CONCEPT NOTE
(AFOLU sector-Fundacion Bariloche)

Assessment of the potential contribution that synergistic nature-based solutions can make to climate change mitigation and adaptation in Belize

1. Introduction

Given the interdependence between the biophysical processes that regulate the climate, and between the political and social processes that regulate decision-making at the global level (Foley et al., 2011), this concept note points to the implementation of a proposal aimed at coupling goals based on the climate agenda. Rather than present a specific case study as a concept note, we want to contribute our perspective from the complex systems and synergistic approach and its modeling.

Synergistic outcomes between GHG reduction, restorative land use changes, and biodiversity conservation can be achieved through coordinated policy action. More integration is required between agendas for climate mitigation and adaptation and conservation (Schmidt-Traub, 2020). The gap between scientific recommendations and policy actions can be reduced by constructing spatially explicit maps of priority conservation areas and improved coverage of AFOLU emissions in National Determined Contributions (NDCs) or Long-Term Low Greenhouse Gas Development Strategies (LT-LEDS), ensuring coherence across all land use system sectors.

This integrated approach and the importance of spatial information are increasingly recognized in international policy and is consistent with the philosophy that the next two COPs will adopt (Jung et al., 2020, Sachs et al., 2019, Schmidt-Traub et al., 2020). China will host the 15th Conference of the Parties of the UN Convention on Biological Diversity in Kunming, China. The zero-draft framework calls for spatial planning of conservation and restoration actions, and sustainable use outside conservation areas (Foley et al., 2011). Following the 2019 UN Climate Action Summit, discussions under the UN Framework Convention on Climate Change (UNFCCC) also focus on nature-based solutions that seek to generate co-benefits between biodiversity and climate objectives (Kapos et al., 2019, NBS, 2019).

The synergistic approach resolves several controversies at the same time: the existing trade-offs within the SDGs and the disputes that exist between global goals and national ambitions (Hickel, 2019, Hoff et al., 2019, Roelfsema et al., 2020, Pradhan et al., 2019).

1.1. Global context: top-down forces

Among the major global agreements that guide planetary actions within their biophysical limits (Rockstrom et al., 2009; Stefen et al., 2015), is the Paris Climate Agreement and the Sustainable Development Goals (SDGs). This global consensus is not exempt from a set of coupled controversies (Roelfsema et al., 2019): trade-offs, competition for financial resources, asymmetry in the order of priorities between the global and the national scales, different levels of vulnerability to climate impact (Pradhan et al., 2019), enormous disproportion in the responsibility to each country in terms of GHG emissions as part of the problem (Hoff et al., 2019), and their mitigation as part of the solution.

Given the functional structure of nature, made up of hierarchically nested ecosystems (Klijn and Udo de Haes, 1994), any change in climate has global and long-term consequences, and these changes have repercussions on geomorphology, water regime, productivity, biodiversity, ecosystem services and the human economy. For this reason, the central countries are extremely active, politically and financially, in implementing actions that manage to contain global warming below 1.5 ° C (Masson-Delmote et al., 2019, Rogelj et al., 2018), in good part, because of all the environmental calamities of the Anthropocene, climate change is the one with spillovers all over the world. On the contrary, the affectation of the water regime of a basin, or the extinction of species (Ceballos et al., 2015, 2020; Diaz et al., 2019) or the loss of food security (FABLE, 2019), are local or regional processes, which do not produce spillovers in the global context, so they are not in the same order of priority in global solutions (Hoff et al., 2019).

Despite the top-down logic, the only solution to the global crisis is joint action: it depends on the sum of independent decisions within each country. For this reason, global governance is extremely conservative, and very difficult to change in the short window of time we have to reverse the alarming trends warned by the International Panel on Climate Change (IPCC, 2019a). Each national government has been elected on the basis of a primarily national agenda, and in global negotiations, is committed to it. This leaves each of the actors with little room for maneuver in the global context, which practically immobilizes planetary governance.

In the case of climate change, it is difficult for a government to adopt climate change mitigation measures that detract from the well-being of its population, the conservation of its natural capital, and in general, in the opposite direction to the sustainability goals at a national or regional scale. This difficulty is increased in the case of a country whose GHG emissions and mitigation measures are irrelevant in the global context, while the adoption of these measures can have enormous environmental, social and political costs.

For the reasons stated, the solution must be found by minimizing the trade-off between top-down and bottom-up priorities, in turn maximizing the benefits that greenhouse gas mitigation measures can bring to the priority goals of national scale.

This is what this concept note is about.

1.2. National context: bottom-up forces

As we argued above, to achieve the global climate change mitigation goals set out in the Paris Agreement, a coordinated contribution from the bottom-up is essential, that is, the contribution that each country can make from its NDCs and LT-LEDS. For the sum of bottom-up efforts to be successful, it is necessary to understand that the needs and priorities of each country must be considered (Sachs et al., 2019, Schmidt-Traub et al., 2019).

Although mitigating the effects of climate change is a global priority, the climate agenda is not necessarily among the highest priorities of each country, especially when, as is the case of Belize, its contribution to mitigation is not relevant compared with countries such as the USA, Brazil, China, India and Russia, which are the main drivers of the path that humanity will take between now and 2050 (FABLE, 2019; SDSN, 2020).

In this sense, this concept note is focused on exploring which is the best route that Belize can take to meet its NDCs without detriment to other sustainability goals on a national scale.

The best route, in this case, is one that contributes to the mitigation of climate change and also to the adaptation to its consequences, adding co-benefits associated with other sustainable development goals: food security, maintenance of the integrity of the ecosystems, water sources, preservation of natural heritage.

Carbon fixation in biomass and soil is a complex process that depends on the water cycle and biogeochemical cycles. The machinery that makes these cycles work is biodiversity. For this reason, these processes are inseparable, no matter how much their political and financial agendas go down different tracks. It is essential to implement a policy of coupled goals that reflect the indivisibility of natural processes.

To convert these theoretical ideals into national policies, it is necessary to develop spatially explicit prioritization models that compare alternative scenarios, reflected in maps and databases. With these tools, the decision maker can clearly visualize what the consequences of their actions are on all goals at once.

For example, increasing the area of planted forests to strengthen NDCs can be an effective measure at a global level, although it is not very relevant in its percentage of contribution to global mitigation. However, the effect of this measure on the water regime and on the conservation of biodiversity may be disproportionately negative at the national level compared to the small contribution at the global level.

A prioritization model can indicate better alternatives, such as, for example, trying to mitigate emissions from the increase in the conservation of native forests, prioritizing those areas where slopes are stabilized, sources of pure water are protected, and the biodiversity and employment is generated from tourism or by increasing the green employment into the value chains. These measures could have benefits in adapting to the impact of the climate, since it increases ecosystem resilience (Seddon et al., 2019; Soto-Navarro et al., 2020).

2. Objectives

• Identification and location of the areas that best contribute to the fulfillment of several goals concurrently (carbon retention and sequestration, preservation of water sources, biodiversity conservation)

• Calculate the necessary area of biomass to achieve carbon neutrality in Belize.

• Recommend spatially explicit implementation measures to achieve carbon neutrality through nature-based solutions.

3. Methods (summary)

Study area: The entire continental surface of Belize

Data gathering: it will be important to draw on national data where these exist, and to explicitly evaluate the value of using global data where they do not.

Biodiversity data: The best-available, taxonomically updated species distribution data for Belize is required. A short list can be made by selecting all threatened terrestrial mammals, birds, reptiles and amphibians present in the country. The conservation status may be based on IUCN Red List unless there is a national assessment available. The conservation status is translated into a numerical ranking (CR = 10, EN = 9, VU = 8, NT = 7) multiplied by 2 if they are endemic to Belize. Each species is assigned a conservation target to be reached, for the CR and national endemics it is 100% of its distribution range, the remaining 80%.

Information on species distribution can be gathered from two sources, range maps and point records. Species ranges (shapes) can be downloaded from the International Union for Conservation of Nature Red List database (IUCN, 2019) and may be corrected based on expert opinion and collections data. Point records can be obtained mainly from GBIF (www.gbif.org).

Protected areas: Includes national and private protected areas equivalent to categories I to VI in the World Database Protected Areas (WDPA). This data will be rasterized for the analysis, including all polygons from the database.

Land cover data: Land cover data can be downloaded from publicy available global databases, unless Belize has more accurate information. The ecoregion distribution is obtained from global databases.

Water data: We will estimate water provision in Belize using Co$tingNature (www.policysupport.org/costingnature), applying the relative realized water provisioning services index (RRWPS) (Mulligan 2015a, 2015b). This is an index of the volume of clean (not human impacted) water available to downstream beneficiaries. Water quantity in each pixel is calculated as the water balance (rainfall minus actual evapotranspiration) cumulated downstream (Mulligan et al., 2011a). Potential water provisioning services for each cell are first calculated as the volume of clean (i.e. not human impacted) water available from upstream. Human impact on water is calculated using the Human Footprint on Water Quality index (HFWQ; Mulligan et al., 2011b), The volume of potential water service is calculated as downstream accumulated rainfall minus actual evapotranspiration (Mulligan et al., 2011a). The realized water service depends on the intensity of downstream use which is measured as the normalized area of irrigation, number of people and number of dams downstream. The RRWPS is thus the product of the normalised potential service and the normalised downstream beneficiaries. RRWPS is high where the prevailing climate and land use generate high volumes of clean water which can be used (and reused) by large numbers of downstream users. Not all water provides a service, only that which is used by people or dams. The national water footprint should be obtained, by default, from Mekonnen and Hoekstra (2010, 2011, 2016) and Tateishi and Ahn (1996).

Carbon data: Land-use changes impact ecosystem carbon balances affecting carbon stored in living (aboveground and belowground) and non-living biomass (litter and dead wood). Carbon stored in these pools is assumed as vulnerable since it could be lost as a result of land-use changes. We will estimate living aboveground and belowground biomass, litter, and dead wood by selecting the best available biomass stock estimates for different types of land cover classes, forest, cropland and grassland (FAO, 2018; Le Quére et al., 2019). Belowground carbon is estimated from aboveground carbon and root-to-shoot ratios obtained from the Guidelines for National Greenhouse Gas Inventories (IPCC, 2019b). We will land cover maps and climate zones to reclassify the land covers according to biomass tables.

Prioritization modeling: The most important areas to be managed for conservation of biodiversity, carbon and water are identified by means of a spatially-explicit systematic conservation planning (SCP) approach (Kukkala and Moilanen, 2013).

Belize's land will be divided in planning units (PU) of 2 × 2 km2. For each PU, the amount of each resource present (surface of suitable habitat for species, mass of carbon, volume of water) is recorded. In addition, we use a conservation state vector whose components indicate whether or not each PU is currently legally protected. Using these definitions, the vector-matrix product gives a new vector that quantifies how much of each resource is being managed for protection.

Model constraints: Each prioritization solution is constrained to a maximum area expressed as a percentage of the total country's land. This constraint can be generalized by imposing a "cost" to each PU (associated to land yield, economical value, etc.) so the constraint may represent the available "budget" (Cabeza & Moilanen, 2001).

Algorithms: All data preparation, analysis and calculations will be conducted in R (R Core team, 2019) mainly relying on the 'prioritizr' package (Hanson et al, 2019) with the Gurobi solver enabled (Gurobi Manual, 2019).

4. Feasibility

Belize has a great opportunity to show leadership in the implementation of nature-based solutions to climate change, building its NDCs and LTS on the basis of increasing its protected areas and other places where natural processes predominate. Unlike other countries, Belize conserves large areas of forest in a good state of conservation. It is only necessary to prioritize these areas so that mitigation goals have co-benefits with the conservation of water sources and biodiversity. In addition to this, it has a local technical team of excellent professional quality and well-detailed databases and geographic information systems. This allows a project of this style to be carried out working with local partners and technical sectors of the Belize government. The feasibility in terms of costs does not appear as a limitation to the implementation of a project of this type, since - counting a priori with all the necessary information - making a model for prioritizing joint goals for Belize can cost around US $ 50,000 (this is estimated according to the budgets of Argentina, Mexico and Colombia, which are carrying out similar projects.

5. Expected outcomes

To provide the basis for developing nationally appropriate information in order to inform decision-making and action towards achieving climate, ecosystem services, and biodiversity goals.

To identify high synergies between the goals of conservation of carbon stocks and conservation of water supply and biodiversity, to achieve carbon neutrality targets
Demonstrate the feasibility and usefulness of joint area-based prioritization of objectives related to biodiversity, carbon storage, and clean water provision and their integration with agricultural production.

To take greater account of the inherent complexity and interconnectivity of ecosystems. multidimensional goals and their pursuit through integrated strategies are better suited to manage and protect critical ecosystems (Díaz et al., 2019).

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