

Technical Cooperation Document

I. Basic project data

▪ Country/Region:	Regional
▪ TC Name:	Development of Integrated Economic-Environmental Framework
▪ TC Number:	RG-T2503
▪ Team Leader/Members:	Team leader: Sergio Ardila (INE/RND); Co-Team leader: Onil Banerjee (INE/RND) Team members: Michele Lemay (INE/RND); Maria Claudia Perazza (INE/RND); David Corderi (INE/RND); Leonardo Corral (SPD/SPV); Yolanda Valle (INE/RND); and Escarlata Baza (LEG/SGO).
▪ Indicate if: Operational Support, Client Support, or Research & Dissemination.	Research & Dissemination
▪ Date of TC Abstract:	April 2014
▪ Beneficiary:	Latin America and the Caribbean (LAC)
▪ Executing Agency and contact name	IDB
▪ Source of Financing	Fund for Biodiversity and Ecosystem Services Program (BIO)
▪ IDB Funding Requested:	US\$300,000
▪ Local counterpart funding, if any:	N/A
▪ Disbursement period (which includes execution period):	24 months
▪ Required start date:	August 2014
▪ Types of consultants (firm or individual consultants):	Firm and/or consultants
▪ Prepared by Unit:	INE/RND
▪ Unit of Disbursement Responsibility:	INE/RND
▪ Included in Country Strategy (y/n); ▪ TC included in CPD (y/n):	N/A
▪ GCI-9 Sector Priority:	Poverty reduction and equity enhancement; climate change, sustainable (including renewable) energy, and environmental sustainability

II. Objective and Justification

- 2.1 A standard component in the preparation of an IDB loan/grant operation is an ex-ante economic impact assessment to estimate how an investment may affect national/regional welfare, production, income, employment and other economic indicators. Conventional impact assessment approaches tell us little, however, about the environmental consequences of investment alternatives. The objective of this Technical Cooperation (TC) is to advance economic impact evaluation

methods through the pioneering of an integrated economic-environmental impact assessment framework.

- 2.2 Recognizing the importance of integrated economic and environmental accounts for informed decision making, the 1992 United Nations Conference on Environment and Development's Agenda 21 called for the development of national systems of integrated environmental and economic accounts. This integration is a hybridization of economic data with environmental information in a common accounting framework consistent with the United Nations System of National Accounts. After decades of international effort, the System of Environmental-Economic Accounting (SEEA) Central Framework, the first international standard, was published in 2014.¹
- 2.3 The SEEA is a unifying framework that enables the quantitative assessment of the contribution of the environment to the economy and the impact of economic activity on the environment and stocks of environmental resources.² Environmental accounting overcomes some of the limitations of the System of National Accounts with regards to the environment. These limitations are three-fold: (i) the depletion of stocks of environmental assets which may accompany resource use is accounted for only in terms of its positive contribution to economic output; (ii) the condition of a nation's environmental assets is not accounted for and thus enables environmental degradation to proceed undetected, and; (iii) perhaps most troublesome, transactions related to environmental damage, for example, the restoration of the stability of eroded hillsides caused by deforestation or unsuitable timber harvest techniques, are treated as positive contributions to output and GDP. The standardization of integrated accounts presents an opportunity to represent the environment in a more robust and realistic manner, increasing the environmental information that may be used in structured decision making frameworks such as cost-benefit analysis, and ultimately improve the evidence base upon which investment decisions are made.
- 2.4 A prerequisite to using the SEEA to inform decision making is the development of a consolidated economic-environmental database customized for modeling purposes, and a modeling framework to structure interactions between accounts and enable simulations to be undertaken. This TC proposes the development of an integrated economic-environmental Computable General Equilibrium modeling (IEEM) approach to impact assessment with Guatemala as a pilot case. Guatemala is the most advanced country in LAC in data collection under the SEEA and

¹ United Nations, European Commission, Food and Agriculture Organization, International Monetary Fund, Organisation for Economic Cooperation and Development & the World Bank 2014. System of Environmental Economic Accounting 2012- Central Framework. New York: UN.

² Dube, Y. C., & Schmithusen, F. (2003). Cross-sectoral policy impacts between forestry and other sectors. FAO Forestry Paper (142).

recently released integrated economic-environmental accounts for 2001 to 2010. Furthermore, a Guatemalan pilot is aligned with the IDB's strategic goal of focusing on less developed and smaller countries. IEEM will have the capability to provide decision-makers with information on the economic impact of a program intervention, the environmental resource costs, changes to stocks of environmental assets and the negative externalities that may arise in the form of emissions. The database structure and modeling framework will be transferable to any country in the region and beyond.

- 2.5 The computable-general equilibrium (CGE) modeling framework is more sophisticated than traditional input-output (I-O) approaches to economy-wide modeling. A CGE approach overcomes many of the deficiencies of I-O modeling by endogenizing the price and demand system, enabling substitution of goods and services in production and demand, providing a more realistic treatment of factor scarcity, institutions and the macroeconomic environment, and allowing for the optimization of agent behavior where producers compete for scarce resources and consumer expenditures. Strengths of the CGE approach includes its capacity to: shed light on important inter-sectoral dependencies; capture feedback effects arising from agent behavior, and; characterize the regional economic and distributional impacts of a diversity of policy and program interventions through time.
- 2.6 There is growing experience with environmental applications in a CGE framework, particularly in the case of forests, water, fisheries, mining and energy. Typically, these analyses have focused on one environmental resource in isolation. For example, water has been introduced in both national and global CGE frameworks, emphasizing the water sector's interaction with agriculture,³ the impact of improvements in irrigation efficiency,⁴ drought impacts⁵, and water

³ Berck, P., Robinson, S., & Goldman, G. E. (1990). The use of computable general equilibrium models to assess water policies.

Berrittella, M., Hoekstra, A. Y., Rehdanz, K., Roson, R., & Tol, R. S. (2007). The economic impact of restricted water supply: a computable general equilibrium analysis. *Water Res*, 41(8), 1799-1813.

Brouwer, R., Hofkes, M., & Linderhof, V. (2008). General equilibrium modelling of the direct and indirect economic impacts of water quality improvements in the Netherlands at national and river basin scale. *Ecological Economics*, 66(1), 127-140.

Dixon, P. B., Rimmer, M. T., & Wittwer, G. (2011). Saving the Southern Murray-Darling Basin: The Economic Effects of a Buyback of Irrigation Water. *Economic Record*, 87(276), 153-168.

Smajgl, A., Hatfield-Dodds, A., Connor, J., Young, M., Newth, D., Kirby, M., & Banerjee, O. (2012). *Energy-Water Nexus for Green Growth: Towards a Better Basis for Policy and Investment Decisions*. Canberra: Commonwealth Scientific and Industrial Research Organization.

Wittwer, G., & Banerjee, O. 2014. Investing in Irrigation Development in North West Queensland, Australia. *Australian Journal of Agricultural and Resource Economics*, early view, April 7.

⁴ Banerjee, O. (in press). Investing in recovering water for the environment in Australia's Murray-Darling Basin. *International Journal of Water Resources Development*.

Calzadilla, A., Rehdanz, K., & Tol, R. S. J. (2011). Water scarcity and the impact of improved irrigation management: a computable general equilibrium analysis. *Agricultural Economics*, 42(3), 305-323.

pricing.⁶ Economy-wide frameworks have increased in prominence in the exploration of forest-related issues, for example, stumpage fees,⁷ forest products trade,⁸ land-use dynamics between forestry, agriculture and deforestation,⁹ and biofuel crops and land-use change.¹⁰ Energy and climate change applications are increasing exponentially in the case of both national and global models.¹¹ Perhaps least explored are applications to the mining¹² and fisheries¹³ sectors.

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- ⁵ Horridge, M., Madden, J., & Wittwer, G. (2005). The impact of the 2002–2003 drought on Australia. *Journal of Policy Modeling*, 27(3), 285–308.
- Wittwer, G., & Griffith, M. (2011). Modelling Drought and Recovery in the Southern Murray-Darling Basin. *Australian Journal of Agricultural and Resource Economics*, 55(3), 342–359.
- ⁶ Berrittella, M., Rehdanz, K., Roson, R., & Tol, R. S. J. (2006). The Economic Impact of Water Pricing: A Computable General Equilibrium Analysis.
- ⁷ Alavalapati, J. R. R., Percy, M. B., & Luckert, M. K. (1997). A computable general equilibrium analysis of a stumpage price increase policy in British Columbia. *Journal of Forest Economics*, 3(2).
- Dee, P. S. (1991). Modelling steady state forestry in a computable general equilibrium context. Working Paper - National Centre for Development Studies, Australian National University.
- Stenberg, L., & Sirwardana, M. (2009). A Computable General Equilibrium Model for Environmental Policy Analysis: The Case of Deforestation in the Philippines. New York: Nova Science Publishers.
- ⁸ Dufournaud, C. M., Jerrett, M., Quinn, J. T., & Maclaren, V. (2000). Economy-wide effects of forest policies: A general equilibrium assessment from Vietnam. *Land Economics*, 76(1).
- Gan, J. B. (2004). Effects of China's WTO accession on global forest product trade. *Forest Policy and Economics*, 6(6).
- Gan, J. B. (2005). Forest certification costs and global forest product markets and trade: a general equilibrium analysis. *Canadian Journal of Forest Research-Revue Canadienne De Recherche Forestiere*, 35(7).
- ⁹ Banerjee, O., & Alavalapati, J. (2010). Illicit exploitation of natural resources: The forest concessions in Brazil. *Journal of Policy Modeling*, 32(4), 488–504.
- Banerjee, O., & Alavalapati, J. R. R. (2009). A Computable General Equilibrium Analysis of Forest Concessions in Brazil. *Forest Policy and Economics*, 11(4), 244–252.
- Banerjee, O., & Alavalapati, J. R. R. (2014). Forest Policy Modelling in an Economy-Wide Framework. In S. Kant & J. R. R. Alavalapati (Eds.), *Handbook of Forest Resource Economics*. London: EarthScan.
- Cattaneo, A. (2001). Deforestation in the Brazilian Amazon: Comparing the impacts of macroeconomic shocks, land tenure, and technological change. *Land Economics*, 77(2).
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- Persson, A., & Munasinghe, M. (1995). Natural-Resource Management and Economy-wide Policies in Costa-Rica - A Computable General Equilibrium Modeling Approach. *World Bank Economic Review*, 9(2).
- ¹⁰ Banerjee, O., MacPherson, A. J., & Alavalapati, J. R. R. (2012). Socioeconomic and Land Use Trade-offs of Ethanol Expansion in Brazil. *Journal of Sustainable Forestry*, 31(1/2), 98–119.
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- ¹¹ Böhringer, C., & Rutherford, T. F. (2013). Transition towards a low carbon economy: A computable general equilibrium analysis for Poland. *Energy Policy*, 55, 16–26.
- Bosello, F., Eboli, F., Parrado, R., Nunes, P. A. L. D., Ding, H., & Rosa, R. (2011). The economic assessment of changes in ecosystem services: an application of the CGE methodology. *Economia Agraria y Recursos Naturales*, 11(1).
- Bosello, F., Roson, R., & Tol, R. S. J. Economy-wide estimates of the implications of climate change: Human health. *Ecological Economics*, 58(3), 579–591.
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- Thurlow, J., Dorosh, P., & Yu, W. (2012). A Stochastic Simulation Approach to Estimating the Economic Impacts of Climate Change in Bangladesh. *Review of development economics*, 16(3), 412–428.

- 2.7 The IEEM approach advances previous economy-wide impact evaluation frameworks and uses the SEEA as a core data source which integrates data on forests, fisheries, water, energy and emissions and mining. Since these data are consistent with the United Nations System of National Accounts, analysis may be undertaken across countries and over time. With the representation of all environmental sectors in the IEEM, it may be used to analyze a broad spectrum of policies and programs and provide insight into impacts on both economic and environmental indicators. Due to the consistent accounting framework, IEEM may be readily updated as new National Accounts and SEEA data become available. Both these features reduce the lead time and resources required to implementing integrated economic-environmental analysis in IDB Member countries.
- 2.8 Another key advancement over previous frameworks is the ability of IEEM to consider the impact of a policy or program on environmental stocks as well as the negative externalities that may be associated with the use of environmental assets. Negative externalities could include for example, greenhouse gas emissions from fossil fuel consumption or the reduction of water quality resulting from inadequately treated water used in industrial processes. Accounting for changes in environmental stocks enables GDP and other economic indicators to be adjusted for depletion of environmental assets, pollution and transactions related to environmental remediation. While a CGE/IEEM approach is the most sophisticated framework available for economy-wide analysis, database construction, model development, scenario analysis and interpretation of results

Yu, W. H., Alam, M., Hassan, A., Khan, A. S., Ruane, A. C., Rosenzweig, C., . . . Thurlow, J. (2010). Climate change risks and food security in Bangladesh (pp. xxiv, 144 p., 116 p. of plates). London ; Washington, DC: Earthscan.

- ¹² Higgs, P. J. Australian mining and the economy. *Resources Policy*, 12(2), 117-132.
 Lofgren, H., Robinson, S., & Thurlow, J. (2002). *Macro and Micro Effects of Recent and Potential Shocks to Copper Mining in Zambia*. Washington, DC: IFPRI.
 Tourism Research Australia. (2013). *The Economic Impact of the Current Mining Boom on the Australian Tourism Industry*. Canberra: TRA.
 Wiebelt, M. (2001). Hazardous waste management in South African mining – a CGE analysis of the economic impacts. *Development Southern Africa*, 18(2), 169-187.
- ¹³ Floros, C., Failler, P., & Bernard, P. (2003). Development of a Simple CGE Model to Fisheries. Paper presented at the XVth EAFE Conference, Brest.
 Jin, D. (2012). Aquaculture and Capture Fisheries: A Conceptual Approach Toward an Integrated Economic-Ecological Analysis. *Aquaculture Economics and Management*, 16, 167-181.
 Kiyama, S. (2012). Development of a Marine Ecosystem Dynamic Computable General Equilibrium Model and its Application to a Fishery Depression Problem. *International Journal of Energy and Environment*, 2(6), 251-259.
 Narayan, P. K., & Prasad, B. C. (2006). Doubling fish exports or garment exports: which would benefit the Fijian economy most? Evidence from a computable general equilibrium model. *Applied Economics*, 38(6), 717-723.
 Pan, H., Failler, P., & Floros, C. (2007). *A Regional Computable General Equilibrium Model for Fisheries*. Portsmouth: CEMARE.
 Seung, C. K., & Waters, E. C. (2010). Evaluating Supply-Side and Demand-Side Shocks for Fisheries: A Computable General Equilibrium Model for Alaska. *Economic Systems Research*, 22(1), 87-109.

- requires significant in-country capacity that may require strengthening. As such, capacity building and dissemination is an integral component of this TC.
- 2.9 Investment in IEEM is considered “a strategic investment” for the IDB’s BES Program.¹⁴ The proposed TC will result in an impact assessment approach contributing to the IDB’s two key objectives for LAC: reducing poverty and inequality, and; achieving sustainable growth. The IEEM may be used to assess the economic and environmental impacts of investment alternatives and facilitate the selection of the welfare maximizing option, considering their inherent environmental externalities. This is essential to, as stated in the IDB-9, confront the largest challenges of the century: environmental sustainability and meeting energy requirements in the face of climate change.
- 2.10 Pilots of the SEEA Central Framework are underway in LAC in Guatemala, Colombia and Costa Rica. Spearheading efforts is the World Bank’s Wealth Accounting and the Valuation of Ecosystem Services ([WAVES](#)) program, a global partnership of United Nations and other international agencies, government, academia and non-government organizations with the mandate of integrating natural capital accounting into national accounts data collection processes (WAVES, 2014). In the development of this TC, discussions have been held with the World Bank’s WAVES Team as well as the WAVES Secretariat in Guatemala. Important synergies between WAVES and this TC have been identified and interest has been expressed in formal collaboration, initially in the area of capacity building, through the joint hiring of expertise. A member of the Project Team will participate in a World Bank WAVES mission to Guatemala on September 12 with the goal of presenting the integrated economic environmental modelling approach and application, explore policy relevant questions and develop a road map for ongoing collaboration.
- 2.11 Current analytical approaches for evaluating policy and program impacts focus on economic indicators. To effectively respond to the IDB-9 sector priority of *protecting the environment, responding to climate change, promoting renewable energy and ensuring food security*, more robust analytical methods are required to develop the evidence base in support of innovative solutions to emerging challenges. Understanding the impacts of policies and programs on water supply, agriculture, forestry, biodiversity and energy- all key resources for promoting sustainable growth- is now more pressing than ever and may be realized through this TC.

¹⁴ BES External Advisory Committee Meeting Minutes, April 29, 2014, [available here](#).

- 2.12 Finally, IDB-9 emphasizes the need for leveraging its comparative advantage and improving the delivery of nonfinancial value-added products, and; increasing the importance of these products as a component of the IDB's core business. This TC contributes to this goal and is also aligned with the Cancun Declaration's call for disclosure of comprehensive project-level reporting with stronger metrics including ex-ante analysis.
- 2.13 Key outputs of this TC will be:
- A transferable approach to database construction and model development that may be implemented in other LAC countries to quantify investment impacts on economic indicators, environmental assets and levels of emissions.
 - Facilitation of mainstreaming environmental considerations into analysis of alternative investment opportunities.
 - Demonstration of proof of concept to catalyze integrated data collection and consolidation efforts in LAC.
 - International dissemination through peer reviewed journal publications, a final report describing/evaluating project outputs, workshops, international/regional meetings and speaking events, and recognition of the IDB as leader in the field of integrated economic-environmental impact assessment.

III. Description of Activities

Activity	Description	Outputs	Results
1. Construction of the economic-environmental SAM/data matrices	<ul style="list-style-type: none"> • Build integrated SAM/data matrices. • Build modules to track stocks and flows of environmental resources. 	<ul style="list-style-type: none"> • Integrated economic-environmental SAM/data matrices and environmental modules; documentation. 	<ul style="list-style-type: none"> • Integrated SAM/data matrices built. • Proof of concept demonstrated and in-house capacity enhanced.
2. Development of integrated modeling framework	<ul style="list-style-type: none"> • Build and document IEEM. • Test policy applications. 	<ul style="list-style-type: none"> • IEEM built and documented. • Policy applications tested and documented. 	<ul style="list-style-type: none"> • IEEM developed. • IDB in-house expertise enhanced.
3. Dissemination and capacity building strategy	<ul style="list-style-type: none"> • Consolidate documentation. • Write IDB Technical Note/methods paper/policy impact paper and final report describing/evaluating project outputs. • Dissemination via WAVES/international speaking events. • Deliver workshops in region. 	<ul style="list-style-type: none"> • Database and model construction documented. • IDB Technical Note describing methods and applications, final report describing/evaluating project outputs and two papers submitted to international peer reviewed journals. • Database/model disseminated. • Workshops delivered. 	<ul style="list-style-type: none"> • Transferable approach to database/model developed. • Greater transparency on investment impacts enabled. • Environmental considerations in impact analysis facilitated. • Proof of concept demonstrated, data collection catalyzed. • Enhanced capacity in region in integrated economic-environmental databases and modeling.

IV. Indicative Budget

Activity	Description	Funding US\$	Counterpart Funding	Total Funding US\$
Activities				
1. Construction of the economic-environmental SAM/data matrices	• Database construction.	85,000		85,000
2. Development of IEEM	• IEEM construction and testing with policy applications.	145,000		145,000
3. Dissemination and capacity building	• Documentation, publications, local and international speaking engagements, workshops.	70,000		70,000
TOTAL		300,000		300,000

V. Executing Agency and Execution Structure

- 5.1 Given the strategic corporate objectives of this TC in contributing to the Bank's impact evaluation frameworks and informing decisions regarding the optimal allocation of IDB resources, this TC will be executed by the Bank. The Bank has the capacity to attract the services of the most qualified and renowned professionals in the field which will be required to undertake a cutting edge endeavor of this nature. The Bank's regional presence will enable products developed through this TC to be disseminated throughout the region. With Guatemala as the pilot case for database and model development, the IDB has the capacity to: foster south-south regional cooperation; catalyze data collection and model development efforts, and; promote internalizing environmental concerns into high-level decision making in the region. Where activities will take place in the territories of the member countries, for example, data work shopping in Guatemala, the Bank will obtain a letter of non-objection from the corresponding country prior to initiating any activity in such country.
- 5.2 The Bank will select and contract all consulting services (firms and individuals) according to current corporate procurement policies and procedures (GN-2303-20). INE/RND will have responsibility for the execution, monitoring and supervision of this TC. The IDB will be responsible for the work under this TC. As such, the IDB will be responsible for developing Terms of Reference comprising the activities in section II of this TC.

VI. Project Risks and Issues

- 6.1 One potential issue that may be faced is the increasing complexity of adding environmental sectors into the modeling framework. Each additional environmental sector adds a progressively thicker layer of complexity to the work at hand. Substitution possibilities of environmental assets and goods and services; the geographic specificity of environmental resources, and; cascading effects, thresholds and feedbacks arising from the use of environmental resources are all challenges that this project will confront, which makes the development of the IEEM cutting edge in the field. To mitigate risks, environmental sectors will be incorporated in a step-wise fashion. Given the budget, it may be possible to incorporate only a subset of the key environmental sectors into the framework in this phase. Taking a phased approach will enable future efforts to resume based on the advances made through this TC.

- 6.2 The potential for IEEM development and application in LAC is conditioned by data availability, both in terms of the basic building blocks of a standard SAM as well as data collected under the SEEA. While it is anticipated that countries in the region will eventually collect data under the SEEA framework and this TC, demonstrating proof of concept, will catalyze this data collection, this process will require time. In countries where data is lacking, this risk may be mitigated through: subnational implementation of IEEM, and; step-wise introduction of environmental sectors. IEEM may be implemented in sub-regions of a country thereby reducing the initial data collection investment required. SEEA's design enables environmental sectors to be incorporated incrementally which can help distribute costs over time. It is anticipated that demonstration of IEEM capabilities through these types of pilot initiatives will spur resource mobilization for data collection under SEEA.

VII. Environmental and Social Classification

- 7.1 It is not anticipated that the activities to be financed in this TC will have negative direct or indirect social or environmental effects. According to the Bank's Safeguards Screening Toolkit, this operation is classified with "C": (i) no environmental or social risks; (ii) direct contribution to solve an environmental issue. See [Safeguard Policy Report](#).

Annexes

- I. Terms of Reference (IDBDocs [#38981857](#); [#38981860](#); [#38981863](#); and [#38981872](#)).
- II. Procurement Plan (IDBDocs [#38981881](#))

DEVELOPMENT OF INTEGRATED ECONOMIC-ENVIRONMENTAL FRAMEWORK

RG-T2503

CERTIFICATION

I hereby certify that this operation was approved for financing under Special Program for Biodiversity and Ecosystem Services (BIO) through a communication dated July 23, 2014 and signed by Gerhard Lair (ORP/GCM). Also, I certify that resources from said fund are available for up to US\$300,000 in order to finance the activities described and budgeted in this document. This certification reserves resources for the referenced project for a period of four (4) calendar months counted from the date of eligibility from the funding source. If the project is not approved by the IDB within that period, the reserve of resources will be cancelled, except in the case a new certification is granted. The commitment and disbursement of these resources shall be made only by the Bank in US dollars. The same currency shall be used to stipulate the remuneration and payments to consultants, except in the case of local consultants working in their own borrowing member country who shall have their remuneration defined and paid in the currency of such country. No resources of the Fund shall be made available to cover amounts greater than the amount certified herein above for the implementation of this operation. Amounts greater than the certified amount may arise from commitments on contracts denominated in a currency other than the Fund currency, resulting in currency exchange rate differences, for which the Fund is not at risk.

Original signed

8/22/2014

Sonia M. Rivera
Chief
Grants and Co-financing Management Unit
ORP/GCM

Date

APPROVAL

Approved:

Original signed

8/25/2014

Hector R. Malarin
Chief
Environment, Rural Development Disaster Risk
Management Division
INE/RND

Date