

Pope Francis's Encyclical *Laudato Si'* and global environmental sustainability: a theoretical and empirical assessment

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Abstract

This paper examines the approach suggested by the Pope Francis's Encyclical *Laudato Si'* (i.e., an inter-disciplinary perspective that combines science and ethics), and theoretically and empirically assesses its scientific and ethical statements in terms of their ability to achieve global environmental sustainability. Scientific statements are shown to be empirically infeasible (e.g., personal fulfillment without population reduction), vague, obvious (e.g., climate as a common good, ecological debt of developed countries), and not novel (e.g., markets and environment in the a-growth paradigm, slowdown of production and consumption in the de-growth paradigm, ecosystem values independent of usefulness in the deep-ecology paradigm). Some ethical statements in the Encyclical are theoretically inconsistent with scientific disciplines (e.g., inter-generational solidarity vs. equity, individual organisms vs. whole species), vague, obvious (e.g., universal communion, happiness as limiting needs), or unnecessary (e.g., cruelty undermines human dignity, animals should not suffer or die needlessly), and thus, contribute little to achieving global sustainability; some other ethical statements are useful, but not novel (e.g., they have been proposed by Eastern Orthodoxy, Judaism, or Buddhism), late, or empirically unreliable (e.g., a contemplative lifestyle, the liberation provided by sobriety). In summary, *Laudato Si'* is unsuccessful from a scientific perspective, and is inadequate from an ethical perspective.

Keywords

Pope Francis; *Laudato Si'*; global environmental sustainability; theoretical assessment; empirical assessment

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1. Introduction

The increasing damage to the environment and human society caused by climate change suggests that global sustainability is an *urgent* problem (www.sdgindex.org/reports/2018). In other words, we must act now: even if technology can be improved rapidly, consumption preferences can be changed, and populations begin to decrease, we cannot afford to wait for these processes to succeed. The literature has recently begun to emphasize the role of ethics in achieving global environmental sustainability (Menning, 2016; Lenzi, 2017; Spahn, 2018). In particular, two main groups of environmental ethics can be identified: secular and religious ethics. *Secular* ethics focus on our responsibility to nature, responsibility to future generations, perceptions of the rights of humans and non-humans, and beliefs in inter- and intra-generational equity (Zagonari, 2018a). *Religious* ethics has a different focus in each religion. For example, we could (simplistically) say that Judaism focuses on stewardship (here, maximizing the use of resources to achieve the highest sustainable total welfare), Islam focuses on trusteeship and parsimony (here, minimizing the use of resources for the benefit of future generations), Hinduism and Buddhism focus on maintaining equilibrium, and Christianity focuses on love of neighbors (Zagonari, 2018b).

The observed failures of international agreements on climate change suggest that the unsustainability of global society is a *practical* problem (i.e., one related to actual practice rather than to beliefs; www.sdgindex.org/overview). In other words, it is not enough for an ethical principle or precept to be consistent and to be intended to move the world away from unsustainable practices; the principle or precept must also provide behavioral rules that are *feasible* (i.e., theoretically successful or implementable) and *reliable* (i.e., practically trustworthy), positive (i.e., do that, possibly supported by reward) or negative (i.e., do not do that, possibly supported by punishment), to achieve sustainability through the application of consistent ethical concepts to achieve realistic equilibrium conditions.

Both the methodological literature (e.g., MacLeod, 2018) and the applied literature (e.g., Anderson et al., 2015) support the idea that sustainability must adopt an *interdisciplinary* approach (i.e., it cannot be analyzed from a purely scientific or a purely ethical perspective, but it must include many perspectives).

The Encyclical *Laudato Si'* by Pope Francis (2015) supports an inter-disciplinary approach: “A science which would offer solutions to the great issues [*such as sustainability*] would necessarily have to take into account data generated by other fields of knowledge, including philosophy and social [*both secular and religious*] ethics” (§110) (italics text is mine). Indeed, the Encyclical has been presented as an excellent opportunity to trigger a conversation between science and religious as well as secular ethics about sustainability (Zsolnai, 2017).

The purposes of this paper are to (i) assess the *interdisciplinary* accuracy of *Laudato Si'* from a theoretical perspective in terms of its conceptual and methodological integration of science with ethics in an effort to solve global sustainability problems, (ii) empirically assess its *feasibility* in term of whether the stated goals and constraints can be realistically achieved; and (iii) empirically assess its *reliability* in terms of whether the suggested instruments can be realistically implemented to achieve global sustainability. In particular, sections 2 and 3 will evaluate the main scientific and ethical statements, respectively; section 4 will discuss the remaining ethical statements and the overall scientific model by stressing the low effectiveness, concreteness and dogmatism of *Laudato Si'*; and section 5 will highlight the inaccuracy of the proposed interdisciplinary approach and the implausibility of the suggested inter-religious dialogue by justifying the fact that its ethical statements are not novel (i.e., other religions have said this before) and are late (i.e., the Catholic Church could have said this long ago).

Note that the proposed interdisciplinary approach, in which both ethics and science are involved, implies that *Laudato Si'* is not a dogmatic letter, but rather a political letter (i.e., scientific truths cannot be accepted without doubt). Consequently, I will assess the Encyclical by applying criteria suitable for a political perspective (i.e., the consistency between the stated goals or constraints and the suggested policy instruments). I discuss the possible relationships between ethics and science in

an effort to achieve global environmental sustainability within an interdisciplinary context in section 5. Moreover, consistently with *Laudato Si'*, I will perform a cross-country rather than a within-country analysis: “The worst impact of climate change will be probably felt by developing countries in coming decades (§25); “Water continues to be wasted, not only in the developed world but also in developing countries which possess it in abundance” (§30); see also §51 and §172. Finally, although global environmental sustainability has been specified differently by different scientific, philosophical, and theological theories, I will assume that these alternative perspectives are compatible and can be summarized and quantified based on the concept of an ecological footprint (i.e., the biologically productive area needed to provide all services that an individual uses). In summary, the stated objective (i.e., global environmental sustainability) is measured in terms of the sustainable per capita use of Earth’s resources. In section 5, I also discuss the potential development of an inter-religious dialogue on specific issues and attitudes to achieve global environmental sustainability.

2. Main scientific statements

In this section, I summarize the main scientific statements in *Laudato Si'*, and evaluate them in terms of the *feasibility* of achieving the stated goals and constraints. I discuss the overall scientific model that can be elicited from these statements in section 4. Note that scientific statements must be quantifiable and grounded on significant quantitative estimates to be considered feasible.

2.1. Empirical feasibility

This section will refer to the World Bank’s world development indicators (<http://data.worldbank.org>) for data on the per capita GDP (on a purchasing-power-parity basis, PPP), life expectancy at birth (LEB), enrolment in secondary school (ESS, % of the population), and the population in 2012. Moreover, I estimated the per capita use of the environment for representative individuals in these countries using data from the Global Footprint Network (<http://www.footprintnetwork.org>), where the current ecological footprint has been measured at a national level. Finally, I classified countries into pre-industrial, industrial, and post-industrial (respectively) if the agriculture sector accounts for more than 16% of GDP, the industry sector accounts for more than 32% of GDP, and the service sector accounts for more than 64% of GDP. I based this classification on global data (<http://data.worldbank.org>). I defined countries that did not meet any of these three criteria as “other” countries.

The following statements from the Encyclical can be proven to be empirically *infeasible*, although they are quantifiable:

To blame population growth *instead of* extreme and selective consumerism on the part of some, is one way of refusing to face the issues (§50). Nobody is suggesting a return to the Stone Age, but we need to slow down (§114).

In summary, population growth and consumption level are assumed to be *constraints* that are unrelated to sustainability (Pareglio and Oppio, 2018).

Table 1 summarizes the ecological footprint and GDP for all countries combined and for the four categories of country. The data suggest that we all should return to the lifestyle that currently prevails in pre-industrial countries, which have an average EF at 1.4, since industrial and post-industrial countries are characterized by an EF of 3.3 and 4.6, respectively. Both of these values are far larger than the value of 1.7 ha that is calculated by the Global Footprint Network to represent sustainable use of resources per capita at the current population level. On this basis, we would have to reduce the population of industrial and post-industrial countries by more than half to make these countries sustainable, and also reduce production and consumption by at least 26% in post-industrial countries; that is, by $(4.6-3.4)/4.6$. This could be achieved, for example, by changing one’s car every 5 years rather than every 4 years. Note that the population potentially guided by *Laudato Si* is nearly 2.3 billion people in 83 countries where Christianity is the majority religion.

Table 1. Ecological footprint (EF) (ha) and gross domestic product (GDP, PPP) (US\$ per capita) for all countries combined and for pre-industrial, industrial, post-industrial, and other countries. CHR = countries that are predominantly Christian, TOT = the whole sample of 145 countries.

	Mean GDP (PPP)	St.Dev. GDP (PPP)	Mean EF	St.Dev. EF	Total population	Religion	Number of countries
All countries	18,780	16932	3.6	2.47	2,271,416,410	CHR	83
	15,426	15967	3.1	2.27	6,813,033,095	TOT	145
Pre-industrial countries	3,065	2254	1.5	0.86	354,426,792	CHR	18
	3,078	2140	1.4	0.66	1,230,794,985	TOT	42
Industrial countries	18,216	12968	3.6	1.63	693,819,793	CHR	21
	15,939	11750	3.3	1.71	4,063,572,507	TOT	40
Post-industrial countries	26,594	17317	4.6	2.68	1,205,726,127	CHR	42
	26,970	17782	4.6	2.51	1,385,585,914	TOT	52
Other countries	2,033	448	1.3	0.65	17,443,698	CHR	2
	6,141	6876	1.9	1.40	133,079,689	TOT	11

The following statements can also be proven to be empirically *infeasible*, although they are quantifiable:

A true ecological approach always becomes a social approach; it must integrate questions of justice in debates on the environment (§49). Every ecological approach needs to incorporate a *social* perspective which takes into account the fundamental rights of the poor and the underprivileged (§93). Any approach to an integral ecology, which by definition does not exclude human beings, needs to take into account the value of labour (§124). Work is part of the meaning of life on this earth, a path to growth, human development and personal fulfillment (§128). We are faced not with two separate crises, one environmental and the other social, but rather with one complex crisis which is both social and environmental. Strategies for a solution demand an integrated approach to combating poverty, restoring dignity to the excluded, and at the same time protecting nature (§139). The human person [is] endowed with basic and inalienable rights ordered to his or her to integral development (§157).

In summary, social *goals* are supported as a prerequisite to environmental sustainability (Da Fonseca, 2016).

Table 2. Ecological footprint (EF) as a function of life expectancy at birth (LEB) and enrolment in secondary school (ESS). CONS represents the constant term. $R^2 = 0.46$.

ef	Robust		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
leb	.0589916	.0280032	2.11	0.037	.0036346	.1143487
ess	.0384504	.0070756	5.43	0.000	.0244632	.0524376
_cons	-4.05767	1.504281	-2.70	0.008	-7.031349	-1.083991

I tested the relationship between life expectancy at birth and enrolment in secondary school and found that (Table 2) a 1-year increase in LEB and a 1% increase in ESS would require an increase

in per capita EF by 0.06 and 0.04 ha, respectively (i.e., $EF = 0.06 \text{ LEB} + 0.04 \text{ ESS} - 4.05$). For example, in order to achieve 90% ESS and an LEB of 78 years, we need $EF = 0.06 \times 90 + 0.04 \times 78 - 4.06 = 4.46$ ha, which is much greater than the sustainable level of 1.7 ha. Note that reducing 4.46 ha by 26% gives us 3.3 ha, which is less than the value of 3.4 ha that is feasible if we reduce the world's population by half.

Similarly, Table 3 suggests that the environmental Kuznets curve (i.e., $\ln EF = 0.44 \ln GDP$) moves upward significantly if LEB and ESS are set at 78 years and 90%, respectively. In addition, LEB is less significant than ESS (i.e., has a lower t value), since old people are likely to consume less than young people. Note that the marginal impact is the same as the impact we obtained in Table 2 (i.e., 0.06 and 0.04 for LEB and ESS, respectively).

Table 3. Environmental Kuznets curve with the ecological footprint (EF) increasing and concave down for gross domestic product (GDP) as a function of the life expectancy at birth (LEB, at least 78 years) and enrolment in secondary school (ESS, at least 90%). CONS represents the constant term. $R^2 = 0.78$.

lnef	Robust		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
lngdp	.4455859	.0397793	11.20	0.000	.366945	.5242268
aboleb	.0428296	.0340318	1.26	0.210	-.024449	.1101081
aboess	.0624794	.0376229	1.66	0.099	-.0118985	.1368574
_cons	-1.398503	.1426598	-9.80	0.000	-1.680532	-1.116475

To account for the effects of religion, I used the method described in Zagonari (2018b). Table 4 shows that the same Kuznets curve (i.e., $\ln EF = 0.49 \ln GDP$) moves downward if religions are taken into account. In this analysis, religions are represented as dummy variables, with the majority religion for a country, if any, receiving a value of 1. In particular, although there is no religion with a negative sign that is both large and significant, the ranking of the religions in terms of how strongly they promote sustainability, both in terms of magnitude and significance of coefficients, can be summarized as Buddhism and Hinduism > Islam > Judaism > Christianity.

Table 4. Impacts of religious environmental ethics on the environmental Kuznets curve with the ecological footprint (EF) increasing and concave down for gross domestic product (GDP), with budhin, isl, jud, and chr defined as dummy variables that identify countries where Buddhism or Hinduism, Islam, Judaism, and Christianity are the majority religions. CONS represents the constant terms. $R^2 = 0.77$.

lnef	Robust		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
lngdp	.4991936	.0235559	21.19	0.000	.4526194	.5457678
budhin	-.0644674	.0759184	-0.85	0.397	-.2145716	.0856368
isl	-.0384913	.0430743	-0.89	0.373	-.1236569	.0466743
jud	.1084827	.0375022	2.89	0.004	.0343342	.1826313
chr	-.000919	.0389121	-0.02	0.981	-.0778552	.0760172
_cons	-1.557305	.1047988	-14.86	0.000	-1.764511	-1.350099

Note that these statistical results confirm previous theoretical insights on Judaism (i.e., a less negative impact on sustainability) and on Christianity (i.e., a non-significant impact on sustainability) presented in Zagonari (2018b).

2.2. Clarity

The following statements (*italics is mine*) are too unclear to be subject to estimation:

... humanity *runs the risk of* destroying [nature] (§4). We have an *irrational confidence* in progress and human abilities (§19). We have not yet managed to adopt a circular model of

production capable of preserving resources for present and future generations, while limiting *as much as possible* the use of non-renewable resources, *moderating* their consumption, maximizing their efficient use, reusing and recycling them (§22). [Climate change's] worst impact will *probably* be felt by developing countries (§25). The cost of the damage caused by such selfish lack of concern is *much greater* than the economic benefits to be obtained (§36). The growth of the past two centuries has *not always* led to an integral development and an improvement in the quality of life (§46). The developed countries ought to help pay this ecological debt by *significantly* limiting their consumption of non-renewable energy and by assisting poorer countries to support policies and programs of sustainable development (§52). People's quality of life actually diminishes—by the deterioration of the environment, the *low quality of food* or the depletion of resources—in the midst of economic growth (§194). *Halfway* measures simply delay the inevitable disaster (§194).

Note that the reduced quality of food is problematic to evaluate, in particular if it is compared with the increased proportion of the world's population with access to basic food.

2.3. Consensus

The following statements are too obvious to be worth estimating:

The climate is a common good (§23). Such effects will continue to worsen if we continue with current models of production and consumption (§26). The exploitation of the planet has already exceeded acceptable limits (§27). A true ecological debt exists, particularly between the global north and south, connected to commercial imbalances with effects on the environment, and the disproportionate use of natural resources by certain countries over long periods of time (§51).

In particular, Vasconcelos et al. (2015) support the first statement, whereas Walrenius (2018) supports the last statement.

2.4. Novelty

The following statements might be subject to estimation, but they are emulated from other scientists.

We need to slow down and look at reality in a different way, to appropriate the positive sustainable progress which has been made, but also to recover the values and the great goals swept away by our unrestrained delusions of grandeur (§114). Ecosystems have an intrinsic value independent of their usefulness (§140). The environment is one of those goods that cannot be adequately safeguarded or promoted by market forces (§190).

In particular, de-growth by Kallis (2011), deep ecology by Naess (1986), and a-growth by Van Den Bergh (2011) theoretically support the first, second and third statements, respectively.

3. Main ethical statements

In this section, I will evaluate the main ethical statements of *Laudato Si'* in terms of two criteria: *interdisciplinary* accuracy, which means how well they are conceptually and methodologically integrated with sustainability science, and *reliability*, which means whether they can be realistically implemented as instruments to achieve global sustainability. I will examine practically useful ethical statements in section 4. Note that ethical statements must be quantifiable and supported by tight quantitative relationships with behaviors to be characterized as reliable.

3.1. Theoretical consistency with scientific disciplines

The following statements can be shown to be theoretically inconsistent with ecology:

Man must respect the particular goodness of *every* creature (§69). Each creature has its own purpose. None is superfluous (§84). Each organism, as a creature of God, is good and admirable in itself (§140).

In summary, the concept of species is assumed to be a substitute for the concept of organism (i.e., the Encyclical focuses on individual organisms rather than on the more ecologically important concept of species), in accordance with the Biblical tradition (Matthew 6, 26). However, the respect (a term that should be better specified) for each single organism is different from the respect for a species, and the survival of individuals is not required to achieve preservation of the species or global sustainability (Frank, 2017). Note that sustainability, defined in the context of social and ecological resilience (Salas-Zapata et al., 2017), refers to species rather than individuals.

The following statements can be shown to be theoretically inconsistent with economics:

Intergenerational solidarity is not optional, but rather is a basic question of justice (§159). There is an urgent moral need for a renewed sense of intergenerational solidarity (§162).

In summary, the concept of solidarity (the concerned attitude towards the poor and the vulnerable in Pope Francis, and articulated in terms of friendship or social charity in the Catechism of the Catholic Church 1939) is assumed to be a substitute for the concept of equity, in accordance with the Catholic tradition (St. Thomas, *Summa Theologiae*). However, solidarity (a virtue that is grounded on mutual obligation and shared effort to social cohesion, and manifested in sharing spiritual and material goods in the Catechism of the Catholic Church 1949) is difficult to apply to future generations (i.e., inexistent and unspecified representative individuals), and it is impossible to measure (i.e., an attitude or virtue rather than a specified behaviour or outcome), whereas equity, in its alternative definitions and units, can be measured to test for the reliability of the advocated and implemented policies (Kochuthara, 2017). Note that the strong sustainability paradigm (Jain and Jain, 2013) supports inter-generational equity in access to the same amount of natural resources and the same status of the environment.

3.2. Clarity

The following statements are too vague to be subject to estimation:

If we feel intimately united with all that exists, *then* sobriety and care will well up spontaneously (§11). We cannot adequately combat environmental degradation *unless* we attend to causes related to human and social degradation (§48). We are called to *respect* creation and to recognize that other living beings have a value of their own (§69). We should not think that political efforts or the force of law will be sufficient to prevent actions which affect the environment, because, when the culture itself is corrupt and objective truth and universally valid principles are no longer held, then laws can only be seen as arbitrary impositions or obstacles to be avoided (§123). A decrease in the pace of production and consumption can at times give rise to *another* form of progress and development (§191). Technologically advanced societies must be prepared to encourage more sober lifestyles, while *reducing* their energy consumption and *improving* its efficiency (§193).

Note that human and social degradation should be further specified to become a reliable environmental rule.

3.3. Consensus

The following statements are too obvious to be worth estimating:

We require a new and universal solidarity (§14). Happiness means knowing how to limit some needs (§223).

Note that Zagonari (2011) empirically estimated the happiness arising from slack constraints on economic and social features at a country level.

3.4. Necessity

The following statements about an overall world view are not required to achieve global sustainability:

Peace, justice and the preservation of creation are three absolutely interconnected themes, which cannot be separated and treated individually without once again falling into reductionism (§92). The effects of imposing [science and technology as an epistemological paradigm] on reality as a whole, human and social, are seen in the deterioration of the environment (§107). The desire to create and contemplate beauty manages to overcome reductionism through a kind of salvation which occurs in beauty (§112).

In summary, the Encyclical suggests that the epistemological paradigm behind science and technology should be replaced by knowledge gained through contemplation of nature's beauty. However, this approach is unlikely to be espoused by the majority of the world's population, and there are other less demanding approaches to achieve sustainability. Note that overcoming reductionism is linked to social justice (see Section 3.1) and nature contemplation (see Section 3.7). The following statements about an individual animal's dignity are not required to achieve global sustainability:

Every act of cruelty towards any creature is contrary to human dignity (§92). It is contrary to human dignity to cause animals to suffer or die needlessly (§130).

In summary, the Encyclical assumes that animals have some (sort of) rights, not stated explicitly, in accordance with the Catholic tradition (Catechism of the Catholic Church, 2418). However, the rights of non-humans are not universally accepted (e.g., secular legislation is required to protect them) and even when these rights are acknowledged, this may not contribute to conservation of nature (i.e., it is unnecessary to consider the rights of individual organisms to plan conservation activities). Note that the rights of non-humans include the rights of species (i.e., speciesism), the rights of non-humans who experience pain and suffering (i.e., sentientism), and the rights of any life form (Saner and Bordt, 2016): by attaching value to each individual plant or animal (Campbell, 2018), to communities (Kortetmaki, 2017), or to biological diversity and ecological integrity (Mikkelsen and Chapman, 2014), these rights can extend from the very small (individuals) to the very large (ecosystems).

3.5. Novelty

The following statements might be subject to reliable implementation, but they have already been proposed by other religions:

To commit a crime against the natural world is a sin against ourselves and a sin against God (§8). Accept the world as a sacrament of communion (§9). Francis asked that part of the friary garden always be left untouched, so that flowers and herbs could grow there (§12). Because all creatures are connected, each must be cherished with love and respect, for all of us as living creatures are dependent on one another (§42). We live in a common home which God has entrusted to us (§232).

In particular, the first two sentences are quoted from Greek Orthodoxy, the third and the last sentences come from Judaism, and the fourth sentence is close to Buddhism (Van Tine, 2017). Note that Zagonari (2011) empirically compared the happiness that arises from the prevailing religions at a country level.

3.6. Timeliness

The following statements are interpretations that should have been made long ago:

Although it is true that we Christians have at times incorrectly interpreted the Scriptures, *nowadays* we must forcefully reject the notion that our being created in God's image and

given dominion over the Earth justifies absolute domination over other creatures (§67). Christianity has claimed a Promethean vision of mastery over the world, which gave the impression that the protection of nature was something only the faint-hearted cared about. *Instead*, our dominion over the universe should be understood more properly in the sense of responsible stewardship (§116).

Note that O’Neil (2016) stressed that *Laudato Si’* is the first Encyclical focused on environmental issues.

3.7. Empirical reliability

The following statements are too generic to be subject to reliable individual implementation:

Christian spirituality proposes an alternative understanding of the quality of life, and encourages a prophetic and contemplative lifestyle, one capable of deep enjoyment free of obsession with consumption (§222). It is a return to that simplicity which allow us to be spiritually detached from what we possess, and not succumb to sadness for what we lack (§222). Sobriety, when lived with freely and consciously, is liberating (§223). We should contemplate the lilies of the field and the birds of the air (§226).

Note that “prophetic” seems to mean “inspired by God”, which means that it is empirically unquantifiable.

The following statements are too generic to be subject to reliable social implementation.

The poorest areas and countries are less capable of adopting new models for reducing environmental impact because they lack the wherewithal to develop the necessary process and to cover their costs. We must continue to be aware that, regarding climate change, there are differentiated responsibilities (§52). Human beings, endowed with intelligence, must respect the laws of nature and the delicate equilibria existing between the creatures of this world (§68). Regarding climate change, the poor end up paying the price (§170).

Note that these sentences suggest an analysis based on social cohesion and responsibility (Schmieg et al., 2018), in contrast with a tight policy to achieve sustainability, such as the “polluter pays principle”, that is based on rights and duties.

4. Discussion

In addition to the scientific and ethical statements discussed in the two previous sections, there are other considerations that should be examined. If we focus on single practically useful ethical statements, one should consider the following ones:

Whenever food is thrown out it is as if it were stolen from the table of the poor (§50). Reusing something instead of immediately discarding it, when done for the right reasons, can be an act of love (§211).

Note that the first statement implies a social punishment, whereas the second statement implies a social reward. Next, “We stop and give thanks to God before and after meals” (§227) does not have practical implications for a pro-environmental behavior. Thus, the overall set of ethical statements does not exploit the behavioral driving potentials of an Encyclical.

If the focus is on the overall scientific model, one should consider the following anthropocentric sustainability paradigms:

1. *Laudato Si’* is close to deep ecology, and it is more environmentally concerned than an ecosystem services approach: ecosystems have an intrinsic value independent of their usefulness (§140).
2. *Laudato Si’* accepts a-growth, and it is more environmentally concerned than weak sustainability: the economic market is inadequate to solve environmental problems (§190).

3. *Laudato Si'* accepts strong sustainability: inter- and intra-generational solidarity in resource distribution (§159 and §162).
4. *Laudato Si'* is close to de-growth: we need to slow down and look at reality in a different way (§114).

Note that despite these similarities to the scientific paradigms, *Laudato Si'* differs from strong sustainability, since the latter uses equity rather than solidarity. Next, *Laudato Si'* differs from deep ecology, since the latter advocates a reduction in population. Thus, *Laudato Si'* can be summarized as a happy de-growth paradigm, in which happiness is based on religiosity. The following statement confirms that interpretation:

It is not easy to promote this kind of happy sobriety when we consider ourselves autonomous, when we exclude God from our lives (§224).

However, only the following ethical statements seem to ground happy sobriety on religiosity:

Sin is manifest in ... attacks on nature ... the rupture of our relationships with God, neighbours and Earth is a sin (§66). Living our vocation to be protectors of God's handiwork is not an optional or a secondary aspect of our Christian experience (§217). A loving awareness that we are not disconnected from the rest of creatures, but joined in a splendid universal communion (§220).

Note that the first two sentences suggest punishment, whereas the third sentence suggests a reward. In other words, *Laudato Si'* could rely on the intrinsic value of nature, based on respect for creation and on strong law enforcement, as in the case of all religious ethics as opposed to secular ethics (Cosgel and Miceli, 2018). However, it does not suggest reliable ethics: indeed, universal communion does not imply happy sobriety. Note that frugality is supported by the sanctity of nature combined with pantheism (the belief that God is greater than the universe and both includes and is part of it) in Eastern Orthodoxy (Bracken, 2014), and is combined with the sense that humans and non-humans have the same dignity through pantheism or panentheism in Hinduism and Buddhism (Jenkins et al., 2018).

In summary, despite the roots of *Laudato Si'* in the Catholic tradition, with an anthropocentric perspective that humans are above all other creatures, and without an immanent God so that no things are intrinsically bad, *Laudato Si'* could have been more *effective*. By maintaining St. Francis's model, happy simplicity could have been advocated more firmly. For example, *Laudato Si'* could have said that "happiness is meeting God's will". Moreover, even if poverty is assumed as a constraint to continuous happiness rather than creating a binary condition (poor and happy vs. not poor and not happy), *Laudato Si'* could have been more *concrete*. In particular, the absence of attention to practical policies or actions to collectively advance policy change, whether as parishes, lay communities, educators, or the institutional Church, is a barrier to its realization (O'Neil, 2016). Finally, *Laudato Si'* could have been more *dogmatic* within a realistic modern lifestyle: in other words, *Laudato Si'* could have relied to a greater extent on precepts (e.g., offer your time to reduce pollution or preserve resources) rather than hints and suggestions.

Note that I am not criticizing ethical statements *per se* (i.e., I treat them as stated goals or constraints, regardless of the religious or secular source); rather, my goal is to challenge them in terms of their feasibility and reliability by applying scientific assessment methodologies.

5. Conclusions

The scientific model of *Laudato Si'* is theoretically inconsistent with some scientific disciplines related to sustainability science because it retains concepts from sacred texts on intergenerational solidarity and the value of a single organism. Moreover, it is empirically infeasible due to constraints from assumptions about population growth *and* personal fulfilment. I showed that global sustainability is achievable if either population growth *or* personal fulfilment constraints are abandoned. Finally, *Laudato Si'* is empirically unreliable, due to the loose relationships between its suggestions and human behavior. In other words, *Laudato Si'* shows that it not always possible to

perform an interdisciplinary scientific analysis if we simultaneously try to commit to theological concepts. However, this does not imply that adopting an interdisciplinary approach cannot help us deal with the various aspects of the sustainability crisis (e.g., in §138: Fragmentation of knowledge and the isolation of bits of information can actually become a form of ignorance, unless they are integrated into a broader vision of reality; see also §197). In particular, whether ethics is above science (i.e., it specifies limits for science) or whether ethics is at the same level as science (i.e., they mutually identify goals and instruments), a holistic approach lets us rely on a larger set of instruments to achieve a complex objective, whenever there is no cost-free solution in terms of a lack of achieved goals and met constraints or in terms of a lack of supported ethics.

Next, *Laudato Si'* is too ecumenical in supporting an inter-religions dialogue for the sake of protecting nature (e.g., in §201: The majority of people living on our planet profess to be believers. This should spur religions to dialogue among themselves for the sake of protecting nature, defending the poor, and building networks of respect and fraternity; see also §92). In other words, sustainability achievements should not rely on impossible (in the short-run) and implausible (in the long-run) compromises between religions to cope with an urgent issue. However, this does not imply that the suggested inter-religion dialogue cannot be applied to specific aspects (e.g., community involvement, decreased consumerism) by avoiding the extension of religious ethical principles to other communities or the extension of precepts and proscriptions of one religion to other religions.

Nevertheless, two main justifications can be found in the failure of *Laudato Si'* to provide unequivocal and actionable guidance towards sustainability. As for the issue of novelty, no original approaches were available. Indeed, the main religious environmental precepts cover all alternative analytical solutions of the inter-temporal sustainability problem (Zagonari, 2018b): maximising current welfare subject to an inter-temporal constraint on resource use in Judaism; a minimisation of current resource use to achieve a given welfare level subject to an inter-temporal constraint on resource uses in Islam; and an equilibrium use of resources for all generations in Buddhism and Hinduism. As for the issue of timeliness, although this Encyclical could have been promoted centuries earlier, late is better than never (O'Neil, 2016): indeed, *Laudato Si'* is the first Encyclical on environmental issues and may represent a new age of religiously inspired environmental sustainability for the Catholic church.

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