ENG

latino adapta

Strengthening Links Between Science and Governments for the Development of Public Policies in Latin America

POLICY BRIEF

SCOPE AND LIMITATIONS OF THE COST-BENEFIT ANALYSIS (CBA) FOR THE EVALUATION OF CLIMATE CHANGE ADAPTATION MEASURES

Verónica Gutman

KEY MESSAGE

- The Cost-Benefit Analysis (CBA) is a useful tool for evaluating climate change adaptation measures but its application is limited.
- In order to promote informed decision making, it is advisable to consider multiple tools and approaches in the processes of evaluation of adaptation measures, including Cost-Effectiveness Analysis (CEA) and Multi-Criteria Analysis (MCA), as well as involving diverse groups of actors.
- It is also advisable to prioritize the implementation of flexible measures that contribute to socio-economic development in any climate scenario ("no-regret" measures).

Executive summary

The information gaps related to the Cost-Benefit Analysis (CBA) of climate change adaptation measures are primarily related to methodological limitations of the tool itself, mainly: i) inability to economically assess all benefits (because they include intangible aspects) and ii) difficulties in selecting an appropriate discount rate, to determine the present value of future costs and benefits. Since decisions based solely on the results of a CBA can lead to bad decision making, it is important to consider additional tools such as the Multi-criteria Analysis (MCA) and the Cost-Effectiveness Analysis (CEA), and involving in workshops experts and the diverse groups of actors and communities affected.

It is also advisable to prioritize no-regret measures, that is, measures that are flexible, re-adaptable, and even reversible in the face of change in weather conditions, and that contribute to socio-economic development in any climate scenario because of their potential to generate co-benefits.

Resumen ejecutivo

Las brechas de información relacionadas con el Análisis Costo-Beneficio (ACB) de medidas de adaptación al cambio climático están relacionadas fundamentalmente con limitaciones metodológicas de la herramienta en sí misma, principalmente: i) imposibilidad de valuar económicamente todos los beneficios (por incluir aspectos intangibles) y ii) dificultades para seleccionar una tasa de descuento adecuada, necesaria para traer al presente los costos y beneficios futuros. Dado que pueden tomarse decisiones de política equivocadas si estas se basan solo en los resultados de un ACB, es recomendable considerar herramientas adicionales tales como el Análisis Multicriterio (AMC) y el Análisis Costo-Efectividad (ACE), involucrando a grupos diversos de actores y comunidades afectadas en talleres de expertos.

Es recomendable además priorizar medidas «de no arrepentimiento» («no regrets»), es decir, medidas flexibles, readaptables e incluso reversibles frente a cambios en las condiciones climáticas y que contribuyan al desarrollo socio-económico en cualquier escenario climático por su potencial para generar cobeneficios.

Introduction

One of the main information gaps associated with climate change adaptation identified by decision makers in Latin America has to do with determining the costs and benefits of adaptation measures.

This policy brief seeks, on the one hand, to address these gaps by analyzing the scope and limitations of the Cost-Benefit Analysis (CBA) as a tool to evaluate adaptation measures and, on the other, to suggest possible complementary approaches to support decision making.

The CBA is one of the pillars of the economic analysis of environmental problems, including climate change. It consists of identifying, quantifying, and valuing in monetary terms the costs and benefits associated with a measure or project over a period of time, with the objective of obtaining evaluation indicators. The most commonly used indicator is the Net Present Value (NPV). (1)

The CBA establishes a framework to evaluate whether the cost of implementing a measure is greater or less than the benefits that would be derived from it. It allows comparing advantages and disadvantages of a particular measure and comparing between different alternative measures. The CBA can be either financial or social. The objective of a financial CBA is to obtain a monetary return. The objective of a social CBA is to increase the well-being of a community.

The CBA of climate change adaptation measures must be a social CBA. This means that financial profitability cannot be the determining factor when assessing whether or not to implement an adaptation measure. In other words, many should be implemented even if their economic costs seem to exceed their benefits. (10)

In the CBA, the sum of all costs and benefits that will materialize in the future must be brought to present value by applying a discount rate. This rate measures the opportunity cost of investing in a certain measure and not allocating the funds to other activities that could be more profitable. The following two operational difficulties result from this.

In the first place, how to quantify in monetary terms all the benefits associated with an adaptation measure since most of them are intangible and therefore have no market price (e.g. biodiversity conservation). (3). Even though there are ways to quantify the economic value of goods and services that are "outside the market", these methods have limitations. (1).The main one is that they do not take into account the full value of environmental goods and services (e.g. a forest), limiting the value to their attributes or functions (e.g. recreational services, atmospheric carbon fixation). Consequently, underestimating the benefits of an adaptation measure can lead to poor policy decision making.

A second difficulty is how to select an appropriate discount rate to determine the present value of costs and benefits that will take place in different moments in time. The higher the discount rate applied, the lower the present value of something that will happen in the future. That "something" can be a climate impact and/or a benefit of an adaptation measure that is implemented today. Thus, if a market discount rate (10% or greater) is used, investments that yield positive benefits after 30 or 50 years in general will not be profitable according to the CBA. That is, no matter how small the cost of preventing a catastrophe today, if it happens in the distant future, the CBA may recommend not implementing preventive measures.

There are also other challenges such as the ones that follow (10):

• How to define "adaptation" in an operational way, considering that there are different types (anticipatory, reactive, autonomous, planned, public, private) and there is uncertainty as to which climatic phenomena will occur at each place and moment in time. Consequently, it is necessary to weigh the risk of under-adaptation versus the risk of over-adaptation. How much should we adapt then?

• How to address adaptation in the context of the challenges of economic development, poverty reduction, and disaster management, since it is not an independent issue

• How to define criteria to prioritize adaptation measures in certain regions and populations over others, since every decision has distributional and equity implications.

• How to strengthen institutional frameworks, considering that adaptation requires adjustments in all aspects of society, the environment and the economy, it demands short-term and long-term planning capacity, and requires appropriate institutional agreements.

• How to address the lack of information, mainly the lack of national and sub-national statistics with the necessary disaggregation and reliable climate projections.

Proposal

Studies and common practice suggest the following methodology for conducting a CBA of climate change adaptation measures (1), (4), (6), (9):

1. Define the problem and its scope.

2. Model the expected climate impacts in different time horizons. The recommendation is to work with at least two climate scenarios (e.g. low and high impacts), with short term (5-10 years), and medium to long term (20-50 years) horizons. The farther the time horizon, the less accuracy of the climate projections achieved.

3. Identify populations and most vulnerable systems, taking into account the three dimensions of vulnerability posed by the Intergovernmental Panel on Climate Change (IPCC) (5):

I. Exposure (to climate effects)
II. Susceptibility/fragility (predisposition of a system or population to be affected by a climate event)
III. Autonomous adaptive capacity of the system or the population

4. Identification of possible adaptation measures, including the "zero option" (do nothing). The process usually consists of researching and analyzing international bibliography to identify measures adopted in other parts of the world and/or recommended by experts in the field to complete a "long list" of options. The "long list" is then analyzed by selected groups and shortlisted to include measures that can be feasibly implemented in the situation being evaluated, according to local experts.

5. Identification and assessment of costs of implementing the measures. For each selected measure, different cost categories are estimated and added:

- Infrastructure costs and other capital goods (usually they constitute the most significant component of the cost of implementation).
- Costs of planning, preparing, facilitating, and implementing the adaptation measure (including feasibility studies, pilot plans, etc.).
- Costs of operations and maintenance of capital goods throughout their useful life.
- Management, oversight, and financial costs.

6. Identification and determining the value of the benefits of the adaptation measures. Operationally, two main types of benefits are usually estimated: avoided damages, and environmental, social and economic co-benefits (e.g. job creation, improvements in local environmental quality). To estimate the economic value of intangible benefits, complex methods of economic valuation are often applied:

• Direct valuation methods: «Contingent valuation». It seeks to measure, through surveys, the population´s willingness to pay in order to avoid damage or the compensation required to accept it.

• Indirect valuation methods: The benefits of an adaptation measure are estimated by estimating the costs that would be avoided by implementing it:

* "Replacement costs": The necessary costs are estimated to restore all assets affected by a potential climate impact to their original state.

* "Production function - Cost of treatment": Additional costs are estimated for the system that addresses and works with the population affected by a climate event (e.g. additional costs of the health system; wages lost due to mortality or morbidity).

* "Hedonic prices": The impact on the price of a good that results from weather phenomena is estimated (e.g. lower price of a home because it is located in a flood zone).

* "Travel cost": Applies to assess only the recreational services of a natural area. Additional costs of moving to another site are estimated when natural space is affected by a weather event.

• However, these methods have limitations because they can only value some attributes of environmental goods and services. This means that important benefits of adaptation inevitably will always be left out of the assessment process.

7. Discounting the future: Once the costs and benefits of an adaptation measure are estimated in monetary terms, the "net benefits" (benefits minus costs) are estimated for each period considered (e.g. year 1, year 2 …year 50). Afterwards, a discount rate is selected to bring the net benefits to their present value. In order not to fall into the "tyranny of the present" (high discount rates) or the "tyranny of the future" (low or zero rates), some propose using decreasing discount rates that tend to zero in the long term and/or using a sensitivity analysis with different discount rates (e.g. 0%, 4%, 6% and 10%).

8. Evaluation: If the sum of the discounted net benefits (brought to the present) is positive (greater than zero), the CBA recommends implementing the adaptation measure. If it is negative, it means that the costs are greater than the benefits and, therefore, according to the CBA, implementing the measure is not advisable.

Recommendations

Given the above limitations of the CBA, mainly that many benefits cannot be valued correctly and that the results are highly sensitive to the discount rate, applying more practical and qualitative approaches seems advisable. A possible methodology could be based on the following steps:

1. Development of climate models calibrated to the most micro-level possible (cities/rural areas/coastal areas) and selection of two or three possible future scenarios, considering ranges of possible values of physical impacts. It is advisable to define relatively short time horizons due to the high uncertainty implied in long-term modeling.

2. Identification and inventory of the main economic activities, vulnerable populations, ecosystems, and key infrastructure that ensures the normal operation of a city/rural area and that must be preserved in the face of expected climate events (e.g. power systems, transportation, security, public health, water collection, and purification systems, etc.).

3. Development of maps of interdependencies in order to identify chains of climate impacts and possible effects, as well as the potential failures of the systems involved (e.g. power outages due to flooding of underground flood facilities, which in turn would impact health systems, transport - trains and subways -, water treatment systems, etc.).

4. Development of climate risk maps and matrices of infrastructure and population exposure to possible impacts, weighing their probability of occurrence in workshops with experts. This exercise should allow us to identify the types of infrastructure, ecosystems, and populations that would be most affected by the most likely events.
5. Estimates of the economic cost in large numbers (orders of magnitude) of the most probable climate impacts in terms of production and infrastructure potentially lost or affected, in order to have some measure of the cost of the expected damages.

6. Identification of the type of response needed, prioritizing "no regret" preventive measures that contribute to socio-economic development in any climate scenario due to their potential to generate co-benefits. The measures should be flexible, re-adaptable and even reversible in the face of changes in weather conditions. Numbers (2), (7) and (8) are examples of these measures:

- "Soft" measures: Periodic evaluation of the condition of the existing infrastructure in order to identify maintenance or reinforcement needs (e.g. control of leaks in water pipes); land use planning and development of norms and regulations to limit urbanization in climatologically hazardous areas (e.g. use of river banks and areas prone to natural disasters); improve flow monitoring conditions; promote climate insurance; early warning systems; development of emergency contingency plans, including evacuation plans; creation of emergency funds to replenish key infrastructure in the face of extreme events; promote diversification of income sources, especially in agriculture (e.g. crop diversification, crops resistant to higher temperature and rainfall ranges; agro forestry systems, agro ecology); regeneration/restoration measures (e.g. biodynamic agriculture); efficient use of water; tourism and fishing regulations;

awareness raising and capacity building campaigns for adaptation; research and development; inter-ministerial coordination.

- Measures based on the development of new infrastructure: implement safety margins in the design of infrastructure, especially hydraulic; improve sewage and storm water drainage systems; expand water storage capacity; thermal insulation in new homes and improve building standards (e.g. proper ventilation); build irrigation infrastructure in regions where installation involves low costs; flexible coastal defenses and against floods (with capacity for re adaptation at low cost due to changes in climate conditions).

7. Based on the opinion of experts, evaluate the potential effectiveness of the different adaptation measures.

8. Estimate of the investments required to implement the identified measures, differentiating by type of owner or operator of the infrastructure involved (national public, sub-national public or private).

9. Development of cost-effectiveness indicators, estimating the costs of damages that each measure would avoid and/or compensate (with a focus on potentially affected production and infrastructure) in relation to the cost of implementing them.

10. Qualitative identification of the economic, social and environmental co-benefits of adaptation measures, analyzing who would benefit, where and when, taking into account other sectors, regions, and ecosystems. A quantification of these benefits can be made, but without putting excessive focus on their monetization (e.g. the number of lives that would be preserved by preventing an avalanche can be estimated but without "assigning a monetary value" to those lives). If monetary estimates of the benefits are desired, then non-quantifiable aspects that are being left out must be identified with precision and explained.

11. Estimates should not be presented as single values but in ranges.

12. Prioritization of adaptation measures identified by groups of experts in workshops (from the public and private sector, NGOs, academia, potentially affected communities) based on MCA methodologies. MCA allows measuring, even qualitatively, the relevant performance of different measures with respect to different evaluation criteria.

Step 1: First, the decision-making group that was summoned prioritizes a series of evaluation criteria (e.g. contribution to economic development versus the amount and vulnerability of the population involved, versus cost-effectiveness, versus socio-economic co-benefits).

Step 2: This same decision-making group (or another group) scores each adaptation measure with respect to each of the prioritized criteria. To avoid quantification problems, the score can be qualitative (e.g. "+" and "-" signs or scores of 0, +1 and -1, depending on whether the measure contributes positively, neutrally, or negatively to the criterion).

Result: The result is a table in which the adaptation measures are represented in rows and the evaluation criteria in the columns (or vice versa). Each cell represents the performance of each measure in relation to each criterion.

Prioritization: The measures that rank best are analyzed according to the criteria considered a priority.

Lastly, it is important to consider also the potential conflicts and synergies between adaptation and mitigation policies, avoiding the prioritization of adaptation measures that imply, for example, a high consumption of non-renewable energy (e.g. desalination plants powered by thermal energy).

In summary, the CBA is a useful tool for assessing climate change adaptation measures but it has limitations. In order to favor informed policy decision making, it is advisable to consider multiple tools and approaches, including ACE and AMC with the systematic involvement of groups of experts in the evaluation processes. In this way, additional criteria can be included in the analysis process to complement the traditional economic ones used.

References

(1) AZQUETA, D. Introducción a la Economía Ambiental. Capítulos 5 y 6. Mc Graw Hill, 2007.

(2) CEPAL. Portafolio de políticas públicas de adaptación al cambio climático y mitigación de sus efectos con beneficios adicionales o «sin arrepentimiento» en América Latina. Comisión Económica para América Latina y el Caribe (CEPAL). Estudios del cambio climático en América Latina, 2017. Retrieved from: https://www.cepal.org/es/publicaciones/42725-portafolio-politicas-publicas-adaptacion-al-cambio-climatico-mitigacion-sus

(3) FAO y PNUD. Guía de análisis costo-beneficio. Aplicación para medidas de adaptación al cambio climático en el sector agropecuario en Uruguay. Montevideo, 2019. Retrieved from: http://www.uy.undp.org/content/uruguay/es/home/library/environment_energy/Guia_analisis_costo_beneficio_NAP_Agro_uruguay.html

(4) GALARZA, E. y M. Von Hesse. Costos y beneficios de la adaptación al cambio climático en América Latina. Trabajo realizado para la Cooperación Alemana al Desarrollo (GIZ)., 2011. Retrieved from: http://www.riesgoycambioclimatico.org/GADeR-ALC/Costos-Beneficios-Adaptacion-CambioClimaticoVpreliminar.pdf

(5) IPCC. Climate Change 2001: Impacts, Adaptation, and Vulnerability. A Report of Working Group II of the Intergovernmental Panel on Climate Change. 2001. Retrieved from: https://www.ipcc.ch/report/ar3/wg2/.

(6) MAGALLANES PATIÑO, J. Cambio climático: cómo evaluar medidas de adaptación. Instituto Mexicano de Tecnología del Agua., 2016. Retrieved from: https://www.gob.mx/imta/documentos/evaluacion-de-medidas-de-adaptacion

(7) MAGRIN, G. Adaptación al cambio climático en América Latina y el Caribe. Comisión Económica para América Latina y el Caribe (CEPAL), 2015. Retrieved from: https://www.cepal.org/es/publicaciones/39842-adaptacion-al-cambio-climatico-america-latina-caribe

(8) MARGULIS, S. Vulnerabilidad y adaptación de las ciudades de América Latina al cambio climático. Comisión Económica para América Latina y el Caribe (CEPAL), 2016. Retrieved from: https://www.cepal.org/es/publicaciones/41041-vulnerabilidad-adaptacion-ciudades-america-latina-al-cambio-climatico

(9) MINISTERIO DEL AMBIENTE DEL ECUADOR. Manual para la valoración económica de medidas de cambio climático en el Ecuador. Quito, Ecuador. Mafla, S; Chiriboga, M; Guzmán, D; Fuertes, F; Albuja, M; Arroyo, J; Gavilanes, C., 2017. Retrieved from: https://www.academia.edu/35882197/Manual_de_Costo_Beneficio_Medidas_de_Adpataci%C3%B3n_y_Mitigaci%C3%B3n_al_Cambio_Clim%C3%A1tico

(10) UNFCCC. Costes y beneficios de las opciones de adaptación: Una revisión de la literatura existente. Informe técnico. FCCC/TP/2009/2/Rev.1. 2010. Retrieved from: https://unfccc.int/files/adaptation/application/pdf/tp_2009_2_rev1_es_spanish_translation_of_technical_paper_270711.pdf

latino adapta

This document is part of the LatinoAdapta Project: Strengthening Links Between Science and Governments for the Development of Public Policies in Latin America, executed by the Regional Network for Climate Change and Decision Making - UNESCO UNITWIN Program, led by Fundación AVINA and funded by the International Development Research Center (IDRC) of Canada. The project was implemented in six countries in Latin America including Argentina, Brazil, Chile, Costa Rica, Paraguay, and Uruguay.

AUTHOR
Verónica Gutman
Ph.D. in Economy, specializing in Environmental Economy, Climate Change and Sustainable Development. Researcher, consultant and professor in The Master in Law and Economics of Climate Change of FLACSO Argentina
verogutman@hotmail.com
www.researchgate.net/profile/Veronica_Gutman2

REVIEWERS
Hernán Blanco
Catalina Gonda

GENERAL EDITOR
Paula Bianchi

PROOFREADER
Gerardo Ferreira

TRANSLATOR
Patricia Wild

GRAPHIC DESIGN
Hola
hola@estudiocreativo.com

Policy Brief 2019

LEAD
Red Regional Cambio Climático y Toma de Decisiones

COORDINATE
Fundación Avina

SUPPORT
IDRC | CRDI
International Development Research Centre
Centre de recherches pour le développement international
Canada

UNESCO
Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura
uniTwin
Red UNITWIN de Cambio Climático y Toma de Decisiones

ITBA Instituto Tecnológico de Buenos Aires
FLACSO ARGENTINA
UTN.BA
IEE USP Instituto de Energia e Ambiente
FGV EAESP Centro de Estudos em Sustentabilidade
Adapt Chile
Centro UC Cambio Global
Fundación Moisés Bertoni
Universidad Católica Nuestra Señora de la Asunción
SARAS² South American Institute for Resilience and Sustainability Studies
ORT Facultad de Administración y Ciencias Sociales
Universidad de la República Uruguay
CATIE Solutions for environment and development