


Countries start to explain how their climate contributions are fair: more rigour needed

Harald Winkler¹  · Niklas Höhne^{2,3} · Guy Cunliffe¹ · Takeshi Kuramochi² · Amanda April¹ · Maria Jose de Villafranca Casas²

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Abstract In the lead-up to the Paris Agreement, every country was invited to submit an intended nationally determined contribution (INDC), and indicate how it is fair. We analyse how countries have explained the equity of mitigation and adaptation in 163 INDCs, providing a bottom-up analysis of equity to complement a literature that has focused on top-down allocations. While no single indicator of equity was used by all INDCs, a menu of quantified indicators or tiered approaches could provide bounded flexibility across different national circumstances. The most common equity indicator used in mitigation INDCs is the country's 'small share' of global emissions, followed by per capita emissions. The emissions of individual 'small share' INDCs add up to 24% of annual global emissions when using a consistent data set. Per capita emissions are used across a range of countries with low (0.5) to high (25 t CO₂-eq per capita) values for that indicator. Adaptation is included in 89% of INDCs, of which more than half quantify impacts in some manner, and two-thirds use vulnerability as an equity argument. Broadly, we find that most claims to equity are either unsubstantiated or drawn from analysis by in-country experts. Only two INDCs refer to independent evidence, and none consider the consequences of their approach when applied to all countries. Given that the aggregate effect of INDCs will not be sufficient to keep global temperature increase well below 2 °C, and even less to keep temperature below a 1.5 °C rise, the INDCs have distributional implications. More rigorous information is needed to assess relative fair shares, which could be provided officially in future nationally determined contributions (NDCs). Absent

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✉ Harald Winkler
Harald.Winkler@uct.ac.za

¹ Energy Research Centre, University of Cape Town, 6th floor Menzies Building, Upper Campus, Rondebosch 7701, South Africa

² NewClimate Institute, Am Hof 20-26, 50667 Cologne, Germany

³ Environmental Systems Analysis Group, Wageningen University, 6708 PB Wageningen, The Netherlands

improved information, it is likely that researchers and civil society will continue to assess informally what could be considered fair. A hybrid approach to equity—combining bottom-up assessment and top-down allocation—would be consistent with the hybrid architecture of the Paris Agreement, which comprises bottom-up elements such as NDCs and top-down elements such as global goals. Improved information on equity in NDCs will be an important input to the global stocktake ‘in the light of equity’.

Keywords Equity · INDCs · Paris Agreement · Bottom-up methodologies · Global stocktake

Abbreviations

APA	Ad hoc working group on the Paris Agreement
AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change
CAIT	Climate Analysis Indicator Tool
INDC	Intended nationally determined contribution
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least developed countries
LULUCF	Land use, land use change and forestry
NDC	Nationally determined contribution
SI	Supplementary information
SIDS	Small Island Developing States
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

In the lead-up to the Paris Agreement (UNFCCC 2015b), every country was invited to submit an intended nationally determined contribution (INDC), and to include information on how the country considers its INDC is fair and ambitious [in the Lima decision (UNFCCC 2014), para 14]. The terms ‘fair’ and ‘ambitious’ have not been defined. This article focuses on the former term—fairness, or equity—in INDCs. Equity is important to reach agreement, as countries will only join agreements, remain party to them, and increase their own ambition, if they consider the contributions of their peers to be fair. Equity will therefore remain fundamental in implementing the Paris Agreement (Klinsky et al. 2016).

Information indicating that contributions are relatively ‘fair shares’ is important, in order for individual countries to take on progressively stronger contributions. Paragraph 27 of the Paris decision (UNFCCC 2015a) repeated the invitation from Lima [2] for the inclusion of information on how Parties consider their NDCs are fair, while paragraph 28 mandates further guidance on information to be developed by the APA and thereby provides a process for improvement. Equity in mitigation can generate a sense that Parties are contributing their fair share and thereby encouraging greater ambition, while equity in relation to adaptation is important to highlight the support needs of countries that are more vulnerable.

Previous literature on equity in mitigation has tended to focus on top-down allocations of a global carbon budget (Fleurbaey et al. 2014; Clarke et al. 2014; Pan et al. 2015; Höhne et al. 2014). Literature since Paris reviews the normative implication, concept of differentiation and continued importance of equity in a bottom-up architecture (Chan 2016; Voigt and Ferreira 2016; Klinsky et al. 2016); derives national targets for ‘major-economy

countries' from three top-down allocations assuming other countries determine a fair comparable target (Meinshausen et al. 2016); and examines the role of non-state actors (Van Asselt 2016).

Turning to equity in relation to impacts, vulnerability and adaptation, it is well understood that poor countries and communities are most vulnerable to the impacts of climate change (Smith et al. 2009). The magnitude of climate change impacts increases with temperature, and would therefore be more pronounced at temperature increases above 2 °C than at 1.5 °C (IPCC 2014), and will have distributional implications at either level. The literature on equity in adaptation has tended to focus on the legal framework (Mace 2003), damages (Tol and Verheyen 2004), fairness in general (Paavola and Adger 2006) and funding of adaptation (Ayers and Huq 2009; Denton 2010), but not on adaptation in INDCs in particular.

The purpose of our analysis is to improve the rigour with which countries present information on equity. The present article presents an analysis of equity of mitigation and adaptation contributions as defined bottom-up in 163 INDCs (UNFCCC 2016b). The article is part of a special issue on 1.5 °C and climate justice and provides a bottom-up analysis of equity to complement a literature that has focused on top-down allocations—both of which should be assessed in the forthcoming special report of the Intergovernmental Panel on Climate Change (IPCC) on 1.5 °C. Improved information on equity in future NDCs (which will no longer be qualified by 'intended') will be an important input to the global stocktake, to inform the long-term goal for mitigation in Article 4.1 'on the basis of equity' (UNFCCC 2015b), and for civil society and other actors to hold governments to account.

The article proceeds as follows. Section 2 presents our methodological approach, with detailed findings in Sect. 3. Section 4 turns to options for improved treatment of equity in future NDCs, before we conclude in Sect. 5.

2 Approach to analysing equity in INDCs

Equity in INDCs is the focus of this article, homing in on a specific aspect of the invitation to Parties in the Lima decision (UNFCCC 2014). We analyse 163 INDCs submitted by Parties, as of 31 October 2016. The European Union (EU) is counted as one, as the official portal reflects one INDC submitted on behalf of the EU and its Member States. The INDCs, as communicated by Parties prior to COP21 in Paris (UNFCCC 2016b), formed the primary information base of our analysis. Note that, upon ratification, INDCs become the Party's first NDC, as specified in paragraph 22 of the Paris decision (UNFCCC 2015a). Through this bottom-up analysis, the article aims to contribute to improved treatment of equity under the UNFCCC and its Paris Agreement.

Many but not all INDCs include a section on equity, fairness or justice, with terms used interchangeably there and in this paper. Our analysis also included reference to these terms in other parts of INDCs and presentation of information that is included to demonstrate equity. Our method started with a careful reading of the INDCs, which revealed two distinct aspects in the treatment of equity. Firstly, we found broad approaches, in which the level of substantiation and detail provided differed widely (see Sect. 3). Secondly, we identified specific indicators used to support claims to making a fair contribution, with inconsistent selection of indicators between countries. We therefore proceeded by

analysing first the broad approach of INDCs to substantiate their fairness, and second the specific indicators, each of which is explained in turn in Sects. 3.1 through 3.6.

In examining the broad approach, we categorised INDCs according to three levels of substantiation: ‘unsubstantiated’, ‘own analysis’ and ‘analysis by others’. An ‘unsubstantiated’ approach is defined where no detailed explanation was offered to support the claim that the contribution is fair; ‘own analysis’ means that an INDC contains evidence of analysis by in-country experts; and ‘analysis by others’ refers to INDCs that draw on work by experts in other countries. To characterise the level of detail, we considered whether countries provide indicators, whether they include numerical values for those indicators, and whether they translate those indicators into emission or action levels. The results are reported at the beginning of Sect. 3.

The second part of our method analysed indicators, meaning quantitative and qualitative information to support the claim that the contribution to mitigation and adaptation is fair. In our reading of all 163 INDCs, we identified equity indicators as reported in Sect. 3.1 below; part of the scientific method is that others may identify additional indicators or interpret those we identified differently.

To enable others to replicate, we provide the database used in our analysis as supplementary information (SI), which includes further information that was not reported in this paper. At various places in this paper, we refer to the SI, and the first (‘Readme’) worksheet in the SI explains how to read the database. The SI enables replication of results and further improvements in the bottom-up analysis of future NDCs.

We started by counting the number of INDCs using an indicator, whether qualitative or quantitative. Where countries presented quantitative indicators of equity, we recorded both the use of the indicator and the value. This was applicable, for example, to whether a country referred to having a ‘small share’ of annual global greenhouse gas (GHG) emissions, and whether it stated a percentage value that defines its share; in which case, we recorded both the use and the percentage share. Other quantitative indicators identified included emissions per capita, economic emissions intensity and average level of income (typically expressed as GDP per capita). In applying these methodological steps, we took care to distinguish use of indicators used to demonstrate equity from ambition (see Fig. 6), with the latter falling beyond our scope.

For some qualitative indicators, we also recorded verbatim quotes from INDCs, to make clear the basis of these assessments. An example was assessing whether vulnerability was used as an equity argument in the section on equity, or if elsewhere, recording statements that explicitly refer to adaptation in the context of fairness. It should be noted that adaptation was part of separate undertakings submitted by the USA and EU, or included in other communications, and is not in the scope of the information base of this article, INDCs.

To complement the analysis of primary information in INDCs, we refer to independent information, for example, in relation to ‘small shares’, and compare this to the values reported in INDCs (see Fig. 2 and surrounding text). The paper thus also draws on secondary sources, including the earlier equity literature (Fleurbaey et al. 2014; Agarwal and Narain 1991; Grubb 1995; Meyer 2000; Ott et al. 2004; Höhne et al. 2006; Baer et al. 2008; Winkler and Beaumont 2010; Kaniitkar et al. 2010; den Elzen and Höhne 2010; Winkler et al. 2013; Shue 2015; Pan 2003), post-Paris equity literature (Meinshausen et al. 2016; Chan 2016; Klinsky et al. 2016, 2017; Dooley and Gupta 2016), analysis of INDCs in relation to the emissions gap including brief reference to equity (den Elzen et al. 2015), assessments by civil society (Civil society review 2015) and analytical tools on equity (Climate Action Tracker 2016; EcoEquity and SEI 2016; Holz et al. 2017). The extent to which independent evidence was presented on equity in INDCs was very limited; that is,

countries typically relied on their own expert analysis, if any. Hence we compare results on per capita emissions against an internally consistent data set (WRI 2015), as discussed in Sect. 3 (see, for example, Fig. 3).

Through a combination of methodological approaches, we show that while equity is a normative concept, it can be analysed systematically. Neither qualitative information, nor quantitative indicators in themselves ensure equity; rather they provide information about fairness of NDCs. Equity lies in relative fair shares, meaning the distribution of contributions to mitigation, adaptation and support. One country's share, as measured by an indicator, is relative to the share of other countries. The distributional outcomes on climate change are also connected conceptually to development, framing climate action as an opportunity for sustainable development (Stern 2015; Fleurbaey et al. 2014; Gupta and Arts 2017). Several INDCs highlight the link between their actions on climate and development priorities (UNFCCC 2015c), but indicators of sustainable development are too numerous to choose any one for the present analysis.

3 Indicators used to claim INDCs are fair contributions

We find that the level of substantiation and accompanying detail provided to support the claim that an INDC is a 'fair' contribution varies widely. The broad approach to equity is often 'unsubstantiated' or categorised under 'own analysis'. Just over half of INDCs (86 out of 163) use own analysis, 75 are 'unsubstantiated', while only 2 (Nigeria and South Africa) refer to analysis by others (den Elzen et al. 2015). Nigeria reports indicators with values, while South Africa selects indicators but does not report values. Even in these two cases, the INDCs do not state what would happen if all other countries would apply the selected indicator.

The different levels of detail in the argumentation found were:

- Twenty-nine countries provide indicators with values, e.g. state that their 'small share' of global emissions (e.g. less than 0.0x%) is a key reason why their contribution is fair;
- Forty-seven countries provide indicators but no corresponding values, e.g. state that their share of emissions is small relative to the global total; and
- Nine countries translate indicators to emission or action levels, e.g. its 'small share' of emissions (e.g. 0.0y%) is few emissions (e.g. zz Mt) and implies little room for mitigation.

The majority of INDCs (122 out of 163) do not base their claim to equity on scientific parameters. Of the 41 INDCs that do base their equity on science, only 20 refer to being in line with 2, 1.5 °C, or both as an equity argument (see Sect. 3.6 below). We specify how 'in line with recommended by science' was assessed in 'Definition of Approach' in the SI. One example is a reference to the temperature limits in the Paris Agreement's Article 2.1(a), of 'holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C' (UNFCCC 2015b). Fifteen INDCs refer to an emission pathway (per capita, percentage or regional pathways) of the IPCC. Only 3 INDCs refer to the IPCC Fifth Assessment Report (AR5) global carbon budget as their scientific basis, and of these only one (Bolivia) indicates consistency with an IPCC budget for 1.5 °C.

Having reported results on broad approach, we turn next to results on specific indicators, starting with frequency of indicators across mitigation and adaptation in Sect. 3.1, then

analysing mitigation-related indicators in Sects. 3.2 through 3.4, and adaptation in Sect. 3.5. Finally, we consider reference to 1.5 °C in Sect. 3.6.

3.1 Frequency of indicators used to explain fairness in INDCs

We find that a range of indicators is used in INDCs, shown in Fig. 1, most of which relate to mitigation. The most frequently used equity indicator is vulnerability, which is used as an equity argument in 108 INDCs in relation to adaptation (see further analysis in Sect. 3.5).

In relation to mitigation, a ‘small share’ of global emissions is the most frequently used equity indicator. Per capita emissions is an argument commonly found in early climate equity literature (Agarwal and Narain 1991; Meyer 2000), and the most recent IPCC chapter on equity referred to per capita as ‘the most straightforward resource-sharing approach’ (Fleurbaey et al. 2014). Analysis in the following two sections focuses on these two indicators in more depth. Historical responsibility has been advanced as a basis for equity since the Brazilian proposal (Brazil 1997) almost two decades ago, but is used in only 21 INDCs. Membership of two groupings, the Small Island Developing States (SIDS) and Least Developed Countries (LDCs) is cited in 55 INDCs, with that indicator used only

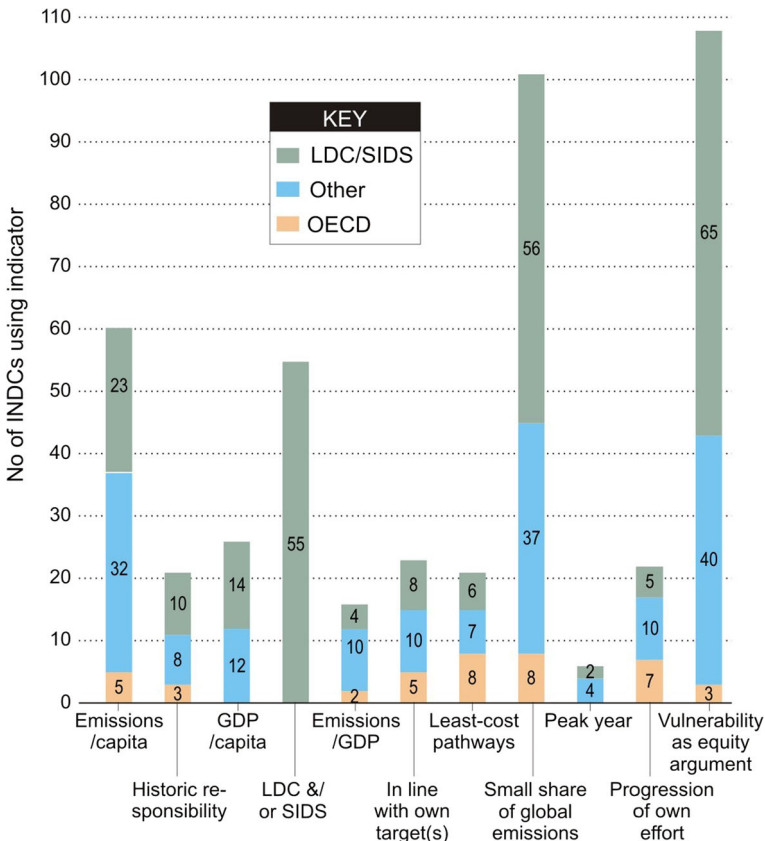


Fig. 1 Frequency of use of indicators when describing equity in INDCs (total = 163). (Color figure online)

by members of the groups. ‘Least cost pathways’ in Fig. 1 refers to countries which argue for having high ‘marginal’ abatement costs for reducing GHGs, as they already have low emissions intensity and/or high energy efficiency.

In Fig. 1, note that adding up the indicators used exceeds the number of INDCs, since many countries use more than one indicator. The highest proportion (31%) used three indicators, followed by two indicators (20%), four (15%) and one (14%). 80% of INDCs use more than one indicator; the most is seven (Moldova). Some INDCs provide quantified values for indicators, and in other cases the indicator is used as an equity argument. Bolivia’s INDC provides a high level of detail on equity calculations, allocating a global carbon budget based on several chosen indicators. This might be considered good practice and might benefit from analysis by others.

We now turn to some of the specific indicators, highlighting further key findings from our bottom-up analysis.

3.2 Examining indicators: a ‘small share’ of global emissions

Figure 2 analyses the most frequent indicator of equity in mitigation, namely having a ‘small share’ of annual global emissions. A majority of INDCs (62%, 101 out of 163) use the indicator of a ‘small share’. Of these, 96 have shares of less than 1%, and 86 have shares of less than 0.3% (detailed information, including the share reported, is included in the SI). While individual countries may claim to have a ‘small share’ of annual global emissions, when added up, they amount to 18.2% of global emissions, based on data from INDCs (see left-hand panel of Fig. 2).

There is a lack of consistency in information provided in INDCs, and no guidance on technical parameters to define a ‘small share’. Hence we compare the result against a consistent data set, CAIT (WRI 2015). The sum of ‘small shares’ based on CAIT data, for the year of 2012, is 23.5%. Figure 2 shows that, using parameters quoted from the INDCs, individual ‘small shares’ add up to about a sixth of annual emissions, whereas the more consistent data show the summed share to be almost a quarter. The difference in the left-hand panel of Fig. 2 between the sum of ‘small share’ INDC based on information in INDCs and the CAIT data set for 2012, is 4 percentage points when excluding land use, land use

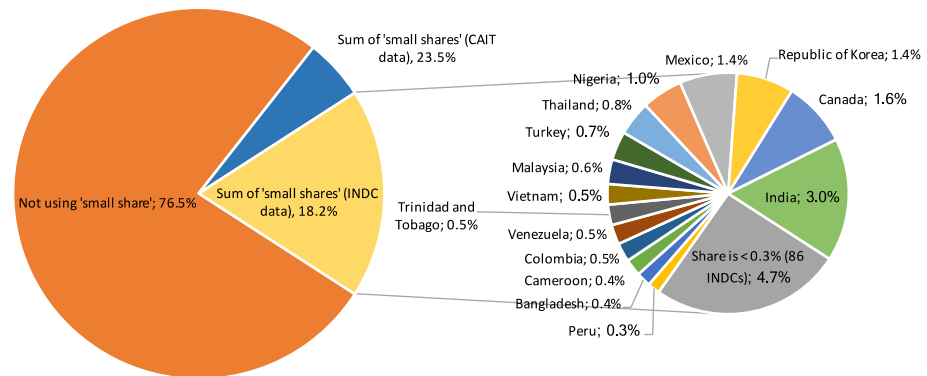


Fig. 2 ‘Small share’ of global emissions used as equity argument in INDCs. The right-hand panel shows ‘small share’, as percentage of global emissions summed by INDC, the left-hand panel using a consistent data set; both including LULUCF, for version excluding LULUCF see supplementary data. (Color figure online)

change and forestry (LULUCF) and 5 percentage points when including LULUCF (the latter shown in the figure). Other differences include different base years, sectors, gases and other parameters, and uncertainties among the relatively large ‘small share’ emitters.

3.3 Examining indicators: per capita emissions

Sixty INDCs referred to emissions per capita as an equity argument, as shown in Fig. 1 above. Yet many countries with low per capita emissions do not use the argument. Figure 3 shows annual per capita GHG emissions in 2012 for all countries, drawn from a single, more internally consistent data set. Based on our analysis, those countries which include the indicator in their INDC are highlighted, and only those country names are labelled on the vertical axis. The figure shows that the indicator is used by countries across the range from low to high per capita emissions, but some INDCs with high per capita emissions state that they have *reduced* their per capita emissions. For those countries, the ‘direction of travel’ supports the claim to a relative fair share (as distinct from the absolute level in a given year). For reference, the global average was 6.3 and 6.7 tonnes CO₂-eq per capita, respectively, excluding and including LULUCF, in 2012.¹ The finding that many countries with low emissions per capita do not use the indicator suggests that this indicator, even though assessed as the most intuitive indicator of equity, is not well understood globally.

3.4 Four quantified indicators for mitigation across a range of INDCs

To understand how countries use indicators of equity for mitigation, it is helpful to focus on a small number of commonly used indicators and compare these across a diverse range of countries. Figure 4 shows four indicators quantified in INDCs: per capita emissions [GHG/cap], emission intensity [GHG/GDP_{ppp}], income [GDP_{ppp}/cap] and ‘small share’ [% of 2012 global emissions]. The analysis has been applied to all INDCs and is available in the SI. An illustrative subset of our results is shown in Fig. 4, for a set of 12 countries that represents a range of high-to-low emitters, different income levels, diverse negotiating groups and various geographic parts of the world. The results focus on ranking of countries, rather than normalisation of their indicators, to highlight the variations in their equity arguments in the context of their relative standing with other countries. The indicators in Fig. 4 are shown by rank (from lowest to highest), with those not used in the INDC ‘crossed out’. A lower rank means a higher degree of mitigation would be considered equitable according to that indicator, and so one would expect countries to choose indicators on which the rank of the indicator is higher (i.e. the indicator value is lower), requiring less mitigation effort.

In Fig. 4, only Nigeria uses all four of the selected indicators, while two refer to none, although they may refer to other indicators shown in Fig. 1. China refers only to its emissions intensity, which ranks more favourably than its per capita emissions. However, Fig. 4 shows that countries do not necessarily use equity indicators that favour their equity argument. Mali, for example, quantifies only its ‘small share’, despite having the highest ranking (and therefore lowest) per capita emissions and GDP of the 12 countries shown. Trinidad and Tobago does not include a ‘small share’ argument, despite this being its most favourably ranked indicator. The combination of per capita and ‘small share’ is also used

¹ A methodological note is that there is no value for Liechtenstein’s per capita emissions in the CAIT database, so this was calculated dividing CAIT (WRI 2015) 2012 GHG emissions by a population estimate from an online database of world development indicators (World Bank 2016).

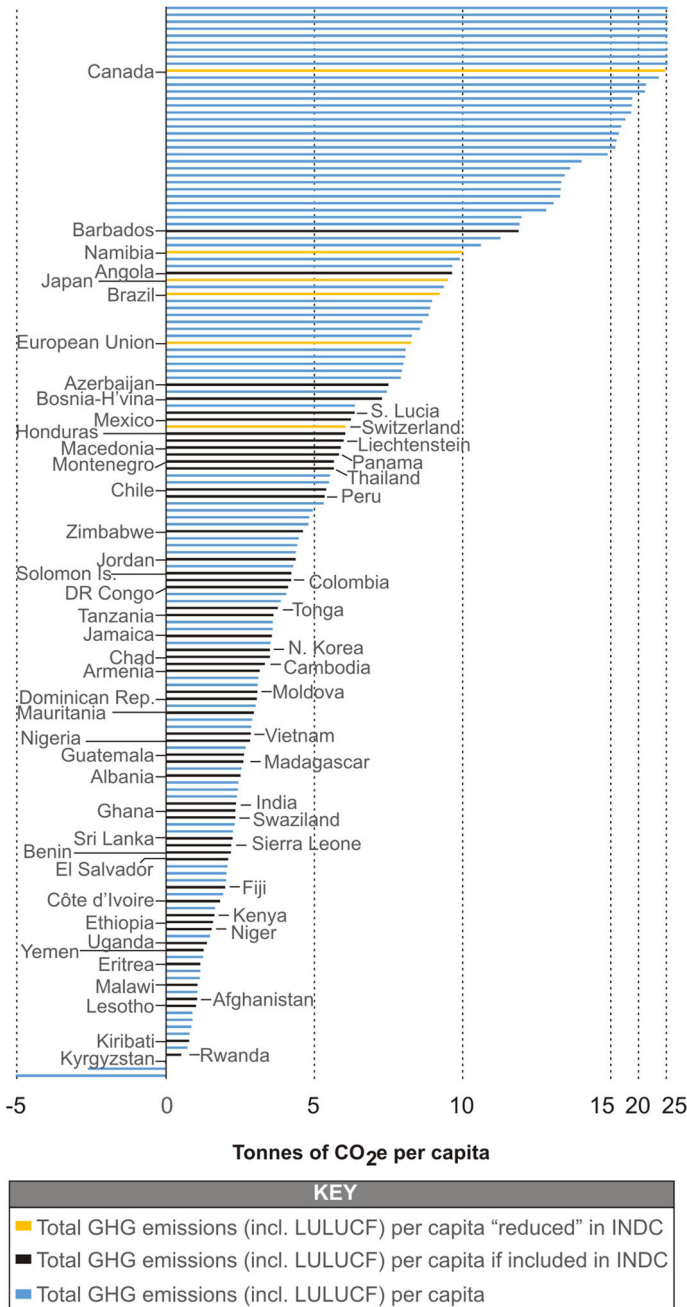


Fig. 3 Per capita GHG emissions in 2012 for all countries, showing countries making an equity argument based on decreasing trend in yellow, low absolute level in black; and those not using this indicator in blue. Source: CAIT—data on 2012 GHG emissions per capita. (Color figure online)

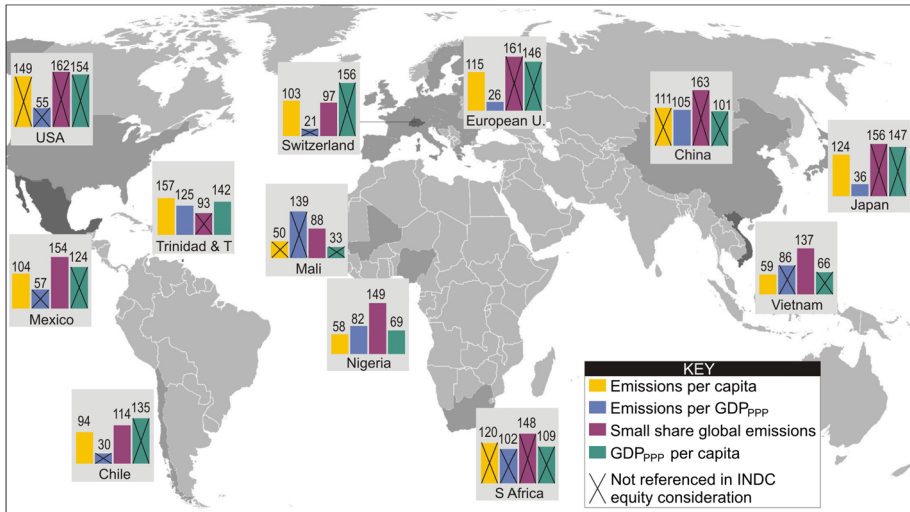


Fig. 4 Rank for a range of countries by four quantified indicators, as indicated in legend. (Color figure online)

in very different national circumstances of Chile, Switzerland and Vietnam. Both the EU and Japan, among the selected INDCs, quantify per capita emissions and intensity.

Where an emissions per capita indicator is used as an equity argument, three of five OECD countries refer to the direction of travel, rather than absolute values, whereas only 3 of 32 other countries make the argument that per capita emission is being reduced. All of the 23 LDC/SIDS that refer to per capita emissions use absolute values. This shows that developing countries more commonly refer to low emissions per capita, indicating reductions could not be fairly required, whereas the argument that reductions contribute fairly is more common among developed countries. Only 16% of countries with per capita emission above the 2012 global average use this indicator, of which two-thirds refer to direction of travel rather than absolute levels. The emissions per capita indicator is used by more than half (54%) of countries with below global average emissions per capita, 83% of which refer to absolute values and only a smaller share direction of travel.

For emissions intensity, the numbers of countries are smaller—one OECD country refers to absolute value, while other refers to reductions in GHG per unit of GDP. Among developing countries, direction of travel is more frequently used, by 3 of 4 LDC/SIDS and 8 of 11 among other countries. It would seem helpful to develop guidance on how to distinguish whether indicators of emissions intensity use absolute values or direction of travel, with or without reference to global average values.

Figure 4 has shown significant diversity in the use of a limited set of commonly used indicators of equity in mitigation, across a range of countries. Diversity of indicators is to be expected in a bottom-up process. However, unbounded flexibility in choice of indicators of fairness makes it difficult to assess the resulting information. Since fair shares are relative to what others do, comparable information would be more helpful. We suggest that a menu of indicators might be applied across a range of different national circumstances. While still allowing choice, a menu would provide somewhat more structure to the information on equity (more than the complete absence of guidance in the Lima and Paris decisions). More structured information would be useful in the global stocktake and, if

collective assessment includes a clearer understanding of relatively fair shares, would encourage greater collective action.

3.5 Adaptation and vulnerability in INDCs

The majority of INDCs (89%) included both adaptation and mitigation. Of 163 INDCs, 145 included adaptation, even though it was a voluntary element in the Lima decision (UNFCCC 2014). Other analysis confirms the broad inclusion of adaptation by developing countries (Mbeva and Pauw 2016). The pie chart in the left-hand part of Fig. 5 shows that of the 145 INDCs that included adaptation (marked by the red line), more than 60% (89) quantified impacts of climate change, while 56 did not provide quantitative information.

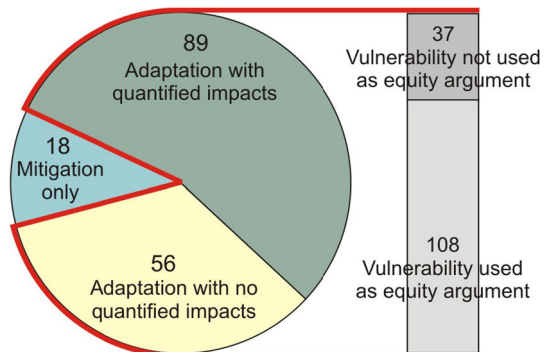
The right-hand panel shows the relationship of vulnerability to equity, for INDCs that included adaptation. Vulnerability to impacts of climate change was used by 108 countries as an equity argument, while just over a quarter (37 of 145) did not. The statements about vulnerability have been recorded in the SI. These include statements on adaptation or vulnerability to impacts in the section on fairness, or making conceptual links between equity and adaptation. Further analysis is needed on whether countries use equity in adaptation to argue for lower mitigation or for international support (Mbeva and Pauw 2016).

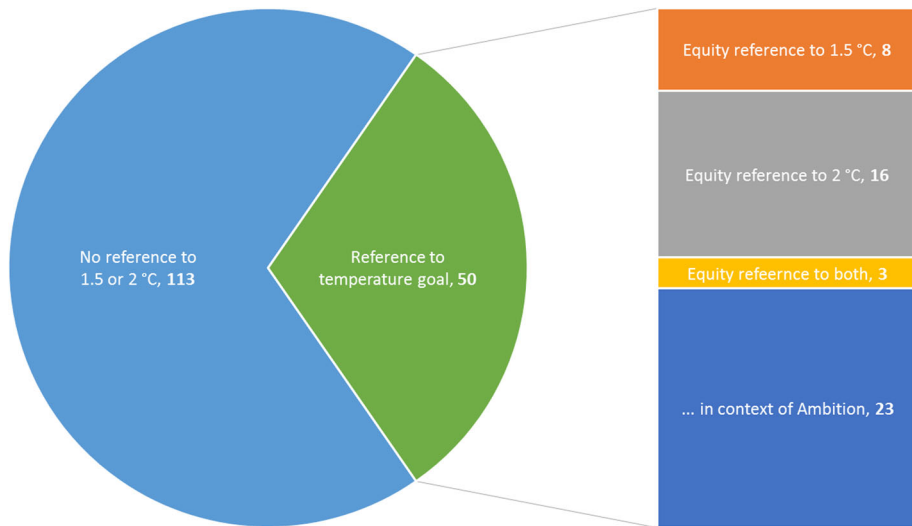
3.6 Reference to 1.5 and 2 °C as equity arguments

Having considered indicators of equity, how might equity relate to 1.5 °C? Relatively few INDCs—27 out of 163—refer to temperature limits of 1.5 or 2 °C as part of their equity argument. The analysis in this paper takes the approach that 1.5 or 2 °C is used as an equity argument, if any of the temperature limits are mentioned in the section on equity; raised together with explicit reference to equity, fairness, justice or common but differentiated responsibilities and respective capabilities; or referenced together with equity indicators such as those analysed in this paper. It may be noted that another 23 INDCs reference 1.5 and 2 °C, but as a scientific parameter to guide ambition as distinct from equity (see the SI for further information). Thus less than one-fifth of INDCs (17%) use temperature goals as an equity argument and slightly fewer (14%) in relation to ambition.

Results from our approach are shown in Fig. 6: the pie chart on the left-hand side shows that the majority of INDCs (113 in total) do not use either temperature goal as an equity (or ambition) argument. The break-out on the right-hand side shows the split between those

Fig. 5 Extent to which equity in adaptation is included in INDCs, quantified and used as vulnerability argument. (Color figure online)





Numbers after comma in **bold** refer to the number of INDCs making (no) reference to temperature goal

Fig. 6 INDCs referring to equity in relation to temperature goals. Showing those referring to 1.5, 2 °C, both or neither limit. (Color figure online)

INDCs referring to 1.5, 2 °C or both as equity arguments, as well as the balance that reference a temperature goal in the context of ambition.

Sixteen INDCs (Azerbaijan, Barbados, Brazil, Central African Republic, Colombia, Comoros, Costa Rica, Haiti, Lesotho, Mali, Namibia, San Marino, Sudan, Tajikistan, Togo, Turkmenistan and Yemen) refer to 2 °C as an equity argument, while only 8 INDCs (Bolivia, Antigua and Barbuda, Nauru, Saint Vincent and Grenadines, Saint Lucia, Guyana, Jamaica and Nigeria) refer to 1.5 °C. 3 INDCs (Cabo Verde, Dominican Republic and Nepal) refer to both 1.5 and 2 °C. No OECD countries refer to 1.5 °C as an equity argument.

Irrespective of which temperature goal is referenced, further substantiation of the effort in relation to the science is lacking (UNFCCC 2015c, 2016a). The UNFCCC Secretariat report on the aggregate effect of INDC available prior to Paris (October 2015) noted the pattern of several Parties referring to 2 °C, ‘while a few Parties referred to 1.5 °C’ (UNFCCC 2015c) (see para 175-8). Following the inclusion of the lower temperature goal in the agreement, an updated report in May 2016 included more analysis of 1.5 °C scenarios—see for example its Fig. 2 (UNFCCC 2016a). Less formally, civil society provided an equity review of INDCs prior to Paris (Civil society review 2015) and is doing further work on equity related to 1.5 °C (Civil society review 2016; Holz et al. 2017).

This paper shows there is some information on bottom-up approaches to equity in relation to 1.5 °C and provides a basis for assessment in the forthcoming IPCC’s special report, in particular in relation to distributional impacts arising from response options.

4 Improved treatment of equity in NDCs

Overall, our analysis of INDCs shows that equity was addressed almost universally in INDCs. In the first round of countries providing information on how they considered their contribution to be ‘fair’, the quantity and quality of information varied, clearly leaving room for improvement. Given the very uneven quality of information on equity in the first round of NDCs, more rigour is required on what is reported about equity. As noted in the introduction, the Paris decision mandates guidance. We turn to some options for more rigour in presenting information on equity, which may be helpful in the facilitative dialogue in 2018 and global stocktake in 2023, both of which will consider equity.

In a top-down architecture, it might have been possible to link the choice of equity indicator to different capabilities. In the hybrid architecture of the Paris Agreement, we start from information generated bottom-up by countries and seek to structure it better. We identified indicators that emerged bottom-up from countries’ INDCs, and that appear applicable across a range of national circumstances. Menus and tiers are ways in which flexibility can be retained while structuring information more clearly.

Discussion in Sect. 3.4 showed that even the limited set of indicators shown in Fig. 4 were reported in a widely diverse manner, across a small selection of INDCs. Menus might provide ‘bounded flexibility’ on quantitative indicators; for example, countries could choose from a menu of indicators. Another means of improvement might be to define tiers of detail. Countries could choose a tier and then be encouraged to move to higher tiers over time. On the first tier, one indicator (or more) might be identified, as was done in many INDCs. A second tier would be to state thresholds or consequences as a function of the indicator for the own country. Current INDCs barely provide this information. At the highest tier, a future NDC (which will no longer be ‘intended’) would describe what the chosen principle would mean for all countries, in order to be in line with the long-term goals in the Paris Agreement. So far, no country has provided this information. Providing such information might encourage countries to increase ambition, in line with pursuing efforts to limit temperature increase to 1.5 °C above pre-industrial levels.

Further means of increasing the rigour of information on equity would be to apply the principles of providing transparent, accurate, complete, comparable, and consistent information. It would assist analysis and comparison if the quantitative elements were more consistent. For example, the most commonly used indicator on equity in mitigation was found to be ‘small share’; guidance on reporting ‘small shares’ would help provide information that is more consistent. Completeness of information would suggest that countries might consider inclusion of new indicators over time, beyond those used in the 163 INDCs pre-Paris.

On equity in relation to adaptation, the starting point is that most INDCs included adaptation and many referred to vulnerability as an equity argument. Countries may choose to include adaptation in NDCs or other communications, as reflected in Article 7.11 of the Paris Agreement (UNFCCC 2015b). Our analysis has shown that quantification is less mature in methodological terms for adaptation than mitigation. Climate change impacts will generally increase if temperature were to increase beyond 1.5 °C above pre-industrial levels to 2 °C and higher. Clearly, the resulting social and economic impacts will be lower at 1.5 °C than for INDC scenarios, with costs of adaptation correspondingly reduced. This has important implications for distribution of costs and hence equity. Further work is needed to quantify biophysical impacts, adaptation needs and costs. Further research is needed to distinguish the financial costs of impacts from the investments required in

adaptation actions. This includes distinct methodological challenges, including the quantification of biophysical impacts across many sectors, and the conversion of impacts into financial units. Researchers might draw on analysis by the Council for Scientific and Industrial Research (CSIR 2015) and exchange with experts across all countries to develop methods for such quantification. The Paris decision (UNFCCC 2015a) in paragraph 42 (b) mandates methodological work. There may be a role for non-state actors in reviewing not only ambition (Van Asselt 2016), but also equity. Their role, and that of civil society, will be important to prevent countries from overstating their contributions.

5 Conclusions

This article assessed information on equity provided in INDCs on how countries considered their contributions to be fair. Understanding that contributions are relative fair shares is an important element in reaching agreement, and improved information on equity will be an important input to the global stocktake, the long-term goal on mitigation and for civil society to hold countries accountable.

We examined the broad approach to substantiation of fairness and found most claims were either unsubstantiated or drawn on analysis from in-country experts. Where equity analysis was presented, in the case of 88 INDCs (just more than half of the 163 INDCs assessed), the level of detail of the analysis varied considerably. Fewer than half of the 88 INDCs presented indicators with quantified values, and only 9 translated these indicators into emission levels, to substantiate fairness of their mitigation effort. Furthermore, the presentation of independent evidence on equity in INDCs was very limited. Good practice would suggest relying not only on analysis of own experts, but also considering those from other countries and to evaluate the impacts on other countries. Two INDCs have demonstrated that this is possible.

The second part of our bottom-up analysis of 163 INDCs found that the most frequently used equity indicator is vulnerability. Most countries included adaptation in their INDCs and, of these, 60% quantified the impacts of climate change. The most common indicator used to claim equity in mitigation was having a ‘small share’ of annual global emissions. We find that, when added up by INDC data, individual ‘small shares’ sum to about a sixth of annual emissions, whereas more consistent data show the summed share to be almost a quarter. Sixty INDCs referred to emissions per capita as an equity argument, yet our analysis shows that many countries with low per capita emissions do not use the argument. Less than one-fifth of INDCs (27) refer to temperature limits as an equity argument and of these, only 8 refer to 1.5 °C. Even when examining a limited set of commonly used indicators of equity in mitigation across a range of countries, few patterns emerge.

There is little reason to think that a single equity indicator would have been used by all countries, given that indicators have emerged bottom-up in INDCs and no definition of fairness. However, we suggest that further guidance by the APA can enable Parties to provide more rigorous information on equity in future NDCs.

We suggest that a menu of indicators might be applied across a range of different national circumstances, in order to assess relative fair shares. Another means of improvement would be tiers of detail: Countries could choose a tier, and then be encouraged to move to higher tiers over time. Improvements should be supported by guidance on applying principles such as consistency and completeness of information. Specific technical parameters such as a ‘small share’ share or approaches to vulnerability

(two common indicators in INDCs) would benefit from guidance too. Whether per capita emissions are currently low, or have been reduced from previously high levels could, as another example, specify this indicator better. These options may assist countries to provide information on equity in future NDCs that is more rigorous than in previous submissions.

Collective assessments would then have a better chance of resulting in greater collective action. A legal question would be whether equity might become a mandatory element; given that voluntary provision of information on equity was widespread, this would be a case of encoding practice. If countries do not provide more rigorous information on equity and adopt menus or tiers to support claims to be contributing relative fair shares, it seems likely that researchers will assess different viewpoints of fairness.

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