored, it provides several different frameworks of the morality of people's treatment of plants.

This chapter aims to give an overview of how theories of plant ethics apply to climate change. In order to set up this overview, two preliminary discussions are needed.

Firstly, this chapter will provide an introduction to the main philosophical positions in plant ethics. This discussion focuses on what is the basis for people's responsibility towards plants: if it is for their own sake (that is, they have *intrinsic* value), if it is because they are of crucial importance for human beings (that is, they have *instrumental* value) or it is because of a special relationship towards them (§2).

Afterwards, this chapter will briefly point out how plants mitigate climate change, how climate change damages them, and how global warming forces plant species to migrate towards more favourable climates (§3).

Once the core concepts of plant ethics are clear and the main interactions between climate change and plants have been identified, the reader finds the crucial section on the chapter, where pressing moral issues of plant ethics as connected to climate change will be explored. Since plant ethics is still at a very embryonic stage, there are not many active debates as to what people's responsibilities towards plants given anthropogenic climate change are. This last section (§4) aims to open the discussion on some key topics. These topics are: how stringent are people's responsibilities to prevent plant and forest extinction, with a particular focus on the Amazon forest (§4.1), whether people have duties to plant trees (§4.2), and whether people should facilitate plant migration (§4.3). The paper concludes with a summary and some brief observations (§5).

2. Plant Ethics

The sentiment that people owe something to plants is widely shared, to the point that several governments have recognized some moral responsibility towards plants.[1] For example, the national constitution of Switzerland protects the moral status of plants (ECNH, 2008), and New Zealand has given legal rights to the plants surrounding the Whanganui river (Vines, Bruce, & Faunce, 2013).

However, there is surprisingly little agreement on what exactly the moral status of plants is. The Swiss Federal Ethics Committee of Non-Human Biotechnology reports that "the only criterion on which all the members could agree, despite their very differing intuitions, was that we should not harm or destroy plants arbitrarily. Whether concrete ways of acting could be derived from this prohibition on the arbitrary handling of plants, and what they might be, remained unclear" (ECNH 2008, p. 4).

Similarly, in the plant ethics debate there is agreement that people morally ought to respect plants to some extent, but it is not clear to what extent, and why. This section explores the different theories about what people's responsibility towards plants is based on.

Many theories base individual responsibility towards plants in that plants have *intrinsic* value. For something to have intrinsic value means that it has moral value on its own. Intrinsic value is to be contrasted with *instrumental* value: for something to have instrumental value means that people's moral concerns towards it are exclusively motivated by how it impacts humans or other intrinsically valuable beings (Moore, 1922).

Typically, people take other human beings to have intrinsic value: people think they have responsibilities towards others as, plausibly, other people's interests are valuable in themselves. As an example of things with only instrumental value, consider pencils: most people believe they have only instrumental value, and they do not think pencils matter for their own sake. They matter morally, if at all, only because they can be helpful (or harmful) to the interests of the intrinsically valuable beings.

Whether plants have intrinsic or instrumental value is one of the main debates of the plant ethics literature. Let us start the overview of plant ethics theories from who thinks that plants have intrinsic value, namely *zoocentrists, constitutivists, perfectionists,* and *biocentrists* (for similar reviews, see (Hiernaux, 2021) (Pellegrino, 2018) (Kallhoff, Pellegrino, & Di Paola, 2018)).

2.1 Intrinsic value theories

[1] On moral responsibility in climate change in general, see chapters "Consequentialism and Climate Change" and "Deontology and Climate Change" in this volume.

A prominent position according to which plants have intrinsic moral value is *zoocentrism*. Zoocentrists believe that plants have intrinsic value in virtue of being sentient (Hall, 2011, pp. 38-43, 156) (Pouteau, 2014) (Sandler, 2018). Being sentient is here understood as having goals, interests, or feeling pleasure, pain, or sensations that are positive or negative in general being sentient. In fact, it is virtually uncontroversial in ethics that sentience is a sufficient condition for intrinsic value. Traditionally, only humans and animals are considered to be sentient. However, according to various researchers, including the father of evolutionary theory Charles Darwin (Darwin & Darwin 1880; for example see p. 574), studies on plant signaling suggest that plants may indeed be sentient (Baluška & al., 2008) (Mancuso & Viola, 2015) (Segundo-Ortin & Calvo, 2021). On the basis of this sentience, zoocentrists can defend that plants have intrinsic value.

The *Constitutivist* position believes that plants have intrinsic value as they are constitutive of something with intrinsic value. Here is what they mean. Constitutivists defended that ecosystems have intrinsic value (Leopold, 1961) (Attfield, 1981) (Rolston III, 1988, chapter 5) (Johnson, 1993), or that species of plants have intrinsic value (Pellegrino, 2018). Since ecosystems and forests at least partially *consist in* their vegetation, and since a species of plants is instantiated in each individual plant, plants have intrinsic value. In other words, plants have intrinsic value since something with an intrinsic value is realized through plants.

Another position according to which plants have intrinsic value is *Perfectionism*. On Perfectionism, what is best for any being is the fullest and most excellent development of its nature. In other words, what is paramount for Perfectionists is the *flourishing* of individuals, a concept indeed borrowed from botany by value theory. On Perfectionism, anything that can flourish is thereby valuable. Since it is clear that plants can flourish and develop their nature, some Perfectionists believe that they have intrinsic value (Kallhoff, 2018) (Rolston III, 1988, p. 108) (Nussbaum, 2006) . Some other Perfectionists defend that the nature of plant is such that they have dignity (Odparlik, 2018), legal rights (ECNH, 2008), or integrity, here intended as capacity to reach natural aims (Bueren & Struik, 2005).

Finally, *Biocentrism* assigns intrinsic value to plants. According to biocentrism limiting intrinsic value to species equipped with human-like consciousness or a nervous system is arbitrary: any living being has intrinsic, non-instrumental value. It trivially follows that plants, being alive, have intrinsic value, whether or not plants are sentient beings (Attfield, 1984) (Attfield, 1991) (Stone, 2010) (Rolston III, 1988, chapter 3).

While these theories agree that plants have intrinsic value, on most versions of these theories it is permissible to treat plants merely as a mean rather than an end (Odparlik, 2018, pp. 63-64). Someone or something is treated as a mean if someone uses them in order to benefit someone or

something else. To treat someone or something as an end means that actions directly impacting something or someone aim to benefit this someone or something. On some moral views, and typically on Kantian views, it is impermissible to treat humans merely as means, and they should be treated always also as ends: for most theories of plant ethics, this does not apply to plants.

It may seem strange that it can be permissible to treat as a mean something with intrinsic value, but it is not something unique of plants. Suppose for example that particularly remarkable pieces of arts are intrinsically valuable: for example, suppose that Modigliani paintings have value in themselves, and it would be wrong to destroy one of them even if no one were to ever look at it anyway. This is consistent with thinking that it is permissible use a Modigliani as a mean by selling it in order to make a large charity donation. The same may be true of plants: while they may have value in themselves, most ethicists agree that people can use some of them in various ways for their own benefit, for example, in order to eat their leaves or to produce medicines.

2.2 Instrumentalist and relational theories

Some theorists do not think that plants have intrinsic value, but only instrumental value (Maris, 2014), (Višak, 2018). Even for *Instrumentalist* theories, however, plants have enormous value, for multiple reasons. Plants provide us with the oxygen necessary for our breathing. The overwhelming majority of human food comes from, is, or feeds on, plants. Plants are crucial in medicine: roughly 80% of the human population relies exclusively on plants for primary health care (Fowler, 2006). On less impressive, but still valuable respects, people derive pleasure from plants, and a great body of research suggests that mere exposition to plants improves human mental and physical health, mood and cognitive abilities (Han, Ruan, & Liao, 2022). People breathe, eat, heal thanks to plants. These are just a few of the ways in which plants are instrumentally invaluable to humankind, and to any species on Earth. Some other valuable properties of plants will be explored in the next section.

Instrumentalist theories do not deny that people have responsibility towards plants. They simply claim that this responsibility is derived from what humans and animals derive from plants: if animals and humans were not to use plants, there would not be no reason to be responsibile towards plants.

Finally, some plant ethicists believe that people's responsibility towards plant is not rooted in any discussion about value. This is true for *relational* theorists: they believe that people's responsibility towards plant has to be found in the special relationship people have with them (Kallhoff, 2014) (Kallhoff, 2018, p. 51) (Schörgenhumer, 2018) (Hiernaux, 2021). The relational perspective is rooted in virtue ethics or care ethics conceptions of morality, and has the advantage of giving action guidance without requiring background assumptions about whether or not plants have

intrinsic value (Hiernaux, 2021, p. 3).[2] People's responsibility towards plants can be based, for example, on the fact that plants are necessary for their survival, and this connects them with us tightly. Or the connection can be based on the recognition that people are part of the same environment. According to relational theorists, these may be the basis of virtuous relationship or a relationship of care with plants.

This concludes the list of all the main positions explored so far in plant ethics. It is now time to examine the connections between plants and climate change.

3. Plants and climate change

Since this is an ethics paper, the following discussion does not aim to provide the reader with an exhaustive representation of the botany of climate change, but to briefly give the very essential information to understand (3.1) how plants help controlling global ecological balance and (3.2) how climate change is harmful to plants.

3.1 The role of plants in the climate system

One of the key roles of plants in an ecosystem is to take out CO_2 from the atmosphere. This happens in two ways. First, via photosynthesis, where plants absorb CO_2 to generate oxygen. Second, by facilitating silicate weathering, a chemical reaction that allows the soil to absorb CO_2 (Berner, 1992). Given plant's abilities of photosynthesis and their effect on the soil, forests are important "carbon sinks", that is, locations where the CO_2 of the planet diminishes.

The main way in which humans cause climate change is the production of large quantities of CO_2. Emitted CO_2 remains in the atmosphere for hundreds of years, where it absorbs heat from the Earth, and radiates it in all directions, including back at Earth itself. Since heat is retained on Earth by CO_2, Earth's temperature is rising.

In order to absorb CO_2, and thus mitigate the damage of anthropogenic carbon emissions, carbon sinks are required. The only natural carbon sinks are soil, photosynthesis and ocean absorption: plants and forests have a key role in two of these three carbon sinks.

In addition to these roles, large forests have additional beneficial effects in regulating the climate of the region they are in. These effects vary from forest to forest; as an example that will be useful later in this paper, the Amazon rainforest has a great role in regulating South American rainfalls. The forest generates a significant quantity of its own rainfalls by retaining moisture, and

[2] On the relation between virtue ethics and climate change, see chapter "Virtue Ethics and Climate Change" in this volume.

this is central to the balance of rainfalls in the South American continent (Staal, et al., 2018). Similar forests have similar roles in regulating the local climate.

3.2 Damages of climate change on plants

While plants can be immensely helpful to control climate change and diminish CO_2, they suffer from climate change in various ways. This section does not aim to cover them all, but tries to give a rough idea of how worrying climate change is when it comes to the effects on plants.

The most serious effect of climate change on plants is that climate change can end entire species. It has been estimated that a baffling 40% of plant species are threatened with extinction by climate change (Lughadha & al, 2020). Individual plant and species are threatened by climate change in various ways. The most evident, already mentioned in the introduction, are wildfires: as increased temperature makes it easier for wildfires to spread, wildfires will reach and burn larger numbers of trees the more global temperature increases.

A main source of plant disruption are the changes in the structure of the ecosystem. For example, the composition of the soil may change (typically, the moisture of the soil would decrease), and it may not be suitable for some plants to grow where they used to. Another example is that, as the level of sea water rises, salty water may contaminate the fresh waters used by low lying plants, which would be damaging for the plants. Or, climate change may introduce into the ecosystem some new pests that are particularly devastating for plants – famously, the Emerald Ash Borer, native of East Asia, has killed tens of millions of ash trees in the USA (Herms & McCullough, 2014).

Climate change also hurts plants in ways that are not necessarily extinction-threatening. For the purposes of this paper, the most important non-extinction-threatening effect of climate change on plants is that it causes them to migrate. In fact, as the soil where they usually grow becomes unfit for them, plants strive to reproduce in different, more favorable soils – typically, the soil of colder regions. The phenomenon of plant migration is not very well understood as it is hard to collect data, but as the next section illustrates poses some interesting philosophical problems.

4. Plant ethics and climate change

Now that the necessary information about plant ethics and about the impact of climate change on plants has been provided, it is time to discuss plant ethics and climate change together. The connection between plant ethics and the specific phenomenon of climate change is widely underexplored. This section points out three unresolved problems in this area: (1) how great is people's responsibility to preserve plants? (2) do people have responsibilities to plant trees? (3) do people have responsibilities to aid plant migration?

4.1 Duties of preservation of plants and forests

There is agreement that plants have enormous value, at least instrumental (§2), and in particular that forests are important carbon sinks (§3). It follows that preserving large groups of plants, and certainly large forests, is extremely valuable (see also Attfield, 2018). But how valuable? And, given this value, what kind of responsibility do people have? To explore these questions, the Amazon rainforest is used as a case study: what will be said about the Amazon is true to different degrees for different groups of plants.

The Amazon Rainforest is one of the most important carbon sinks of the planet, and it contains an impressive number of useful resources. It contains an enormous quantity of plants – specifically, it contains more than 80 thousand *species* of plants, half of which may be unique to this forest (Morales & Vinicius, 2003). It is also home to countless animal species (for invertebrates alone, see (Lewinsohn & Prado, 2005)), and more than 28 million people (Alves, 2023). Finally, as mentioned in §3.2 the Amazon Rainforest is a centerpiece of the South American hydrological cycle. Scientists have warned that a decrease of the Amazon rainforest to 80/75% of its pre-industrial size would be a colossal ecological disaster: the rainforest would change vegetation and change into a savanna, modifying its hydrological role and triggering one of the "tipping points" of no return for global warming (Lovejoy & Nobre, 2018). Triggering the tipping point is predicted to increase, alone, the global temperature by a total of 0.2°C within a hundred years: that is equal to one sixth of the total temperature increase from pre-industrial age to 2020.

The anthropogenic disruption of the Amazon forest is very rapidly approaching the critical 26%: indeed, 20% of the forest has been irreparably disrupted already, and an additional 6% is worryingly degraded (Quillantilla, Leòn, & Josse, 2022). However, restoring this last 6% is still possible until 2030. Given the moral badness of reaching the Amazon rainforest tipping point, what does plant ethics say about people's moral responsibility?

On any theory of plant ethics, an anthropogenic decrease of 26% of the Amazon rainforest's size would be morally bad. Theories, however, disagree on how bad it would be. This is an important question: it is plausible that individual responsibilities towards plants, and towards the Amazon rainforest plants in particular, are proportional to their value. This section will now explore how each position evaluates the loss of the Amazon forest, and the problems with each evaluation.

Instrumentalism is the theory according to which this loss would be less bad, and the badness is already enormous. On Instrumentalism, the badness of a 26% decrease of the Amazon rainforest consists in its damage to humans (and possibly animals) only. This includes the damages to the million individuals living in the forest, the individuals who use resources from the forest, the entire global population which will suffer from triggering the tipping point, and the damage generated by

not having access to some plants that may provide medications.

However, there may be some species of plants that are going extinct that do not affect human lives at all, and individual plants that certainly have little to no impact on humans. If this were the case, on Instrumentalism people do not have responsibility to protect *all* plants of the Amazon rainforest. This significantly decreases people's responsibility.

Suppose that, within the degraded (but still recoverable) area of the rainforest, there is a large section where no human lives, whose animals can be re-located, and there are no edible or medical plants. Suppose further that destroying this area, by itself, would not trigger the tipping point, and that there is the possibility to devote this area to housing for homeless people. Instrumentalists seem committed to conclude that it is better to devote this area to housing. Many environmentalists would balk at this conclusion.

These environmentalists would prefer a theory according to which plants have intrinsic value. However, in order to provide a full account concerning individual responsibilities when it comes to conserving plants and forests, these theories need to answer some theoretical questions.

Let us start with *zoocentrism*, *biocentrism* and *perfectionism*. On all these theories, the intrinsic, non-instrumental badness of destroying the Amazon forest is equal to the badness of the death of each plant that disappears in that forest. Is this intrinsically better or worse than having the same number of animals dying? How easily can this intrinsic value be compensated? Suppose the forest was the only suitable location for some efficient, environmentally friendly way to produce energy. Under which conditions it would be best to decrease the area of that forest or even have it disappear?

It is implausible that at no condition it is best to reduce a forest's area: if people were to take down a single Amazon flower in order to install a small machine that provides zero-emissions energy to a nation of the size and industrial necessities of China for a century, it would be best to do that. But as the forest portion to be taken down increases in size, and the efficiency of the source of energy decreases, what is best becomes less clear. Should people let degrade 1% of the Amazon to have the entirety of North America and Europe running on zero emissions? Is it better to take down 0,01% of the forest to have a city like London running on zero emissions, or is it better no to do that? In order to answer these questions, theories of plant ethics need to research how the value of plants compares to the value of energy production.

For *Constitutivists*, things are a bit different. If forests, ecosystems or species have intrinsic moral value, as constitutivists believe, then the degradation of the biggest rainforest to a savannah, or the loss of hundreds of plant species, has to be added to the damage of instrumental value. However, the badness of this disruption depends largely on how the disruption comes about, and on which

constitutivist theory one endorses. Let us analyse constitutivism about forest, ecosystem and species in this order.

Assume instead that ecosystems are intrinsically valuable: it is true that many ecosystems internal to the Amazon may change, maybe radically, but without necessarily disappear. However, it is not clear why change would be bad. Is the change of an ecosystem a great intrinsic loss, that calls for great effort additional to the effort required to avoid the purely instrumental loss? It is not clear why this would be the case

Assume finally that species are intrinsically valuable. If people were to save all or most seeds of the species that face extinction for the degradation of the Amazon forest, it seems the species loss would be fairly limited. This would be especially true if the value is "non-incremental", that is, the value of a species does not depend on the quantity of its instantiation, but simply in its existence rather than non-existence (Pellegrino, 2018) (Dworkin, 1993). Thus, on this interpretation of constitutivism, the badness of losing the rainforest depends on how many seeds of each species humanity manage to preserve.

If one is unsatisfied by instrumentalists, constitutivists, and the other intrinsic value theories, one may want to adopt a *Relational* theory.

However, it is not clear how this would help in answering how stringent are people's responsibilities towards forest and plant preservations. Remember that *Relational* perspectives bypass questions about value. This creates an obstacle in answering the problems that intrinsic accounts have: without an account of how the value of plants works, it is unclear at which condition, if any, it is permissible to use plants from a forest.

Additionally, relational theories seem to prescribe that who is in a less direct relation with the plants has less obligations towards them. This, however, seem to have counterintuitive implications. This would mean that a business-man living in Europe whose relation with the Amazon forest consists in a very small percentage of revenue has less responsibility to preserve the forest than a person living in the forest. Still, the business-man may be damaging the forest significantly more: it seems that the business-man should have *more* responsibility than who lives in the forest. Relational theories may avoid these problems, for example postulating that the relation is between the human species and the plant species, which would mean that all humans have equal responsibility towards the environment. However, this also needs an account of how individual responsibility is derived from species responsibility.

To conclude, when examining people's responsibilities towards plants and forest preservation, no account of plant ethics can deliver fully satisfying answers just yet. This is a crucial area for further exploration in plant ethics.

4.2 Responsibility of planting trees

Trees have numerous properties that make them instrumentally valuable (§2.2, §3.1). According to some theorists, trees may have intrinsic value (§2.2). Thus, an increase in the number of plants seems desirable. This section explores the extent to which this is true by analysing whether people have responsibilities to plant trees.

Indeed, there have been numerous initiatives to plant large numbers of trees, such as the Trillion Trees campaign or Plant a Billion Trees. These initiatives have been criticized by environmentalists, since they can be counterproductive in many ways, from failing to recognize the value of diversity in an ecosystem, to increasing the risk of fires, to the accusations of incentivizing greenwashing.

Of course, this does not mean that planting trees is impermissible. If a person decides to plant a tree and knows that they are respecting biodiversity, do not increase the risk of fire and are not use the tree as an excuse to pollute, then it certainly seems that the person is doing a good thing. And indeed, the more the better. Efforts like the one performed by Jadav "Molai" Payeng, the “forest man of India” who turned a sandbar into a forest reserve hosting a variety of species, are certainly praiseworthy.

Without going to that extreme, people may indeed have an obligation to plant some trees, at least for a matter of reparation. It is not that implausible, for example, that any time a person consumes a plant, this person may have some obligation to plant another in its place (or in a place where this tree serves the same ecological function). However, plant ethics theories do not immediately provide a justification for intuitions of this kind, or for a responsibility to plant trees in general. What remains of this section explores how each family of theories may do so.

On instrumentalist theories, it is better to plant a tree whenever the tree will create an advantage for humans (or animals). However, this does not straightforwardly transform in a responsibility to plant trees. If the instrumentalist were to know that some action alternative to planting trees is more instrumentally valuable, the instrumentalist is committed to conclude that this other action would be better than planting trees. In order for the instrumentalists to conclude that they have a responsibility to plant trees, they need to show that planting trees is indeed among the best options they have available.

On zoocentrism, biocentrism and perfectionism, people have responsibilities to plant a tree independently from instrumental considerations only if people have a responsibility to make sure there are as many beings with intrinsic value as possible. However, this has heavily contested implications. If people have a responsibility to create as many beings with intrinsic value as possible, people should not only plant as many trees as possible: assuming, as plausible, that humans have

intrinsic value, people should make sure to have as many kids as possible. But it seems counterintuitive that people have a responsibility to reproduce as much as possible. Trying to hold onto the intuition that humans have intrinsic value without also implying that people should reproduce as many of them as possible has been established as a very difficult problem within value theory (Parfit, 1984, 4th part) (McMahan, 2009).

In order to solve this problem, intrinsic value theories may try to defend that people have a responsibility to ensure that the currently existing value does not diminishes. While this is intuitively plausible, it is not clear how this would follow from zoocentrism, biocentrism or perfectionism.

Constitutivists seem to be trapped between the problems of instrumentalism and the problems of zoocentrism, biocentrism and perfectionism. In fact, constitutivists have two possibilities.

One is to believe that what has intrinsic value is to preserve the existence, species or ecosystems. However, only very rarely planting a single plant will *preserve* a species or an ecosystem. Thus, this constitutivist view cannot justify responsibilities to plant trees on the basis of intrinsic value. It seems that this constitutivist view has to motivate planting single plants with instrumental justifications only. This obviously leads them to have the same problems as instrumentalists have.

Alternatively, constitutivists may claim that an ecosystem, or a species thrives more, or increases value, whenever a new plant grows. Or they may claim that people have a duty to create as many forests, ecosystems or species as possible. But this can justified only by claiming that people have a responsibility to make sure there are as many things with intrinsic value as possible, or that people have to ensure that what has intrinsic value is as thriving as possible. This leads to the same problems as zoocentrism, biocentrism and perfectionism have: this version of constitutivism is committed to the claim that not only people should plant as many trees as possible, but also that people should reproduce as much as possible.

Relational theories seem to fare a bit better than the others when it comes to justifying the duty to plant trees. If what motivates people's responsibility towards plants is the fact that people share the same ecosystem, or people's relationship of mutual support, then one may conclude that, indeed, the only way to ensure that this relation is preserved is to preserve the environment – that is, to plant a tree whenever one takes down one.

While this conclusion is intuitively compelling, it has limited application, in that it does not justify planting trees in environments one has no connection with. For example, it does not justify why one should fight desertification around the equator by planting trees unless one lives near the equator. However, desertification near the equator may be caused by emissions of people living far from the equator: it is not obvious how to track the responsibility that people living far from the equator intuitively have. Still, note that this objection may not be that devastating: some people's

intuition that there is some responsibility to plant some trees is much stronger than their intuition that people need to plant some trees regardless their distance from us.

To conclude, on whether people have responsibility to plant trees, and whether planting a single tree is sufficient to repair to the consumption of another, plant ethics theories deliver widely different results, from there being no responsibility to plant any tree to there being responsibility to plant as many trees as possible. This must be a matter of future research in plant ethics.

4.3 Duties to help plant migration

As seen in (§3.2), plants will move to a climate that is more favourable to them. However, migration is sometimes extremely hard for plants. Plant ethics should tell us what are people's responsibilities towards plant migration. This leads to two questions. First, whether people have duties to help plant migration at all: while this may save a lot of plant species, piloting migration may be overstepping the scope of human agency. Second, if people have these duties, how to prioritize plants and plant species over one another, a necessary question given limited space to grow new plants.

Before discussing in details these two questions, let us start from exploring what the obstacles to plant migration are. They can be summarized in two main families.

First, it is not always easy for a plant species to find a suitable environment. Indeed, certain features of the required environment may be missing for the reproduction or development of that plant in a radius that the plant can reach by reproducing. For example, the composition of the soil, or the humidity of the air may be unfit for the plant's survival, or an insect crucial for the plant's reproduction may be missing in the ecosystem the plant is attempting to migrate to.

Second, there simply may not be soil available. Given the large surface occupied with infrastructure, houses, crops, and industries, the surface available for new plants shrinks as time goes by.

It is unclear how many plants will migrate or are migrating: the data are scarce, and the migration models are limited (Nielson, et al., 2005, p. 753). On some estimations, however, half of all species are migrating to more favorable climates due to global warming. There is no reason to believe that plants would differ much in that respect. Human beings cannot afford losing great percentages of plant species: remember the list of crucial benefits people get from plants listed when introducing instrumental value (§2.2). Even if plants were to have only instrumental value, people most likely have, if not as individual agents at least as a collective, a responsibility to help plant migration.

Here the morality of plant migration aid makes plant ethics intersect with the ethics of geo-engineering, that is the "the deliberate large-scale intervention in the Earth's climate system, in order

to moderate global warming" (Royal Society, 2009, p. ix) (for reviews of the ethics of geo-engineering, see (Gardiner, 2019) (Pamplany, Gordijn, & Brereton, 2020)). While it is unclear whether preparing for plant migration needs necessarily to involve large-scale interventions, geo-engineering and plant migration aid face similar ethical issues.

The first issue is that successfully aiding plant migration can prevent awareness towards climate action. In fact, preparing the environment for plant migration means fixing with human technology the environmental damage caused by human technology. This may push the dangerous idea that humans don't need to change their environmentally careless lifestyle that much, given that some technology will always resolve any problem that may emerge from said lifestyle. In the words of Jeff Kiehl, pursuing geo-engineering would be "taking on the ultimate state of hubris to believe we can control Earth. We (the industrially developed world) would essentially be telling the (rest of the) world not to worry about our insatiable use of energy" (Kiehl, 2006, p. 227).

Furthermore, some may worry that changing the environment and deciding where plants should live is being arrogant, or akin to "playing God" with nature, or "messing with nature" (Gardiner, 2010). The worry of this critique may take many shapes. On some views, humans seem to have a terrible track record when it comes to heavy interventions on nature: the "playing God" attitude is the same attitude that caused anthropogenic climate change in the first place. There aren't many data on plant migration after all: humans may cause more damage than help. On other views, there is an opposition to intervening on nature: it seems that the scope of human agency has clear boundaries, and strong intervention on the natural order is beyond these boundaries. Finally, some may be concerned that reaching a too extreme level of control over nature may corrupt the moral character of humans (Hartman, 2017).

However, the survival of too many plant species may be compromised if people don't do anything about their migration. Thus, some may argue that considerations about moral corruption or arrogance can at best limit the pervasiveness of plant migration aid. If this is the case, it is important to balance intervention without incentivising environmentally irresponsible behavior.

Plant migration aid is peculiar with respect to the ethical challenges of geo-engineering in that may be continuous with normal agricultural practices. If there is enough continuity, the risk of moral corruption or "playing god" may be lower in plant migration aid, thus, plant migration aid is more permissible than other kinds of geoengineering. Certainly, however, this difference disappears if what needs to be changed are features of the air, or presence or absence of certain insects. But this would mean that people should privilege some plant species over others purely on the basis that some changes seem more like "playing god" than others. This is certainly a theoretical problem plant ethicists need to research on, that will require support from ethicists of geo-engineering, and whose

answer seems invariant across all theories.

The last moral dilemma examined in this section is that, given limited space, people may need to decide which plants to prioritize. The plants that are migrating need a specific environment, but the space that would be available is less and less. The surface of the potentially fertile sections of the world is already covered with infrastructures, houses, industries, and crops. And, as plants will migrate toward colder climates, so will animals and so will humans: more humans mean a greater need for infrastructure and houses. Thus, the space for plants in milder climates is not only limited, but is diminishing.

Furthermore, as the migrating plants need specific conditions to survive, so do many other plants: the components of the soil and the air that may work for one plant species may not work for another. Thus, some plants may be incompatible with themselves, and people may need to decide which plants to prioritise. How to prioritise one species of plant above another is a topic of research in plant ethics that is widely underexplored.

The question of how to prioritize plants when aiding migration is particularly thorny for relational theories. In fact, on these theories, people have responsibilities only for plants people are *already* in a relation with. And even if a theory were to somehow derive from this a responsibility towards plants that will exist, this does not help at all in deciding which plants should be prioritised over which others: to deal with this prioritization issue, a theory of the value of plants seems needed. This is incompatible with the commitment that relational theorists have to stay neutral between any position concerning the value of plants.

Some may think that it is not a problem that relational views cannot justify plant migration. In fact, this position has some of its roots in virtue ethics, and virtue ethicists criticized geo-engineering as it would worsen moral character (Hiernaux, 2021). Relational views would therefore be very consistent with some of their roots in not being able to justify plant migration: on some virtue ethics plant migration aid is never permissible, as geo-engineering is never permissible. However, this reveals a problem for these virtue ethics theories and any relational theory that wants to be consistent with them. Aiding plant migration can be *indistinguishable* from agriculture at times: plant migration aid may simply consist in planting a tree in a new place. These theories imply that agriculture is never permissible as it corrupts moral character. This is very hard to believe: plant migration aid responsibility does represent a problem for relational theorists.

Plant prioritization in migration aid is not much easier for who believes that plants have intrinsic value, as there is no basis to conclude that all plants have the *same* intrinsic value. Plants may differ in the extent to which they have faculty of perceiving and desiring, the extent to which they can flourish, the extent to which they contribute to the environment, or the extent to which people

have connections towards them. In fact, humans differ from plants in all these senses just listed, and in these differences, zoocentrist, perfectionists and constitutivists may find the root of the justification for prioritising human beings over plants. However, as it is difficult to compare humans and plants with respect to each of these parameters, difficulties in comparing plants between themselves according to these parameters are to be expected.

Biocentrists may indeed defend that all plants are equally valuable, as it feels strange to think that some being are more *alive* than others. However, this has two problems. First, it means that biocentrists can't justify prioritizing humans over plants, which has the counterintuitive result that people should not pluck a single flower to make a medicine to cure a man's life. Second, even if all plants had equal value, biocentrists will still need to rank plants according to their instrumental value, but instrumentalism requires further research before providing answers about prioritization.

On instrumentalism, people should prioritize plants according to their value for human beings. Thus, people should, for example, prioritize plants with curating properties or nutritional properties over other plants. However, scientists are unsure of the properties of many plants. Humanity may be about to condemn to extinction some species with potentially useful properties scientists have just not discovered yet: this is surely undesirable.

To avoid that, humanity may want to preserve as many species as possible even under instrumentalist assumptions. But this means giving less space to plants scientists currently believe having more instrumental value. How should people allocate space between plants scientists know are useful and plants scientists are unsure they may be? How much does the value of each individual plant weigh if compared to the value of preserving an entire species of plants with unexplored qualities? This is a venue of exploration for instrumentalists.

Note that the difficulty may be more theoretical than practical for instrumentalists if there will be enough space in seed vaults. However, deciding to store seeds in seed vaults raises further ethical problems, as seeds do not increase biodiversity in the environment, nor will make the species further develop, which raises a new set of ethical issues beyond the scope of this paper and discussed in (Karafyllis, 2018).

Let us conclude by summarizing this section. It is often hard to justify large human interventions in nature. However, these interventions may be easier to justify when it comes to plants, because agriculture is a large intervention on nature. Thus, people may be in the position to help plants migrate without "playing God"; indeed, it may be required to do so, given the great value of plants (instrumental or intrinsic as it may be).

A responsibility to aid plant migration, however, raises new moral questions. The space for

plants is limited, and people may need to decide which plants to let survive, and which ones not to aid. All theories face different difficulties with this question.

5 Conclusion

This chapter explored the connection between plant ethics and climate change. It introduced the main theories of plant ethics, explaining some of the main ways in which it has been defended that plants have intrinsic value, highlighting their immense instrumental value, and examining whether people's responsibility towards plants may come from the relation people have towards them rather than any conception of value.

Afterwards, this chapter gave a brief overview of how plants are a resource to fight climate change, focusing especially on how they capture CO_2, and of how plants are damaged by climate change, that threatens them with extinctions, lowers their efficiency in performing photosynthesis, and forces them to migrate.

Finally, the chapter introduced three new questions about climate change for plant ethicists.

The first question is how to motivate people's responsibility to preserve plants and forests. On all accounts of plant ethics, people have some responsibility to preserve forests. However, some theories currently struggle in motivating why people should save individual plants, and most theories seemed to struggle with tradeoffs between losses in plants and other kinds of gains. This is a crucial question for climate change, and because of this plant ethics needs much more research in this direction.

The second question was whether people have a responsibility to plant trees. While no theory has a straightforward way to justify this responsibility, all theories show promise for this justification. In particular, relational theories seemed particularly close to a solution.

The last question was whether people have a responsibility to aid plant migration. The question has two further specifications.

First: is it permissible to aid plant migration, or does this constitute a too big modification of nature beyond the scope of what human activities would be? This paper concluded that plant migration aid is most likely morally permissible, at least if one uses techniques sufficiently similar to agriculture.

Second: given limited space, people are most likely unable to aid the migration of all plants. Thus, people may need to decide which plant species to let survive and which ones to let end. How to prioritise species over other species, and how to prioritise species of plants over individual plants? All theories greatly struggle with this question. In particular, relational theories seemed incapable to provide a solution.

The destiny of the fight to climate change will be in great part determined by people's attitude towards plants. Therefore, it is crucial for plant ethics to deliver answers on this topic. Plant ethics is a young subject, that shows promise: there is hope that this discipline can play a key role in understanding individual responsibilities towards their environment, and avoid the worst outcomes of anthropogenic climate change.

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