



A critical perspective on the European Commission's publications 'Evaluating the impact of nature-based solutions'

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ABSTRACT

The European Commission's (EC) double publication 'Evaluating the impact of nature-based solutions' (NBS) can be considered as a milestone for the adoption and evaluation of these solutions, which reportedly have a significant potential for climate change mitigation or the improvement of social justice. This optimistic view, however, is not equally held by everyone: a widespread scepticism over the NBS concept makes clear that the debate about the potential and convenience of NBS is far from over. Here we review some of this criticism and put this EC double document (handbook + appendix) under deep scrutiny, with the aim of proposing improvements for it and as an opportunity to discuss general aspects of the NBS field. In particular, we base our criticism on four perspectives: climate emergency, economy-driven ideology, ecolinguistics and the presence of logic pitfalls. The general aim of this article is to discuss the relevance of the NBS concepts present in the EC texts in relation to the climate crisis.

1. Introduction

If well understood [1,2], and if well explained, nature-based solutions have a significant potential to address climate crisis and biodiversity loss [3] and can also 'deliver tangible impacts in a given time frame' [4,5]. However, the Intergovernmental Panel on Climate Change (IPCC), in its sixth assessment report (group II), claims that they 'cannot be regarded as an alternative to, or a reason to delay, deep cuts in greenhouse gas emissions' and that there is a 'lack of robust, site-specific investigations of the effectiveness of interventions compared to alternatives and of more holistic appraisals accounting for broader social and ecological outcomes' [6].

On 2021-05-04, the Directorate-General for Research and Innovation from the European Commission published a double document: *Evaluating the impact of nature-based solutions*, one part as *A Handbook for Practitioners* [7] and the other as an *Appendix of Methods* [8]. From now on in this article, they will be simply referred as the EC documents or the EC texts. Pages from the handbook will be cited as (p-number) and pages from the appendix as (pp-number), always referred to the aforementioned version. These documents are the result of a massive compilation effort 'to support the adoption of common indicators and methods for assessing the performance and impact' of NBS [7] (p-6), and they have a potentially huge impact on how many and in which way NBS are implemented, so their already valuable content deserves to be

scrutinised in depth.

This perspective aims to criticise general aspects of the NBS field, taking the mentioned texts as a reference, also trying to contribute to what the authors call 'living documents' [7] (p-25), which, although mainly being practical texts, they contain a thorough exposition of NBS theory, which is the main target of the following criticism.

This article has been purposely written with a provocative tone and pondered against a current climate emergency scenario that does not leave much room to neutrality or laconism. Moreover, being a perspective, it necessarily relies on (informed) subjectivity, something that far from confronting more methodological and objective approaches, it complements them. Such subjective character does not, by any means, imply lack of structure. There is a clear line of reasoning here, which begins with a discussion of the relevance of the EC documents in relation to our current situation of climate emergency, undoubtedly being the first and topmost entry in every serious agenda.

A second angle of attack is the discussion of the strongly economically-focused language of the EC texts, which reveals an ideology that is in direct conflict with the interests of Nature. Simple instances of ecolinguistic analysis, based on frequencies of relevant words, will be scattered along this section and the rest of the article. The number of occurrences of a word in the handbook/appendix will be written as (n-number)/(nn-number). All these metrics are measured from the aforementioned version of the EC documents.

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The third angle of criticism is a natural continuation of the previous one: the ideology uncovered by the strongly economy-focused language needs to be scrutinised and be put into question. It is of paramount importance to see why the ideology being at the root of climate disruption cannot be an appropriate framework to address its conservation and restoration.

Fourth, the technique of close reading, if applied to the EC documentation, reveals an interesting collection of logic pitfalls, that are presented as a miscellaneous assortment without any particular order, lack of order not implying lack of relevance.

The overarching philosophy of this article is that the ecosystem, being under a deep threat, must be an absolute priority for every field and policy containing the word 'Nature' in it, so that every reference to this topic, even if tangential, must be put under a laser focus to uncover any greenwashing attempt. Given the strong relevance and influence of the EC documents, the aim of this perspective is primarily to place these publications under examination to identify every angle that can potentially row against the conservation and restoration of Nature, and to uncover whether the current commitment of the EC's policy is more shifted towards profit endeavours or climate action.

To be fair, the following criticism is not to be exclusively directed at the EC documents, which are after all aligned (both in content and in their market-driven language) with the NBS framework proposed by the International Union for the Conservation of Nature (IUCN) [9]. Intended to become the "Global Standard", such framework aspires to establish the basis upon which we must decide what is to be considered a NBS and what is not. This is both positive, as a starting point, but also potentially dangerous: the existence of a top-down standard is a strong reason for meticulous vigilance.

2. Climate emergency

2.1. Review of NBS criticism

The field of NBS should not be indifferent or ambiguous with respect to the fact that the Earth's climate is under a deep crisis. Unfortunately, this field has not sufficiently clarified its standpoint yet. To illustrate this, we present a small review of literature, critical with the current NBS trends.

Nowadays, even the NBS term 'has not been universally welcomed' yet. From academia, environmental activism, NGO's and civil society, it has been argued that NBS 'do not substantially address climate change and can even be harmful to both the environment and humans' [10]. The main praise for NBS 'has mainly come from the U.N., policy-makers, international conservation organizations and corporations, while grass-roots movements and civil society groups have voiced concerns over the concept.' Some critics even claim that NBS 'can be used as a tool to finance destructive activities by corporations and greenwash ongoing carbon emissions and destruction of nature' [11].

The 'conventional business model approach' has been considered 'a failure in case of decentralised, participatory natural resource management processes'. In other words, the NBS narrative 'needs to come out of business-based solutions' [4] if it really tries to be a valuable asset for Nature. There are positions suggesting that 'the conceptual flexibility associated with a vague or loosely-defined term can risk missing important opportunities to improve the management of natural resources' [12].

The terms 'solutions' and 'ecosystem services', which will be further analysed later, are suspected to imply that 'nature is only beneficial in its utility to humans, not necessarily for its own sake'. Both the Bolivian and the Algerian delegations were reported to bring this to the table at the recent COP26 in Glasgow [10,13,14]. A press statement of ActionAid International said that NBS are now 'almost universally synonymous with carbon offsetting'. It further mentions that 'we increasingly see that the most prominent advocates of nature-based solutions tend to be the polluters because they see it as a solution to their pollution' [10].

In 2021-11-02, 257 organisations, networks and movements from 61 countries said 'NO to NBS', a concept that 'governments and corporations are peddling at COP26.' They claim that their 'primary function is to buy another decade or two of unrestrained corporate profiteering from fossil carbon extraction and industrial agriculture while increasing outside control over community territories' [15]. Some critics also object to 'the implied commodification of the natural world' and say that the NBS term is 'misused by big business to justify continued pollution' [16].

NBS is promoted as an umbrella concept (p-18), but the same metaphor can be appropriated by critics claiming that such parasol can be used to give shade to big corporations promoting carbon offsetting and other deceptive practises. An explicit emphasis to avoid the misuse of the NBS is needed [1,17–20]. Many concerns have been raised about NBS 'being used to excuse business-as-usual consumption of fossil fuels' [1,21,22].

The NBS concept is said to be 'distracting from the urgent need to protect and connect a wide range of intact ecosystems across landscapes and seascapes' [1,23,24]. It is 'vital to ensure that the concept is not misappropriated, co-opted or corrupted.' Also, there are concerns over 'interventions badged as NBS' that may be ultimately 'harmful for biodiversity', and distracting 'from the need to decarbonise energy systems' [1].

NBS is labelled as 'a contested term', where 'oil majors create new "NBS" business units unaligned with the basic elements of the definitional criteria being set out by the academics'. In essence, NBS is suspected to mean 'what the powerful actors using it to green their images want it to mean' [10,25].

Furthermore, Indigenous Peoples are 'often excluded from land-use decisions involving ecosystem protection and management', having 'their rights disrespected' [1,26]. The NBS term may be used 'to justify dispossession through land grabbing and "fortress conservation"' [25]. As a first bit of ecolinguistic analysis, we can reveal that in the EC documents, the term 'indigenous' features (n-0, nn-9).

All these references point toward the same conclusion: if the NBS field is serious about providing solutions to help Nature, it must make a considerable effort to clarify its standpoint and to explicitly declare any profitable relation with the corporate world and with market-based economies, which are the culprit of climate disruption. If, on the other hand, NBS are defined as the manufacturing of products that are just reminiscent of Nature, being its climate mitigation potential only a small part of them, then their relevance in the context of the climate crisis must be considered as marginal and an effort is required to avoid confusion between real climate action and NBS implementations.

2.2. Relation to the IPCC reports

It is worth inspecting to which extent the sixth assessment reports [6, 27,28] of the IPCC mention NBS as approaches that can address the climate crisis problems. The WGII report [6] features several references to NBS, but never in depth. It says that this term 'is not globally used in the scientific literature, and it raises concerns that it can lead to the misunderstanding that NBS on their own can provide a solution to climate crisis.'

The WGIII report [28] only gives a handful of references to NBS, and these are not even mentioned in the (allegedly tampered [29]) summary. Its full version mentions NBS as having 'immense potential for cost-effective adaptation to climate change, but their impacts vary by scale and contexts.' It also addresses the 'important knowledge gaps in this field'. Especially in 'urban contexts, we lack consistent and comparable Greenhouse Gas (GHG) emissions data', and there is also lack of 'a deep understanding of carbon neutrality'.

The EC handbook, although acknowledging the climate scenario, is far from the very explicit and emergency-driven tone of the IPCC reports, whereas the IPCC reports do not give a lot of prominence to NBS. There is a worrying disconnect between 'NBS' and 'N' that must be

seriously considered. As a significant example, the handbook does not consider the net carbon footprint of a solution as an indicator. It recommends to measure the captured carbon (pp-22) and the emissions avoided (pp-25) but not the obvious number that would ultimately assess the environmental validity of NBS. This lack of climate focus cannot be accepted in an emergency scenario.

It is worth asking why the IPCC documents do not feature NBS with a prominent role. We could argue that the level of empirical evidence behind the IPCC reports is considerably more solid than that of the NBS field. This could change in the near future with NBS having a stronger evidence-based foundation, although this should not be an excuse to currently default on grey policies, as we will discuss later. Another reason for the IPCC reports not prominently featuring NBS could be what was discussed before: the NBS field not stating with clarity its standpoint regarding its relation with the liberal market and its commitment towards climate action versus other, not climate-driven interventions.

2.3. Relative weights of challenges

The list of 12 societal challenges of NBS arises from the list of 16 United Nations' Sustainable Development Goals (SDG) [30]. The UN list already has an intriguing order. For example, why aren't 13 (climate action), 14 (life below water) and 15 (life on land) the first three items, when the rest heavily depend and literally hang on them? Also alarming is the presence of corporative interests in 8 (decent work and *economic growth*) or the strong focus on finance and trade on 17 (partnerships for the goals).

The sorting order of NBS challenges is less disturbing, except for biodiversity appearing in 5th place, which should be 2nd as the rest of the challenges heavily depend on it. However, the perspective of all them is too biased toward human interests. The list would dramatically improve its climate focus if we would replace: (1) 'Climate resilience' with 'climate action', 'climate crisis' or simply 'climate'. The term 'resilience' shifts the focus towards human convenience and passivity/inaction towards mitigation. (2) 'Water management' with 'Oceans and rivers'. As it usually happens, the sea is largely underappreciated, despite its massive role (and size) in our ecosystem. Green (n-533, nn-1804) overwhelms blue (n-36, nn-146). (3) 'Natural and climate hazards' could easily be misunderstood to mean that the hazards of the current climate crisis are 'natural' and not caused by the unrestrained globalised capitalism and growth of our species. For this reason it should perhaps be referred to as 'consequences of destruction and pollution'. Along with this, counteracting and changing the capitalist system responsible for this destruction should be an explicit goal, which should include components such as building robust ecological systems, vulnerability analysis and critical thinking education. (4 and 5) 'Green space management' and 'Biodiversity enhancement' with 'Earth rewilding'. (6) 'Air quality' with 'Atmosphere'. Under these new names, the order of these first six items would be less relevant, since all of them are of paramount importance.

When we inspect lists such of those of SDG's or the societal challenges from NBS we can also ask what is the relative relevance of each entry in the list. The front cover of the EC documents hints at an equal-weighting of the 12 challenges, although it seems to (willingly?) place the most important ones at the centre. It is crucial to realise that by equalising issues, we equalise relevance, thus committing dangerous biases with huge consequences. The handbook could explicitly state the importance of relative weights and commit to a tentative and qualitative hierarchy of challenges in which climate, biodiversity, oceans, atmosphere and Earth in general are assigned an overwhelming majority of the total weight, after having given the prominence of the first positions in the sorting. The almost equal development of all the challenges on the indicators list, in the absence of an explicit weighting, could be misinterpreted as NBS giving only a small relevance to the climate crisis in favour of more urban, less urgent and more profitable interventions. For example, the complaints of a high-class Western

citizen enjoying a green roof appearing on equal footing with the conservation of an endangered species is already a standpoint that currently defines NBS as poorly relevant to the climate scenario.

3. Ecolinguistic discussion of NBS terms

3.1. Definition of NBS

The EU Research Innovation policy agenda defines NBS as 'Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience' (p-6). On the one hand, the term 'nature-based' tries to be a step forward to approach Nature, but its '-based' suffix imposes an alienating distance from it. The extent of such distance requires close scrutiny. On the other hand, the term 'solutions' is equivocal. Literally being about solving a problem, it is difficult not to see its industrial flavour as well, which frontally collides with its literal meaning. Moreover, the problems that it addresses are complex and still open, so the use of this term may not be precise. In essence, the contributions of 'B' and 'S' to 'N' are far from clear.

In the recent Glasgow Climate Pact from COP26, the initially proposed term 'NBS' was finally replaced with 'protecting, conserving and restoring nature' [16,31]. Accordingly, alternatives terms like 'Nature promoting/conserving measures' could help freeing the field from its neo-liberal resonances and would help closing the pernicious and ultimately non-existent gap between *Homo sapiens* and Nature.

Also intriguing is the presence of the term 'cost-effective' (n-17). Although 'effectiveness is determined without reference to costs' (p-52) [32], the 'cost-' prefix effectively renders it a synonym of efficiency. We later discuss how this term is the polar opposite [33,34] of what a climate emergency calls for: robustness.

The definition also includes the equivocal term 'benefit' (n-236), where its literal meaning can be self-cancelled by its strong economic tinge, close to the term 'profit'. Although this term is widely used in social, biological and environmental sciences, the NBS definition places the environment, society and economy as equal-footing subjects, without addressing the obvious conflicts between economic, societal and environmental benefits. And more importantly: a species, for instance, does not 'benefit' from our interventions. In the best of cases, it *stops being harmed by them*. We may give priority to its well-being, give prominence to its relevance, and most of all, stop destroying its habitat. After this, it knows how to seek its own benefit. Consequently, NBS should be focused towards preventing harm and not so much towards directly providing benefit, which sounds unlikely and conflicting with other, more human-oriented benefits.

The original concept of NBS was notably centred around adaptation (n-55), but it has recently given more prominence to mitigation (n-42) [10]. This definition, however, focuses on building resilience, which is still an adaptation term. This shy improvement is not well aligned with the current climate crisis scenario, which is still within a mitigation window. Without subtracting relevance to adaptation, mitigation should receive the topmost priority while such window is open.

3.2. Ideology under NBS terminology

Language is ideology [35,36]. "We'd rather see language that recognises the critical importance of biodiversity and ecosystems to addressing the climate crisis, that doesn't set up nature for being a solution to corporations' pollution" [16]. According to the Sapir-Whorf Hypothesis, "It is quite an illusion to imagine that one adjusts to reality essentially without the use of language and that language is merely an incidental means of solving specific problems of communication or reflection. The fact of the matter is the 'real world' is to a large extent unconsciously built up on the language habits of the group..." [37,38]. Or in other words, language is 'not simply an instrument for describing events, but is itself a part of events' [39].

We have already discussed the equivocal meanings of terms like 'nature-based', 'solutions', 'cost-effective' or 'benefit'. Following along this ecolinguistic analysis, we may underscore how the use of the term 'trade-off', extensively used in the texts, with trade (n-34), is also telling of a market-driven mindset, and so is the sentence 'capitalising on existing experiences' (p-65). Furthermore, the concept of sustainability appears as liable to manipulation and misunderstanding if it is understood as 'sustained growth' (p-149).

One of the most prominent terms of the texts is 'ecosystem services' (n-90). Wikipedia currently defines them as 'the many and varied benefits to humans provided by the natural environment and from healthy ecosystems' [40]. Again, we find Nature treated as a 'service' (n-193) (a system that supplies something 'that people need' [41]), providing benefits to humans.

The handbook says that NBS 'intrinsically provide biodiversity benefits and support the delivery of ecosystem services' (p-6). In this abstruse sentence, even the word 'delivery' has a dark tinge. An intentionally provoking translation of this sentence without the NBS slang could be: 'Nature preserving measures allow Gaia to be less harmed by the pseudo needs of the Homo sapiens species'. Here we have purposely replaced the term 'ecosystem' with the more uncomfortable 'Gaia' [42], with the aim of illustrating how more technical and dispassionate terminology does not necessarily provide more seriousness to a subject, but quite the contrary: it could conceal and de-escalate its full meaning.

The EC texts use expressions that we could interpret as oxymorons: 'aesthetic and spiritual benefits' (p-19), 'natural capital' (p-119), 'cultural services' (p-19, 138, 293, 345), or 'social capital', which has the astonishing count (nn-100). All these expressions try to inflict economic meaning to otherwise non-quantifiable concepts. In particular, the expression 'resource-efficient and socially inclusive economic growth' (p-121), happily mixing a panoply of concepts that are mutually incompatible, deserves a place in the oxymoronic hall of fame.

One of the most pervasive words across these texts and all NBS literature, even inside academia [43], is that of 'stakeholder' (n-250, nn-175), which is deeply rooted in the business mindset. While it is true that there are many beings and systems with high *stakes* in this topic, this pernicious word is flooding the NBS field with neo-liberal ideology. Alternatives like 'involved groups', 'community/team members/participants/contributors' would be more appropriate. We could ask whether it is necessary or even positive to have an universal agglutinating word. It may be the case that explicitly naming the groups could have a more positive and inclusive effect. Moreover, the countless other beings affected by human pollution and destruction arguably have a much larger stake in this than any human stakeholders do, and no say whatsoever, which makes the term even more deceptive and imprecise.

Climate terminology deserves special mention, in relation to the following sequence of increasing seriousness: change, crisis, emergency, breakdown. The texts feature the following counts: 'climate' (n-263), 'climate change' (n-91), 'crisis' (n-1), 'emergency' (n-3), 'breakdown' (n-0), 'climate crisis' (n-0, nn-0) and 'climate emergency' (n-0, nn-0). This is surprising, since the EU declared the Climate emergency in 2019 [44], along with many other nations, councils and non-governmental groups [45]. But not too surprising: In the three sixth assessment (full) reports of the IPCC we find: 'climate emergency' 34 times (19 of them in references) and the expression 'climate crisis' is found 30 times (25 of them in references). These terms seem to be widely present in literature and in society, but they don't easily reach official documents.

As already mentioned, this language is inherited from previous literature, like the IUCN text for the NBS Global Standard [9], where we can read expressions like 'the sustainable deployment of natural capital', and where 'natural capital' is further defined as "the world's stocks of natural assets". This eco-capitalist language is a worrying sign regarding the voices currently articulating the supposedly true needs of the ecosystem. We could quote Carl Sagan here: "Who speaks for Earth?" [46]. The language used in this literature reveals that Earth is not properly represented yet.

4. Economics

4.1. From economy to ecology

The field of NBS, and the EC texts in particular, are strongly formulated in economic terms. This seems unnecessary and counter-productive, unless it represents a signature of the true meaning of such field. It is not coincidental that the term 'NBS' was coined by the World Bank in 2008 [10]. After all, the climate crisis has its roots in the Western [47,48] Homo sapiens' economy, which treats the natural environment and human work as resources to be exploited without a sense of respect or self-control [49].

As astrology was superseded and made obsolete by astronomy due to the weight of the empirical evidence, our current scenario screams for economy to transition towards ecology (with a satisfying conservation of letters [50] between both transitions). The handbook revealingly features the following frequencies for these prefixes: 'econ-' (n-329) vs 'ecol-' (n-84). Also, Figs. 2 and 3 (p-57) shows a central and huge role of economy against other 'equal' factors like the environment or society.

The breakdown of the climate implies that there is a gigantic bill to pay, where our species may not have the rights to negotiate terms, so decisions based upon efficiency calculations, plagued by profit-driven biases and which usually deny the infinite value/cost of the presence/absence of a healthy climate, are far from being appropriate. The economic character shown by the NBS field is, then, quite dissonant, and could be read as (subconscious?) denial in the best of cases. The EC texts would significantly increase their relevance by shaking off its penchant for economy-oriented terminology and its associated ideas, thus committing NBS to a more climate-driven attitude.

This article purposely mixes criticism of capitalism at different levels, from its most fundamental to its most derivative aspects. Profit-driven ideology permeates across many layers of abstraction and action, and it would be dangerous trying to segregate them, since such compartmentalisation would allow someone to disagree with the fundamental principles of market economies while at the same time (unconsciously or not) applying them at the level of a specific NBS implementation. Consequently, a transversal criticism is key here.

4.2. Humanocentrism

Considering the human species as an entity separated from Nature is an old mistake. Already in Descartes' time we can read that 'the progressive destruction of nature and an ecological crisis were predictable' [51]. The philosopher wrote about rendering 'ourselves the masters and possessors of nature' [52].

Marx's theory of alienation analyses the disengagement of the Homo sapiens from Nature and thus from itself [53]. Civilisation is also considered as a disengagement, even an opposition to the natural world. The handbook collects concerns from citizens related to this alienation, like 'lack of social cohesion, lack of physical activity and the absence of nature' (p-35).

The activist Val Plumwood saw that 'anthropocentrism, as a value system, rests on the assumption that there is a deep division between humanity and nature: human beings, though embodied and, in that sense, material, are somehow different in kind from the rest of material nature' [54]. She was "among the first to suggest that it is these attitudes themselves that cause the world's environmental crises". For her, the 'opposition between reason and nature also legitimised the subjugation of social groups who came to be closely associated with nature, women, the working class, the colonised, and the indigenous among them.' Addressing this 'will take time, and education is key. Higher education textbooks and courses across disciplines consistently perpetuate destructive relationships with nature. These must be redesigned to steer those about to enter the world of work towards care for the environment' [55]. The handbook is no exception of these mentioned textbooks: it revealingly calls for a 'peaceful coexistence between nature and

humans' (p-25), which, even if written with a good-natured intention, it still perpetuates the division.

The EC texts also use expressions of instrumentalisation of Nature, considering it as a resource, biomass or a buffer (p-19). There is also a tendency to functionalize Nature (p-56, pp-783), and to alienate from it through quotation marks (p-24). An intriguing aspect of the EC documents is its emphasis on *Homo sapiens* over those who supposedly should benefit the most from NBS: other animals, especially those who are systematically mistreated or in danger of extinction. The text counts 'animal' (n-11, nn-30) and 'human' (n-97, nn-225), and when 'animal' appears we mostly find it in objectifying expressions like 'plant or animal material', 'grazing animal stocking' or 'grazing animals'. We can read about 'the well-being of all urban residents, independent of their socio-economic status, gender, cultural background, or age' (p-21), but not 'species'. In (p-56), the 'well being of the population' does not seem to include other beings either. For non-human species we only care (and not enough) about biodiversity, but never about their well being. This lack of consideration and empathy is a telling example of how we treat Earth in general.

4.3. Management

A significant harm of a profit-driven ideology 'occurs through its management, more precisely, through the unquestioned practice of a dehumanized view of how management works and should work. [...] It neglects anything that does not affect performance' [56]. The first three chapters of the handbook have a strong focus on management (n-168) theory. This is another significant link with the business world. A potential practitioner could see these first chapters as an unnecessary barrier. The diagram and the tangled language of (p-53) are representative examples. The message from (p-67) about the 'need for scientific and intercultural translation' should be self-applied to these chapters.

A list of 27 projects related to NBS is presented in (p-[29–33]). Their brief summaries, teeming with corporate language, reveal a majority of projects that don't seem to implement NBS themselves. There is a real danger of projects becoming corporations.

Undoubtedly, every NBS project will work better if well managed. But it will also work better with, say, specialists in sensor electronics, and this does not mean that the handbook should begin with 100 pages of semiconductor theory. The handbook is a case of the too-much-of-a-good-thing (TMGT) effect applied to management [57]. Also, management theory here, especially in chapter 3, uses terms like outcomes, results, impacts, evaluations, measurements in a fuzzy and confusing way.

Good pedagogy always places examples at the beginning and abstraction at the end. In these texts, it would not be unreasonable to propose this reading order: appendix + chapter 4 (indicators, with a unified 1–12 numeration!), chapters 5 (case studies), 7 (data requirements), 6 (disaster risk reduction) and then the rest (management and NBS theories). Unfortunately, this order would also sort the documents by decreasing tabularity.

4.4. Quantifying beyond measure

It can be argued that something that is not translated to a monetary value may not be accounted in the global balance of a process, so that a potentially harmful process may escape from accountability. 'The weakness of this indicator is that it is sometimes *ignored* in decision-making because of the difficulty of assigning an actual economic value to the indicator' (pp-296).

This is a dangerous logic, which can be unmasked in two points. Firstly, it is crucial to remark that decisions and policies can still be actionable upon qualitative conditions, the same way a doctor can prescribe a painkiller even if the reported pain is not quantified. There is a bias here that shifts the burden from the legislator, who has the duty to listen and interpret any data, to the practitioner, who is pushed to

absurd enterprises like providing a 'Recreational monetary value' (pp-1089).

Secondly, everything that has a price label can be immediately sold, bought and in general, exposed to the volatile market. If valuable NBS indicators are labelled with a price, we set the stage for the richest to buy the good ones and to sell or outsource the bad ones. This is what is happening, for instance, with carbon offsetting.

The text of the handbook could be improved by praising the value of non-monetisable indicators and qualitatively-oriented policy criteria. It is clear that qualitative results are more difficult to agglutinate, but in an emergency framework, easiness would be a criterion of immature mindsets.

4.5. Black swans: Fat-tailed statistics

Extreme events are extremely important, but also extremely subtle in terms of statistics [33,34]. Their occurrences usually follow power laws and as such, they don't even accept a clear definition of concepts like average, frequency or even probability.

There are known uncertainties and uncertain uncertainties, the latter being the most pervasive and the ones with more damaging potential. How can we build evidence on such intractable fat-tailed statistics, then? The chapter on Disaster Risk Reduction (DRR) should address these issues.

In general, the EC texts do not include any discussion of statistical analysis or statistical significance. This is surprising: such analysis should be central to the evaluation of the impacts, because without a rigorous statistical background, what is the basis to decide the extent of a prevision? Risks are to be assessed in relation to the robustness of a system, which is the opposite of its efficiency. In simple terms: having two kidneys instead of one is inefficient, but quite robust.

Unfortunately, efficiency is what profit-driven mindsets pursue (with efficiency numbers always calculated by them), and wherever efficiency is pursued to maximise profits, there is a corresponding loss of robustness. As a consequence, vulnerability to hazards is increased. Hurricanes and floods are really important hazards, but gas and oil corporations are even more dangerous and lay at previous steps on the causal chain.

The 6th chapter of the handbook should introduce these concepts before diving into relevant case studies. And most of all, it should identify profit-driven efficiency as the biggest creator and accentuator of structural and social vulnerabilities. Moreover, the extreme volatility of the current economic system should be underscored as the most dangerous hazard.

In the case of risk management, the possible elitism of some NBS (and its indicators) becomes a crucial issue, and words like 'poverty', 'poor' or 'indigenous' are nowhere to be found in the texts. This can be improved by underscoring the connection of these risks to social and economic status. For example, rare events being rare, modelling them becomes important, but very difficult. They require extremely high technical skills and access to very sophisticated (and usually closed) software running on expensive machines with high computational costs. These are all aspects that can be identified as elitist and exclusionary. And while risk analysis is more important for the more vulnerable communities, it is less accessible for them in terms of knowledge and resources.

5. Logic pitfalls

5.1. The burden of proof vs the caution principle

The handbook makes a huge emphasis on the importance of gathering data so that legislators can use it to promulgate greener solutions (p-7, p-47). In particular, we can read that the lack of a complete set of evidence 'may deter decision-makers from investing in the design and implementation of NBS [...] rather than solely relying on conventional grey solutions' (p-20).

Although pushing for more and better data is undoubtedly crucial, it

is important not to fall into a shift of burden. The already available evidence on NBS, and more importantly, on climate crisis, is more than enough for legislators to avoid grey as the default colour. Scientists don't carry the burden of proof with respect to the adoption of green policies. Legislators are the ones with the burden of action.

The text also falls into another related bias: 'Knowing which NBS interventions are effective and at what cost is crucial for informing decisions about whether an intervention could be scaled up and replicated' (p-53). To this, we could ask: What if they have a high cost but are still necessary?

The principle of caution must prevail again, and the burden of action, no matter at which price, is on the side of policy-makers. This is what means being in an emergency. Furthermore, it seems self-evident that we need to pay an astronomic price for our climate negligence. So even if it can be optimal to find which approaches are less costly, the absence of cheap alternatives cannot deter or delay any action.

In summary, the texts should encourage the acquisition of good data, but should not place the burden of proof on scientists. Instead, it should remark how data completeness must not be a necessary condition for legislators to move a first finger, and encourage social action based on intuition and common sense.

5.2. Comparative of different actions

Before proposing a NBS, the relative impacts of different interventions must be addressed. Otherwise, we can fall into the bias of selecting actions with a low relative weight and dismiss (or undervalue) others with more relevance.

One highly valuable indicator for an implementation would be its relative value with respect to other equally available interventions with the same financial capacity, or in the same neighbourhood. Without this, we could easily fall into the bias of not having well established *priorities*, which could lead to choices based on environmentally irrelevant factors such as ease of implementation, advertising opportunities or human convenience.

Objective criteria to prioritise NBS would be a great addition to the documents. These should be strongly correlated to the relative weight of the societal challenges. As a meta question, we can ask whether NBS are a priority in the current climate breakdown scenario. If so, we can ask which ones, in particular.

The handbook also exposes the theory of multicriteria decision-making (p-57), which asks a question: how are decisions made? It is optimal to have all the factors on the table before taking a decision, but when this is fulfilled, the decision does not make itself. The criteria for decisions are not the same as the exposition of facts. Figs. 2 and 3 only shows the latter. A diagram describing the decision process should also feature the amount of change driven by facts, the lobby pressures, the conflicts of interests and most importantly, a tree of transparent and publicly available priorities with a log of how faithfully they are being followed.

5.3. Self-saturating self-satisfaction

When a person or an association performs an action, the action itself can induce a feeling of self-satisfaction that may inhibit further actions, making the person happy with the feeling that something has already been done. This readily reveals another danger of not having priorities: one can begin with the easiest action, usually the less important one, and already become self-saturated with self-satisfaction, an effect strongly associated with the concept of green washing. A very small action can induce a lot of relaxation and calm a lot of criticism.

Here it is relevant to consider how *superficial* may a NBS be, in the sense of how an implementation can conceal a lot of negative factors. For example, a green building could cover grey human behaviours, or a massive but perhaps inadequate or ecologically inappropriate tree planting can be a great advertisement for the implementer but a damage

to the ecosystem it superficially claims to protect. Furthermore, a council promoting little actions can become self-satisfied with enough green press, and avoid more relevant commitments.

Many times this can happen without any malice. A person or an institution could truly believe that it is doing really well, with plenty of effort towards climate goals, while in fact lacking any priority. That is why the handbook should give great emphasis to the hierarchies between different topics.

5.4. Entropic barriers

5.4.1. Collaboration

The handbook, strongly 'realistic' in economic terms, becomes equally 'idealistic' when considering cooperation, participation and communication (p-64). There is a great emphasis on the importance of coordination and participatory processes, while acknowledging its difficulty (p-93). This is to be highly praised. The only aspect worth criticising here is the lack of practical resources given to achieve successful 'co-production' (n-58). The enormous difficulty of coordinating an interdisciplinary group could inhibit action, especially if it acts as a dragging force, through frequent and non-actionable meetings or with formal or bureaucratic bloating. Although cooperation is presented as a way to overcome barriers, it can also be a huge barrier if not properly understood.

The text could also emphasise the art of dealing with *conflicts*, and give practical resources for it. Conflicts are mentioned only once in the handbook. The appendix mentions general conflicts (nn-10) and conflicts of interest (nn-1), poor numbers for such important issues.

5.4.2. The burden of standardisation

Up-scaling, replication and standardisation are key concepts, but they require a huge investment of time and effort. The handbook makes excellent points about this (p-37, p-38, p-117). But once again, the lack of total achievement on the practitioners' side cannot justify policy-makers defaulting on grey approaches. The burden must be on the policy-makers' side, who need to make the effort to extract the relevant information from different sources, standardised or not.

It could be interesting to perform a comparison between the effort required to unify sources and the effort to analyse non-unified ones. When there are thousands of different voices and only a couple of ears, we have two approaches: (1) unify all voices into one, or (2) let the ears listen to all the voices, one after the other. The first approach makes the process of listening easier but dramatically poorer, while the second approach guarantees a richer listening, at the price of a greater effort from the listener.

Standardisation can be interpreted to imply an industrial/manufacturing mindset wanting standard pieces so that the assembling process can be up-scaled and replicated. While optimal for some technical aspects, it is undesirable for others. Two related compromises could be mentioned in the text: (1) between the virtues and the dangers of standardisation, and (2) between the standardisation efforts of practitioners and the listening efforts of legislators.

We move on to analyse the ethics around standardisation: If, for example, an indicator requires a software with a closed license (p-65), or an expensive laboratory analysis (p-31), should the indicator be considered as a valid standard? Communities that are suffering the heaviest consequences of the climate disruption also have the least resources. Should not all standards be free, open-source and accessible to everyone? A standard locked under a license should not figure as a valuable indicator. Elitist standards are not ethical standards. And elitist solutions are not ethical solutions. Licensing information for every indicator could be featured in each indicator, and only the most openly licensed should be recommended. After all, what is not open cannot be sustainably up-scaled.

5.5. Neutrality

It is self-evident that every Nature-loving person wants NBS to function well and to provide positive results for Earth and all its inhabitants. However, it is one of the pillars of science to collect both positive and negative outcomes, and formulate questions in a neutral manner. Failure in remaining neutral is a very well known phenomenon known as publication bias [58] that permeates the scientific world. We know how most negative results are not published, usually because they don't look fashionable to some editorial interests. Here it is not different. If, for example, we talk about new jobs (pp-1140), why not talk about destroyed jobs as well? Why not define the indicator as simply 'net job balance'?

It is perfectly plausible that a NBS results in place degeneration, social injustice or climate fragility. Also plausible is that a NBS, instead of removing carbon, has a globally positive carbon footprint, so a 'net footprint' indicator is more appropriate than a 'carbon capture', and 'GHG net balance' is preferable to 'avoided GHG' emissions'. Why measuring 'mindfulness' and not 'anxiety'? Why just 'positive environmental attitudes'? All such indicators that only represent the positive side of a balance need to be changed to a neutral reflection of both sides, else they lose all meaning by being biased to begin with.

Another concern is the bias that can appear if we only ask questions to people enjoying NBS. Questionnaires could be proposed to people not enjoying them, especially if they can't afford or access them. Accessibility is frequently mentioned (n-38, nn-98), but it seems that only the physical closeness of a green space, in terms of distance, is considered. The accessibility to data is also mentioned, although vaguely.

The text could mention and add indicators related to two other types of accessibility: (1) in terms of easiness/difficulty to access the space, which is not necessarily correlated to distance, and (2) in terms of property, which spans from neighbours living under a green but closed roof to Indigenous People having all their land sequestered by colonial nations.

5.6. Elephants in the room

Interestingly, United Nations' SDG 4 (education), the true basis for any real change, is not explicit in the NBS list. Such a paramount field is nowhere to be found, except for a shy mention in the appendix (pp-777). Also alarming is SDG 12 (responsible consumption and production) almost completely missing from both the handbook and the appendix, when they, together with education, hold the key to any hope of dodging the climate breakdown. A tentative explanation could be that education and the ethics of consumption/production are not products that can be manufactured, so they don't give a quantifiable and short-term profit and thus don't deserve to be mentioned by a field suspicious of being profit-driven.

Women and girls, who are absolutely essential players in the fight against the climate crisis, feature these counts: woman (n-0, nn-0), women (n-4, nn-15) and girl (n-0, nn-5), where most of these occurrences are in relation to SDG's or from references. They do not seem to make it to the text, as another sign of the strong correlation between true ecology and true feminism [59]. Although, when it is time for handling the blame, inclusive language is rapidly adopted: 'challenges arising from *anthropogenic* pressures on the environment'. Why not 'androgenic'? Additionally, the lack of mention of Indigenous Peoples in the texts is also worrisome.

Another elephant in this room: diet (nn-3, n-0) where 2 occurrences are from references. We also measure the following frequencies: meat (n-0, nn-2), plant-based (n-0, nn-0), vegetarian (n-0, nn-0) and vegan (n-0, nn-0). There are extremely shy mentions, with some proposed questionnaires asking about 'purchase of soya products' (pp-790) or 'How often do you eat meat? How often do you eat dairy products such as milk, cheese, eggs, or yogurt?' (pp-794). And even in this questionnaire, one of the entries is 'I usually buy milk in returnable bottles.' Does it

count as green or extremely grey? Or perhaps as black humour? How come the adoption of a plant-based diet is not a nature-based solution? It has one of the easiest, most direct and highest potential positive impacts on the ecosystem [6,28,60–62], yet once again, it is not something that would please current big manufacturers.

How is, in general, the ethics of consumption/production not present in these texts or in NBS theory? These supremely relevant issues (education, women & girls, diet and Indigenous Peoples) are mostly missing from the EC texts, and admittedly, they are also mostly missing from the works from which these EC documents stem [9,32,63], but this is not a reason not to include them in new publications. What is not present at the scope of a document is as relevant as what is explicit on it. A posterior EC text [64] already introduces some of these topics, although scarcely, but under an even stronger economic flavour.

While we could argue that the EC documents would not need to address every aspect that could be considered a NBS, it must be noted that they ubiquitously feature the expression 'holistic approach' (n-17) underscoring the importance of approaching NBS in a holistic way. As a consequence, our criticism needs to be holistic as well. Moreover, the explicit presence of low priority aspects and the granularity with which they are presented make the absences mentioned here even more noticeable and serious.

6. Conclusions

We begin our concluding section by reviewing some of the positive aspects we have detected from the EC texts. Primarily, the EC handbook claims that NBS show a lot of potential for improving social justice and cohesion, although this can be true only as long as local communities are taken into account when designing them. It also shows how NBS offer an opportunity to have cities with less noise, cleaner air and better water management.

The extensive collection of indicators offers lots of practical information in a friendly manner. This collection and the ordering and classification that it offers is by far the most relevant contribution of this double publication. Although not all indicators are equally worked out, most of them are of great value for practitioners. Social indicators have plenty of explicit examples of questionnaires that are of great help.

The handbook underscores the importance of the scientific method to assess the impact of the interventions, and for people who are not familiar with it, this text represents an approachable introduction to good science. Remarkable aspects are the emphases on: (1) pushing data into legislation channels to produce more suitable laws, (2) giving prominence to cooperation and co-development in the processes, and (3) the effort that must be made in order to communicate between different groups. Moreover, the 'theory of change' and the adoption of a reflexive mindset are great additions that give explicit prominence to critical thinking.

The texts show considerable insight in avoiding missing groups in risk of exclusion, and have a strongly inclusive character: 'It is important to explicitly go beyond the usual suspects to guarantee greater inclusion and participation of the weakest and give voice to critical perspectives' (p-93). It also gives 'paramount importance to take time at the outset of the process to establish good relationships with stakeholders from the outset, for which good communication skills and openness to multiple perspectives is helpful' (p-93).

We continue by presenting a summary of the most negative aspects of the EC documents and how they could be improved. In the first place, there is a lack of a prioritised sorting of the challenges and a discussion about the relative importance of each one. An alternative sorting order and naming of the challenges has been provided in this article.

Moreover, the language used in the EC texts, and its associated ideology are too rooted in economic terms and trends, which are the fundamental causes of the climate crisis. To avoid the suspicion of being working in favour of the climate disruption, these documents should overhaul their use of economy-oriented language in favour of a more

ecology-oriented mindset. Unfortunately, this aspect is only being getting worse according to the last EC document on NBS [64]

There is too much focus on people and human-related issues in relation to the prominence that Nature should be given. Only a flip between these two priorities can allow a future both for the climate and for humans. The texts should work to downgrade the importance of human issues in favour of the rest of Nature. The emphasis on urban topics reveals a bias that enhances the concept of the ecosystem as an 'environment' that surrounds cities, instead of what really is: the foundation of every possible form of life, including ours.

There is too much prominence on management theory in the handbook. This topic should be moved to a specialised appendix.

The chapter of Disaster Risk Management has a state of poor development, and it should be grounded on how efficiency and robustness (in fact, we should say 'antifragile' [65]) are opposite concepts, and how most market-economy trends seek the former at the expense of the latter. This chapter, before discussing specific interventions, should focus on the causes of those risks, which are of economic nature, and how the management of the greatest risks implies addressing these root causes in the first place.

The EC documents place the burdens of proof and of standardisation on the scientific community, justifying the case that without a complete set of empirical evidence and the standardisation of data, policy-makers will default on grey policies. This is a pernicious logic that should be avoided. Although praise for more and better data and for more standardisation of some aspects of the data should be given, it should not come without reminding where the real burden lies: on the policy-makers shoulders, who already have plenty of data to default on green policies.

Despite the positive emphasis on collaboration and co-creation, these texts lack practical resources to deal with conflicts that always arise when collaboration is attempted. Remarking the importance of cooperation is not enough: the text could help explaining how it is practically achieved.

The EC texts should avoid expressions and ideas related to the instrumentalisation of Nature and avoid the monetisation of non-quantitative concepts. Promotion of the intrinsic value of Nature and of qualitative indicators that cannot be exposed to the market would greatly improve the documents.

The texts lack the addressing of how different actions should be weighed against priorities, so that not only the easiest issues are dealt with. The list of indicators could have a priority index assigned to them, without falling into the trap of creating a numerical score for it, otherwise many low-priority actions could end up outweighing a high-priority one.

Indicators should be expressed in neutral terms, and not with biased titles like they are presented in the documents. Moreover, a unified numbering of them across the two texts is needed.

Education, women & girls, plant-based diets and Indigenous Peoples don't seem to be in the scope of the EC texts. They should be featured with high prominence, thus making clear that NBS are not only about industrial manufacturing.

We continue summarising how this article contributes to the advance in thinking about NBS. First of all, it brings to light the pernicious ubiquity of economically-rooted rhetoric of the EC documents and of the prevailing NBS literature, and how this rhetoric directly confronts the need for actions that effectively address the climate emergency.

Furthermore, it reveals how dangerous is to have lists of challenges or indicators without having a prioritised list of them, and how the lack of priorities can lead to greenwashing and to the loss of focus on what is more urgent and relevant.

It also provides an extensive collection of detected logic pitfalls present in the EC documents that are common in the NBS literature, like the misplacement of burdens of proof and standardisation, which must lie with the policy-making side, or the absence of acknowledging of effective solutions, like education or the adoption of plant-based diets

that, despite not being aligned with the current profit industry or with product manufacturing, are in fact fundamental pillars to solve the climate emergency.

Additionally, it shows how the current view of the EC regarding NBS does not give prominence to climate action, featuring it only as one out of twelve challenges, and mostly focused on adaptation, with a very low emphasis on mitigation, something that justifies the ubiquitous criticism that the NBS field is facing.

To conclude, the EC policy regarding NBS and the current NBS field in general should try to dissociate itself from the suspicion of being an attempt to market environmental measures to companies and capitalist funders in general by avoiding its strongly economically rooted language and its associated ideology, since this ideology is the main driver of global environmental collapse and as such directly counterproductive to any nature-promoting efforts. Addressing such topics may be uncomfortable to big corporations but is in an unavoidable component of effective climate action. If a strong and explicit commitment to the climate crisis relative to other challenges is not given, then the NBS field should not have a prominent role in the climate context, and a clear distinction should be made between real climate action and profit-driven NBS implementations.

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