Towards Natural Capital Accounting in Guatemala: Synthesis Report

Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Program in Guatemala

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iarna
Instituto de investigación y proyección sobre ambiente natural y sociedad
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Abbreviations

ANS	Adjusted Net Savings
BANGUAT	Bank of Guatemala
CEDLAS	El Centro de Estudios Distributivos, Laborales y Sociales Center for Distributive, Labor and Social Studies
CONAP	National Council for Protected Areas
CWON	Changing Wealth of Nations
EAU	Ecosystem Accounting Unit
ECLAC	Economic Commission for Latin America and the Caribbean
GHG	Greenhouse Gases
GDP	Gross Domestic Product
GNI	Gross National Income
GTQ	Guatemalan quetzal
HA	Hectares
INE	Instituto Nacional de Estadística National Statistics Institute of Guatemala
INAB	Instituto Nacional de Bosques National Forest Institute of Guatemala
NCA	Natural Capital Accounting
PANCC	Plan de Acción Nacional de Cambio Climático Guatemala's National Action Plan on Climate Change
PINFOR	Programa de Incentivos Forestales Forestry Incentive Programme
PINPEP	Programa de incentivos para pequeños poseedores de tierras de vocación forestal o agroforestal Incentive Program for Small Possessors of Forest or Agro-Forest Land
SEEA CF	System of Environmental-Economic Accounting Central Framework
SEEA-EEA	System of Environmental-Economic Accounting Experimental Ecosystem Accounts
SEGEPLAN	Secretaría de Planificación y Programación de la Presidencia National Development Plan and the Planning Agency
SG	Steering Committee
SIGAP	El Sistema guatemalteco de Áreas Protegidas Guatemalan System of Protected Areas
SNA	System of National Accounts
TC	Technical Committee
TJ	Terajoules
UN	United Nations
UNIPESCA	Unidad de Manejo de la Pesca y Acuicultura Management of Fishery and Aquaculture Unit
URL	Universidad Rafael Landívar
US$	United States Dollar
WAVES	Wealth Accounting and the Valuation of Ecosystem Services

Summary

The continuous pressures to the environment are affecting Guatemala's natural capital base. Guatemala is one of the most ecologically diverse countries on the planet, with 14 different eco-regions and great biological and cultural diversity. However, the country's environment is threatened by deforestation, over-exploitation of natural resources, and pollution. The annual rate of deforestation was 1.7% (more than three times the average rate in Latin America and the Caribbean).[1] About 10% of land was highly degraded and 63% could become highly degraded in the near future. The annual cost of soil and land degradation amounts to 0.55% of GDP.[1] Therefore, assessing and valuing natural capital through Natural Capital Accounting (NCA) allows both environmental and economic information to be mainstreamed into development policy and planning decisions to ensure sustainable economic growth in the long run.

Guatemala has a long history of developing NCA, using the System of Environmental-Economic Accounting framework (SEEA),[2] which contributed to the policy dialogue. The SEEA provides a framework for measuring the link between the environment and the economy, the stocks of natural capital assets and its changes. Before the arrival of the World Bank led WAVES Partnership[3] SEEA institutionalization was fragile in Guatemala and required additional support. WAVES aimed at mainstreaming natural capital in development planning and national economic accounting systems. Initial efforts focused primarily on accounts compilation and it was later recognized that there was a strong need to better link the production of the accounts to their use in policy analysis and dialogue. The program of work was divided in three main areas of work: (i) updating and strengthening accounts developed in the past, (ii) adding new accounts to complete a set relevant for the country, (iii) use the accounts in policy dialogue.

This report presents the results to date of the implementation of NCA in Guatemala, with attention to those interventions related to the WAVES program. This report is divided in six sections: Section 1 is an introduction to the development context in Guatemala, and Section 2 focuses on the state and trends of natural capital. Section 3 describes the measuring rod for environmental-economic linkages, and Section 4 reveals key findings and provides further detail of each account under WAVES. Section 5 outlines the policy dialogue going forward.

Natural capital accounts of Guatemala revealed new information about the link between the economy and environment previously unknown. Key findings included the following, among others:

- Guatemala's share of natural capital (21%) was higher than the global average (9%) in 2014 but decreased 23% to 21% between 1995 to 2014.[4]
- Sugar cane was the largest crop produced in Guatemala (70% of total crop production), and the country feeds on maize and beans. Maize and sugarcane were the largest users of water (maize, exclusively from rain), leaving the production of these crops entirely dependable to climate variability. The production of crops contributes around 9% to total GDP, and other agricultural products, forestry, and fisheries combined only 2%.[5]
- Total contribution of fish farming and aquaculture to GDP oscillated between 0.19% and 0.25% between 2001 and 2005, noteworthy for the Guatemalan economy. More than half of the fish production and catchment were exported and 28% were for domestic consumption. This industry employs 14,133 people. From 2015 and on, aquaculture accounts for 50% of the fish production.[6]

[1] Guatemala WAVES Policy Note (World Bank: WAVES Guatemala, 2016)
[2] SEEA Central Framework (UN et al., 2014)
[3] See www.wavespartnership.org
[4] Guatemala Wealth Account (World Bank, 2018)
[5] Guatemala Agriculture Account (INE, 2001-2013)
[6] Guatemala Fish and Aquaculture Account (INE, 2001-2013)

- Economic growth has moved along with increases in the demand for natural resources and energy, as well as waste production rises. However, there was no evidence of consistent decoupling paths between GDP and the use of environmental inputs. The main source of energy in Guatemala was fuelwood. The total human contribution of greenhouse gas emissions (GHG) from the combustion of different energy sources in Guatemala accounted for 45.6 million carbon dioxide metric tons equivalent. Furthermore, for every million quetzals (GTQ) that electricity generation contributed to GDP, it required 14.2 TJ, manufacturing sector - 2.9 TJ for every million GTQ, and trade activities - below 1TJ for every million GTQ of value added.[7]
- Guatemala lost 40% of forest cover between 1970 to 2005. Over 95% of this deforestation happened outside the control of government institutions, and the impact of fuelwood on the forest was worse than previously thought. Forest cover loss in Guatemala continued even though the net deforestation rate reduced, as a result of reforestation and natural regeneration processes. In the last ten years, there was a net gain of forest recovery in strategically defined ecosystems for hydrologic cycle regulation. The contribution of forest products to the national economy was 3.15% and 2.57% for 2001 and 2006, respectively.[8]
- Nine out fourteen ecoregions in Guatemala were severely fragment to a point where their integrity and provisions of natural goods and services can no longer be guaranteed. Agricultural areas expended at the expense of forests. Economic costs regarding degradation, such as the ability of forests to control erosion and their capacity to store carbon, were equivalent to Q2,919.4 million (~US$374.3 million) between 1991 and 2003.[9]
- The SEEA of Guatemala provided a forward looking perspective and useful information for apprising at least four of the six lines of adaptation considered by the National Action Plan on Climate Change – Guatemala's main public policy instrument on climate change.

Accounts in Guatemala have been useful to better understand the impact of the economy on the environment and the contribution of the environment to the economy, and to identify opportunities for innovation and promoting activities that could lead to sustainable economic growth. These accounts helped inform the national development plan and the competitiveness strategies which are part of the current discussions in the country. Agriculture-environment accounts provided more elements for strategic decisions on issues of food security and sovereignty, critical for future development and poverty reduction and are a primary concern of the National Development Plan.[10] Ecosystem accounts in selected areas were useful for deepening the analysis of strategic natural capital to meet priorities of economic and social policy response, including climate change threats and enhancing tourism potential. From a macroeconomic perspective, accounts were useful for sending signals to decision makers about the need to reduce the negative externalities and promote green growth. By having macroeconomic indicators of wealth including natural capital, policy makers have indicators of the sustainability of economic growth. After WAVES implementation, it has become apparent that NCA and related analysis can serve as the basis for developing methodological and analytical tools that facilitate the assessment of public projects and programs related to natural resources and the environment. There is much more to do to connect policy and data, but the WAVES Program provided a good start and generated a roadmap which apparently can be sustained overtime.

[7] Guatemala Energy Account (INE, 2001-2013)

[8] Guatemala Forest Account (INE, 2001-2013)

[9] Guatemala Experimental Ecosystem Account (INE, 2001-2013)

[10] Current projections are that climate change is potentially going to undermine the country's capacity for food production. There is a clear need for better understanding the relationship between agriculture activities and the ecosystems that support agriculture to enable better decisions on land use. The need to guarantee enough provision of ecosystem services that can allow for an efficient agricultural production.

Development Context in Guatemala

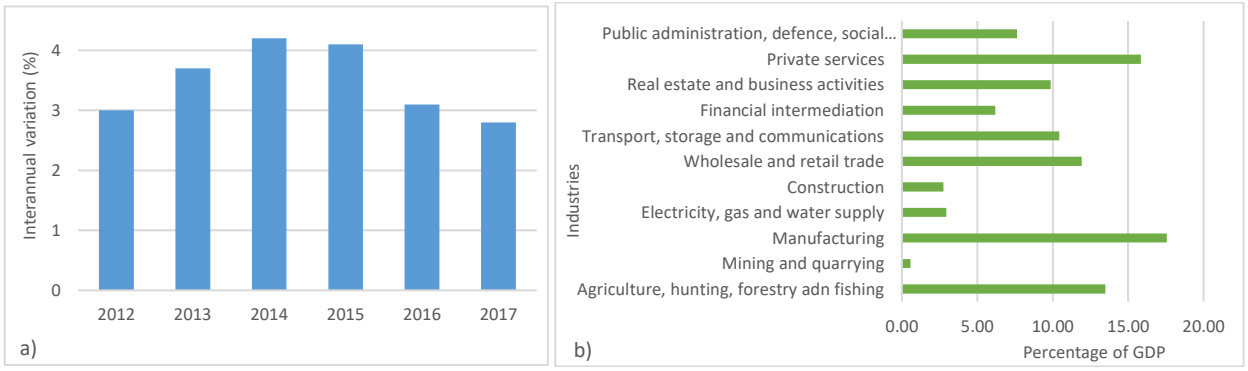
In Guatemala, 60% of the population live in poverty and has one of the most unequal distributions of income in the Americas.[11] Living conditions and health-related problems are especially acute in rural areas (home to 60% of the population), where three-quarters fall below the poverty line and one-quarter live in extreme poverty.[13] The annual cost of water-borne diseases caused by poor quality water, sanitation, and hygiene in rural areas is 0.97% of GDP; and the annual cost of indoor air pollution-related illnesses in rural areas is 0.7% of GDP.[12] This situation is further reflected in the high rates of chronic malnutrition (46.5% of children under five) and the low levels of education (average schooling is below 4 years).

Guatemala's economy has sustained modest economic growth since the 1980's, with an average growth rate of 3.6% between 2001 and 2013.[13] Economic growth was affected by the 2008 global financial crisis, but the country has recovered at a consistent pace since then. Modest economic growth rate and high population growth means low per capita growth rate, close to 1% per annum during the last 15 years. While Guatemala's GDP per capita in constant prices increased 30% between 1990 and 2011, countries like Panama and Chile reported an increase close to 120% in the same period.[13]

During the last two decades, the most notable change in the economy was the decline in agriculture, forestry and fishing share of GDP, from 25% to 13.6%.[14] Although, the agriculture sector still employs the highest number of workers. According to National Statistics Institute (INE), based on data from the National Survey of Employment and Income, 31.3% of Guatemalan workers were employed in agriculture, hunting, and related activities. The service sector shares have increased from 58% to 66% in the same period, similar to the manufacturing industry, whose total share of GDP increased from 17% to 19% (Figure 1).

Figure 1. a) GDP annual growth rates in Guatemala; b) Structure of the economy

a) Period: 2012-2017, Interannual variation %; b) Period: 2017, % of GDP



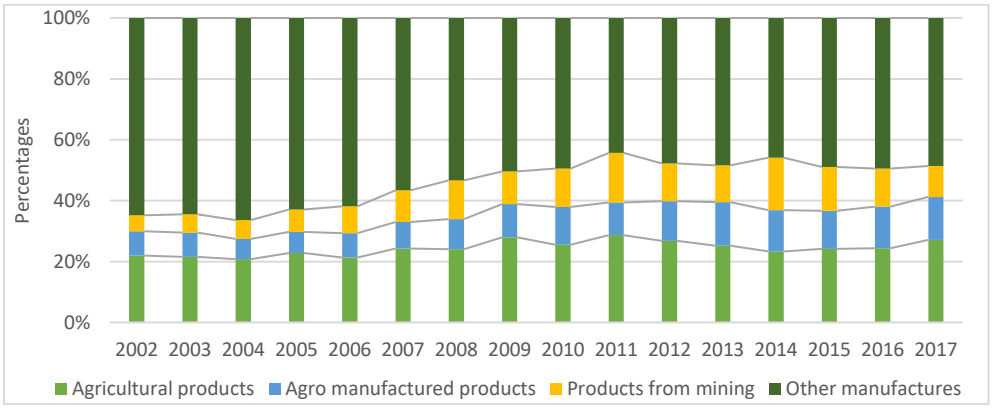
Source: BANGUAT

Natural resource-related sectors, such as agriculture, livestock and forestry, and mining and extractive activities grew below the pace of the economy in general. Of these sectors, only mining and extractive activities increased their share in the economy from 0.7% to 1.1% of GDP. Meanwhile, non-traditional agriculture and livestock suffered strong reductions, as both declined by more than 1.3% of GDP. Finally, traditional crops decreased their share from 3.1% to 2.6% of GDP.

[11] (National Statistics Institute of Guatemala, 2011); (CEDLAS & World Bank, 2014)
[12] Guatemala WAVES Policy Note (World Bank: WAVES Guatemala, 2016)
[13] Guatemala Country Partnership Framework (World Bank, 2016)
[14] Guatemala Systematic Country Diagnostic (World Bank, 2015)

Guatemala's exports depend heavily on natural capital (Figure 2). Agricultural activities (coffee, bananas, cardamom, sugar, palm oil) were some of the highest users of natural resources, such as land, water and nutrients. Exports in agricultural products have gained importance over time, from 30% of total export value in 2002 to 40% in 2017.[15] Agriculture and the rural economy are a critical factor for the reduction of poverty. For example, while the coffee industry corresponds to only 1.6% of GDP in Guatemala, the effect of this industry on poverty and household consumption was important since it generated 500.000 jobs, employing almost 9% of the economically active population. Most coffee producers are small producers in rural areas. Seven out of ten households in the coffee-producing regions live in poverty, and two out of ten live in extreme poverty. A similar situation was true for economic activities related of sugar cane and bananas.

Figure 2. Structure of exports between 2002 and 2016

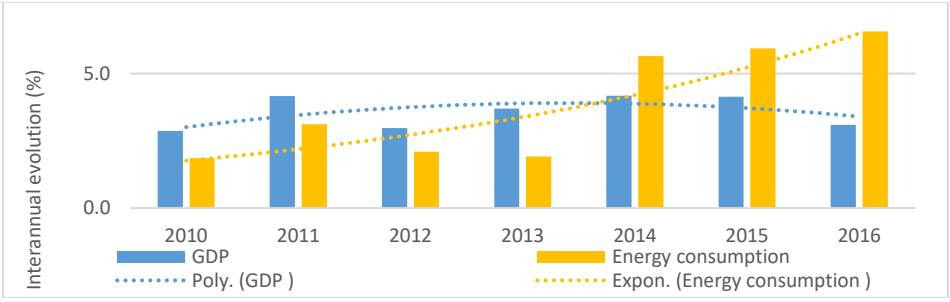


Source: SEEA Guatemala

The trends in GDP have decreased since 2014, while the rates of energy consumption increased year after year (Figure 3). Such dependency has led to undesirable consequences in emissions and waste generation at a similar rate of GDP. Over-exploitation of natural resources and pollution has threatened the ecology in Guatemala, which is one of the most ecologically diverse countries on the planet, with 14 different eco-regions, great biological and cultural diversity. These data are important as the costs linked to resources depletion and environmental degradation are not internalized in the prices of the products nor reflected in GDP. The pattern of production and exports is probably unsustainable and dangerous to the well-being of the country in the long term. Therefore, assessing and valuing natural capital through NCA allows both environmental and economic information to be mainstreamed into development policy and planning decisions.

Figure 3. Annual evolution of GDP and energy consumption in Guatemala

Period: 2010-2016, percentages



Source: SEEA Guatemala

[15] Guatemala Agriculture Environmental Account (INE, 2001-2013)

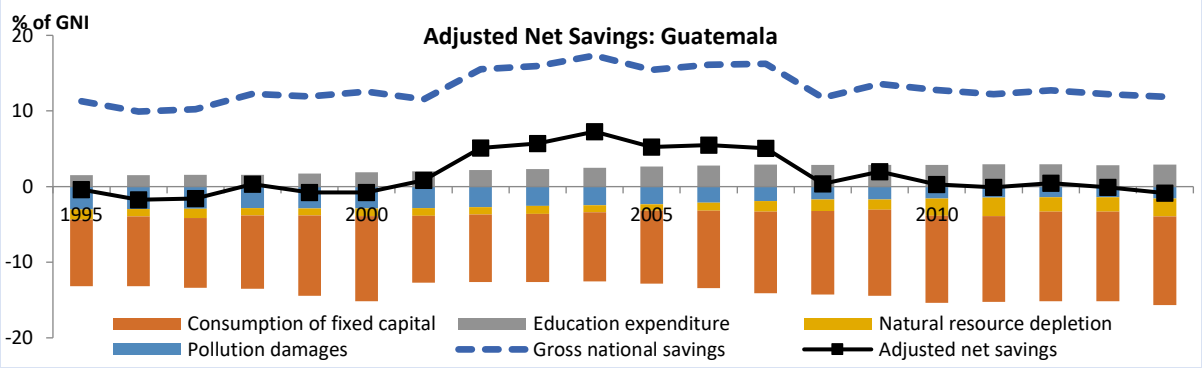
Adjusted net savings (ANS) was developed as an indicator to measure the real difference between production and consumption. ANS adjusts gross savings by taking into account investments in human capital, depreciation of fixed capital, depletion of natural resources, and damages caused by pollution. Figures for Guatemala show that although the indicator was positive for some years, this was driven by high rates of education investments, while natural capital were being depleted (Box 1).

Box 1. Macroeconomic Indicators: Adjusted Net Savings (ANS) in Guatemala [16]

The WAVES program supported the Government of Guatemala in developing estimations for ANS, based on resource depletion, saving and investments**.** Truly comprehensive wealth accounting goes beyond the System of National Accounts (SNA), an international standard for measuring national income and savings, to include broader forms of wealth such as human capital and the benefits flowing from ecosystem services. The World Bank measures changes in wealth through adjusted net savings (ANS), which captures the real difference between production and consumption by including depreciation of fixed capital, as well as investment in human capital, depletion of natural resources, and damage from pollution. Positive ANS indicates an investment in the future—that a nation is accumulating the assets needed to build up its wealth and ensure its economic growth over the longer term. Years of negative saving, on the other hand, can be an indication of declining national wealth and unsustainable development.

Guatemala's gross savings during this period was low, averaging 13% of gross national income (GNI), the gap between gross savings and ANS was modest, with an average ANS of 1.6%. ANS even dipped below zero in many years during this period, indicating that Guatemala's national savings did not cover the depreciation and depletion of its assets in those years. The main driver of Guatemala's low ANS was its significant consumption of fixed capital, averaging 10% of GNI. The second largest driver were damages from CO_2, especially due to emissions from land use, land-use change, and forestry, averaged at 2.3% during this period. Figure 4 shows Guatemala's ANS from 2010-2016, with the stacked bar columns illustrating the adjustments from gross national savings (blue dotted line) to arrive at ANS (black marked line).

Figure 4. Adjusted Net Savings in Guatemala
Period: 1990-2016, percent of GNI



Source: Lange, Wodon, & Carey; Guatemala Wealth Account

Guatemala has a long history of developing NCA, using the System of Environmental-Economic Accounting framework (SEEA)[17], which contributed to the policy dialogue. The Guatemalan SEEA process was a partnership between government and academia, and has helped to create a culture of data-driven decision making.[18] Since its inception, the implementation of SEEA in Guatemala was designed to ensure its institutionalization, and many accounts have been produced over time: forest, energy, land, water, and public expenditure accounts. Today the process has been endorsed by the National Institute of Statistics

[16] Guatemala Wealth Account (World Bank, 2018)
[17] SEEA Central Framework (UN et al., 2014)
[18] Implementing Natural Capital Accounting in Developing Countries: Public-Academic Partnerships and Policy Uptake in Guatemala (Castandeda, Castillo, & Matias, 2017)

(INE) and the accounts produced are part of the official statistics of the country.[19] Table 1 shows the extent of the accounting work.

Before the arrival of the World Bank led WAVES Partnership[20] SEEA institutionalization was fragile and required additional support. The initial efforts focused primarily on accounts compilation and it was later recognized that there was a strong need to better link the production of the accounts to their use in policy analysis and dialogue. Valuation of assets and flows of non-market ecosystem services were a key aspect of this and the emergence of ecosystem accounting provided a key opportunity to test it in Guatemala.

This report presents the results to date of the implementation of NCA in Guatemala, with attention to those interventions related to the WAVES program. The report is divided in six sections including this introduction on Guatemala's development. Section 2 focuses on the state and trends of natural capital. Section 3 describes the measuring rod for environmental-economic linkages, and Section 4 reveals key findings and further details of each updated account under WAVES. Section 5 outlines the policy dialogue going forward. Section 6 are the references.

Table 1. NCA in Guatemala

Accounts classified by accounting component	Accounts classified by theme							
	Forest	Water	Subsoil assets	Energy and emissions	Ecosystem	Fisheries and aquaculture	Wastes	Expenditures and other transactions
Asset accounts								
Natural resources	A	B	A			A		A
Ecosystems					B			A
Land and surface water	B	B			B			A
Flow accounts								
Natural resources	B	B	B			B		A
Ecosystem inputs				B	B			A
Products	A	A	A	A		A	B	A
Wastes and emissions	B	B	B	B		B	B	A
Expenditure and other transactions								
Environmental protection expenditure	C	C	C	C	C	C	C	
Natural resource management expenditures	C	C	C	C	C	C		
Aggregates								
Depletion	C		C					
Intensity Indicators	A	A	A	A	A	A	A	C

- A = Physical and monetary measures, B = Physical measures, C = Monetary measures

[19] Compendio de cuadros estadísticos del Sistema de Contabilidad Ambiental y Económica Integrada de Guatemala (SCAEI). Periodo 2001–10 (BANGUAT, INE, and IARNA, 2013)

[20] See WAVES Program Website [www.wavespartnership.org]

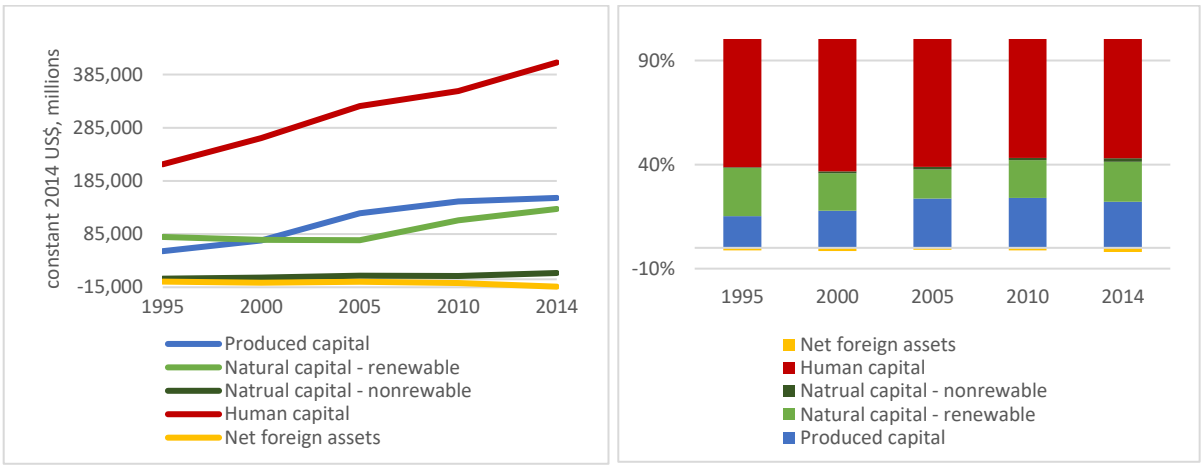
State and Trends of Natural Capital

In this section, key findings of the Guatemalan Natural Capital Accounts are presented. These findings include the share of total wealth in Guatemala; the relationship between energy demand, natural resources and economy; the state and dynamics of forests; fisheries and aquaculture production; and water use and agricultural production. This section also includes a forward-looking perspective how accounting information can be used for building climate change scenarios for overtime. Section 4 of this report provides further detail of the accounts in agriculture, ecosystems, energy, fisheries and aquaculture, and forestry.

As a middle-income country with strong agricultural roots, the share of natural capital (21%) in Guatemala's wealth was higher than the global average (9%) in 2014.[21] Even though natural capital shares in Guatemala was higher than the global average, these shares slightly decreased from 23% to 21% (1995 to 2014), see Figure 5. Natural capital has historically been the most valuable asset of countries at one point in their development. Countries like Guatemala rely primarily on the exploitation of natural capital for their development, with mineral, timber, fish and land resources being used to generate income. Economies can only move beyond subsistence production of food and shelter to producing of goods and services for trade with the addition of human capital, infrastructure, and other types of produced capital.[22] This as similar in the way Guatemala's share of total wealth has evolved over time. Produced capital increased its share from 15% to 22% from 1995 to 2015. However, human capital shares decreased over time from 63% to 59% during this 20-year period.

Figure 5. (a) Total wealth in Guatemala; (b) Share of Wealth in Guatemala

Period: 1995 to 2014; a) constant 2014 US$, millions; b) percent



Source: Lange, Wodon & Carey; Guatemala Wealth Account

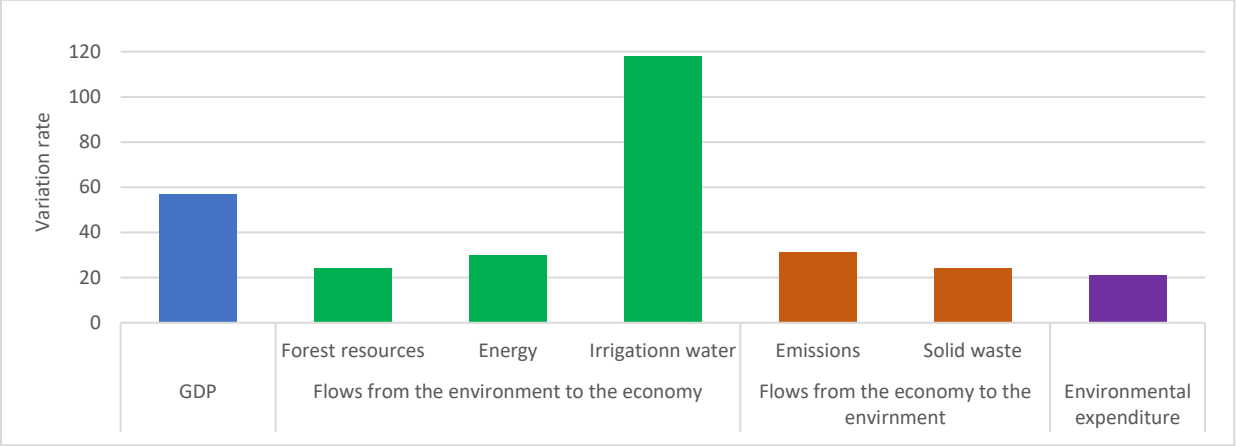
The SEEA of Guatemala shows that economic growth has moved along with increases in the demand for natural resources and energy, as well as waste production rises (Figure 6). While environmental protection expenses have increased in the period 2001 to 2014, they have done so at a slower pace. The system of natural capital accounts of Guatemala provides indicators that allow analyzing the environmental economic performance of the Guatemalan economy, to evaluate the patterns and development models prevailing in the country.

[21] Guatemala Wealth Account (World Bank, 2018)

[22] (Lange, Wodon, & Carey, The Changing Wealth of Nations 2018 : Building a Sustainable Future, 2018)

Figure 6. Changes in GDP and flows between the economy and the environment

Period: 2001-2014, percentage

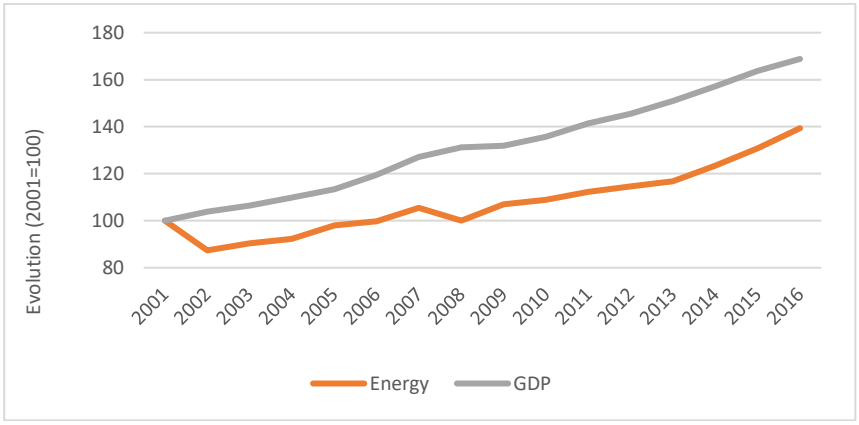


Source: SEEA Guatemala

There was no evidence of consistent decoupling paths between GDP and the use of environmental inputs. Figure 7 shows the decoupling of energy use and GDP, where GDP grew more than energy use.[23] Even though there was economic growth, up until 2006 the energy use remined below the value of use since 2001. Since 2008, energy use has expended at a similar rate as the GDP. In recent years, the annual growth of energy demand has exceeded the rate of GDP, suggesting the economy is becoming more energy intensive.

Figure 7. Relations between the Guatemalan economy and energy demand

Decoupling between GDP and energy use, period 2001-2016.



Source: Energy and emissions account

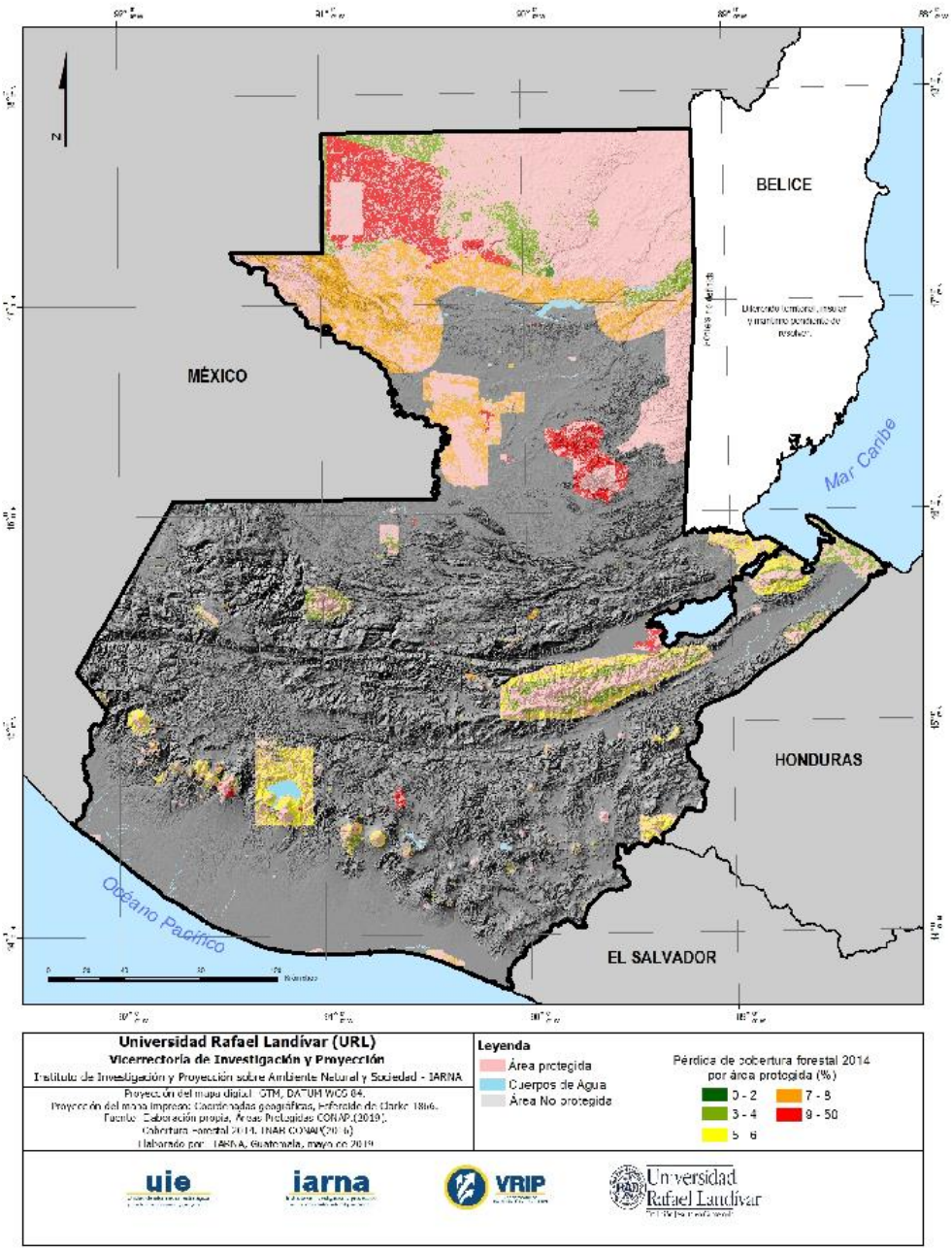
Forest cover loss in Guatemala continued even though the net deforestation rate reduced, as a result of reforestation and natural regeneration processes. Gross deforestation rates changed from 93,000 ha in 2001-2006, to 138,000 ha in 2006-2010, to 128,000 ha in 2010-2014. The net deforestation rate decreased from 60,000 ha in 2001-2006 to 18,000 ha in 2010-2014 because of reforestation and natural regeneration processes. Forty percent of deforestation happened in protected areas, where some areas lost more than 10% of its forestry cover between 2010 and 2014 (Figure 8).[24]

[23] Guatemala Energy and Emissions Account (INE, 2001-2013)

[24] Guatemala Forest Account (INE, 2001-2013)

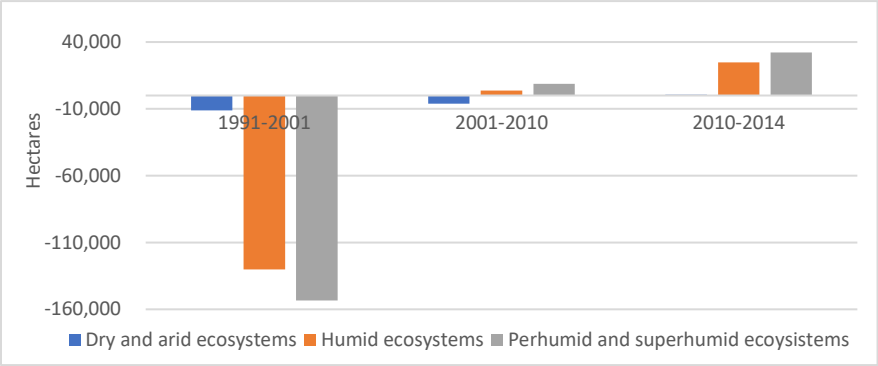
Figure 8. Forest cover loss in protected areas

Period: 2010-2014, percentage



In the last ten years, there was a net gain of forest recovery in strategically defined ecosystems for the hydrologic regulation. The forest account shows high deforestation rates (between 10,000 and 15,000 ha per year) for the period 1991-2001 (Figure 9), mainly for humid and very humid ecosystems. Although moderate, data shows recovery processes for the next periods in those ecosystems, particularly for the period 2010-2014. The available information does not allow an assessment of the extent to which this recovery was promoted by current forestry policies or if it was determined by other factors such as social and community awareness or abandonment of agricultural areas due to reduction in productivity. In any case, it is evident that it is necessary to improve the evaluation and monitoring of current programs with the purpose of being able to make timely adjustments and improve the targeting, as necessary.

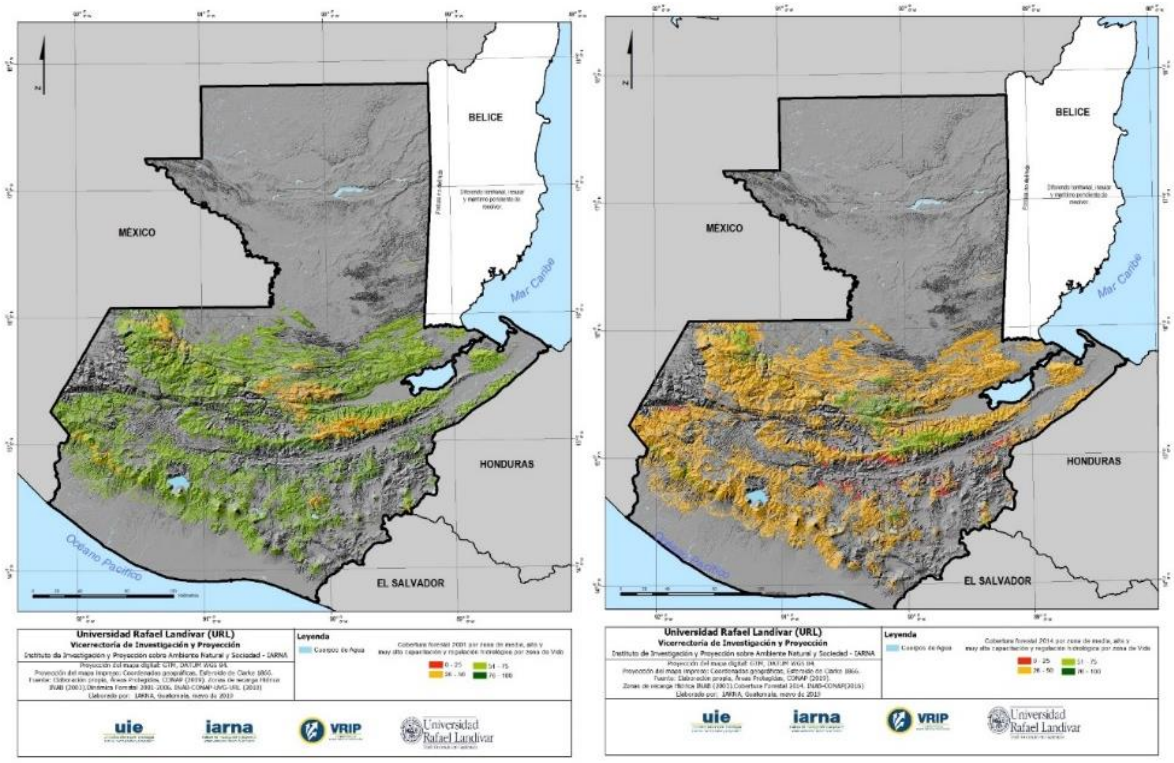
Figure 9. Forest cover dynamics in land defined strategic for hydrologic capture and regulation, according to type of ecosystem.



Source: Forest and Experimental Ecosystem Account

However, forestry cover decreased in almost all these areas important for hydrological capture and regulation. Figure 10 shows that in 2001, forest cover in eighty percent of these areas, was between 50% to 75%. By 2014, only twenty percent were covered by forests above fifty percent, and only ten percent had forest cover below 25%. Forest cover in these areas is very important for risk management associated to floods and regulating the hydrologic cycle.

Figure 10. Forest cover in land defined as strategic for hydrological capture and regulation.
Period: 2001 and 2014



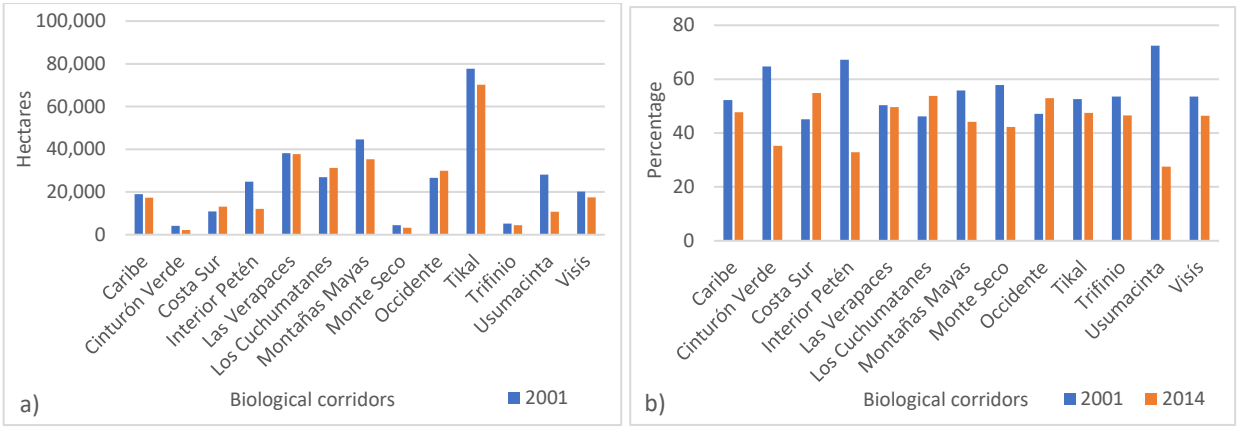
Source: Experimental Ecosystem Account

Ecological connectivity and biodiversity management was threatened and has deteriorated due to forest deforestation on key areas. Biological corridors maintain connectivity between forest fragments and the

development of corridors is an important part of protected areas management and the conservation of biodiversity.[25] Figure 11 shows that nine of the 13 strategic corridors defined by INAB exhibit reductions in forest cover in 2001 and 2014.[26] While ten of these corridors had forest cover greater than 50% of their surface in 2001, the number of corridors decreased to three in 2014.

Figure 11. Forest dynamics in biological corridors proposed by INAB

(a) Area covered by forest (2001 &2014, hectares); (b) Percentage of biological corridor covered by forest (2001 & 2014)

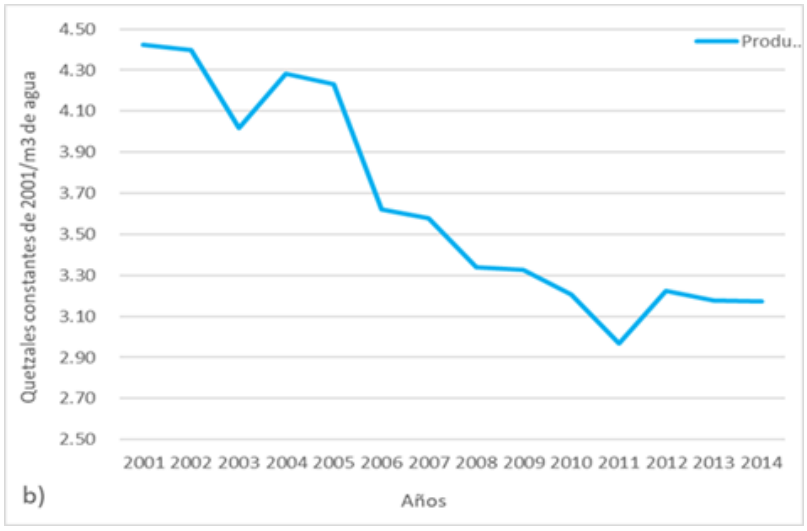


Source: Forest and Experimental Ecosystem Account

Productivity in the water use for agricultural crops consistently decreased from 2001 (Figure 12). The agriculture account shows that the main crops (sugar cane, oil palm and banana), expanded in area since 2001, use 75% of the irrigation water.[27] The estimates indicate that there is room for improving the efficiency of irrigation system. In economic terms, water productivity, measured as the value added generated by each cubic meter used in these activities, was reduced from 4.41 Q/m^3 of water in 2001 to 3.17 Q/m^3 of water in 2014.

Figure 12. Water use productivity of agricultural crops

Period 2001-2014, quetzals of added value /m^3 of water

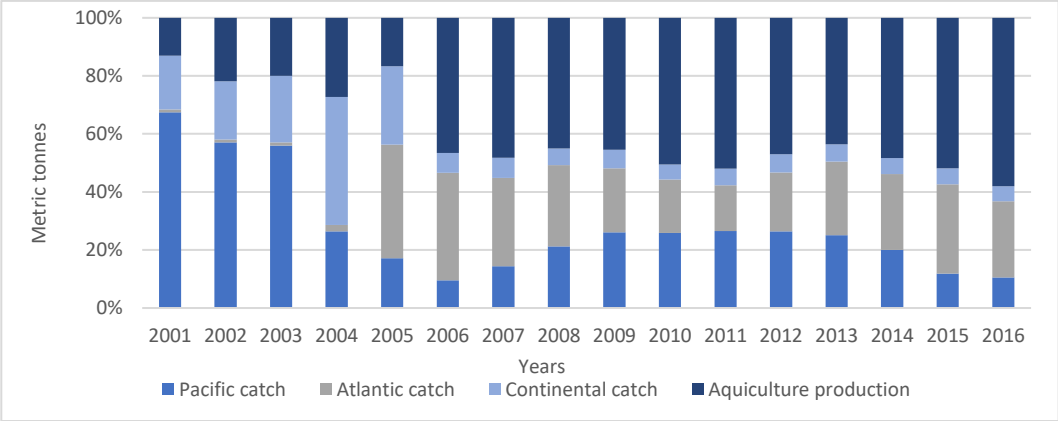


[25] Disaster Risk Programme to strengthen resilience in the Dry Corridor in Central America (FAO, 2015)
[26] Guatemala Experimental Ecosystem Account (INE, 2001-2013)
[27] Guatemala Agriculture Account (INE, 2001-2013)

Aquaculture accounts for 50% of the fish production from 2015 and on. During 2001 to 2006, aquaculture accounted for less than 25% of the national fish production, but its shares quickly increased (Figure 13). This occurred mainly because of poor management of fisheries causing a collapse in capture activities in the Pacific Ocean (2004-2005). This was particularly evident in the overexploitation of shrimp and deterioration of strategic habitats. Whereas aquaculture focused on the production of shrimps and tilapia.

Figure 13. Fisheries and aquaculture production of Guatemala during the period 2001-2016

Unit: volumes captured and cultivated (metric tons)

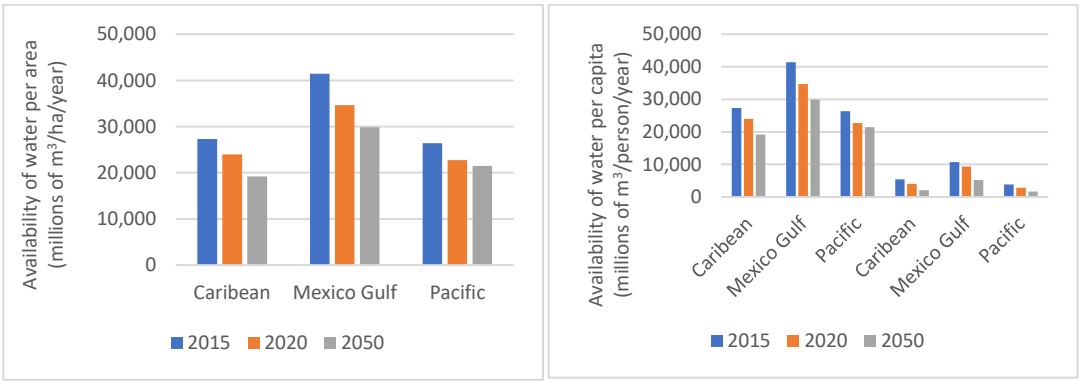


Source: Fish and Aquaculture resources account

The SEEA of Guatemala provided a forward looking perspective and useful information for apprising at least four of the six lines of adaptation considered by the National Action Plan on Climate Change[28] namely: i) agriculture, livestock and food security; ii) forest resources, ecosystems and protected areas; iii) integrated water resources management; and iv) marine coastal zones. The strategic objective of the PANCC is to guide the actions of public institutions with the purpose of: reducing the vulnerability of the country to climate change; preventing and reducing its negative effects; prioritizing the protection of the vulnerable population and their livelihoods, and; identifying opportunities for a better development of the country. Figure 14 shows climate change scenarios for the availability of water in the future for three different years in Guatemala.

Figure 14. Climate change scenarios and water assets

(a) Impacts of climate change on water availability in Guatemala according to slope and scenario A2. (b) Distribution of ecosystems according to provinces of humidity and life zones; (i) rainy and very humid, (ii) wet and (iii) dry and very dry. Based on scenario A-2 climate change. Years 2015, 2020 and 2050.



[28] PANCC: Guatemala's main public policy instrument on climate change

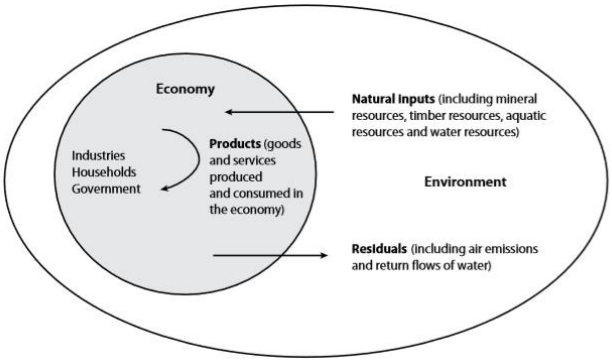
The Measuring Rod for Environmental-Economic Linkages

The system of environmental-economic accounting (SEEA) provides a framework for measuring the link between the environment and the economy, the stocks of natural capital assets and its changes.[29] SEEA is the methodology to operationalize the concept of Natural Capital Accounting. Adopted in February 2012 as an international statistical standard by the UN Statistical Commission, the SEEA brings together economic and environmental information using an agreed-upon set of standard concepts, definitions, classifications, accounting rules, and tables to produce internationally comparable statistics and accounts. The SEEA framework follows a similar accounting structure as the SNA. The framework uses concepts, definitions, and classifications consistent with the SNA to facilitate the integration of environmental and economic statistics, allowing to develop indicators and conduct analysis on the economy-environment nexus.

The SEEA consists of three parts: Central Framework (CF), Experimental Ecosystem Accounting (EEA), and Applications and Extensions.[30] The Central Framework looks at individual environmental assets, such as water, energy, forests, and fisheries resources and how those assets are extracted from the environment, used within the economy and returned to the environment in the form of emissions into air, water, and waste. Applications and Extensions portion supports users on how to use the SEEA CF accounts for decision making, policy formulation, and research. [31]

The Central Framework measures the environment and its relationship with the economy in three main areas. The environmental flow, which are the flows of natural inputs, products and residuals between the environment and the economy, and within the economy, both in physical and monetary terms, see Figure 15. The stocks of environmental assets, which are the stocks of individual assets, such as water or energy assets, and how they change over an accounting period due to economic activity and natural processes, both in physical and monetary terms. The economic activity related to the environment. Monetary flows associated with economic activities related to the environment, including spending on environmental protection and resource management, and the production of environmental goods and services.[32] The agreed methodologies thus far on ecosystem accounting provide sustenance across many sectors.

Figure 15. Physical flows of natural inputs, products and residuals

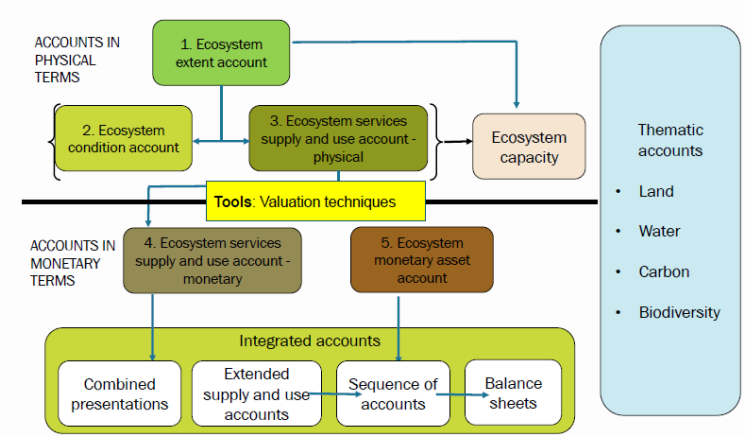


The SEEA Experimental Ecosystem Accounting (EEA) presents a statistical framework for organizing biophysical data, measuring ecosystem services, tracking changes in ecosystem assets and linking this

[29] SEEA Central Framework (UN et al., 2014)
[30] SEEA Website [https://seea.un.org/]
[31] SEEA Applications and Extensions (UN et al., 2017)
[32] SEEA Central Framework (UN et al., 2014)

information to economic and other human activity. [33,34,35] Ecosystem accounting takes a spatial approach and ecosystem assets are defined as spatial areas containing a combination of biotic and abiotic components and other characteristics that function together. These ecosystem assets provide ecosystem services, which are the contributions and benefits of ecosystems to economic and other human activity. The ecosystem accounting framework comprises a set of connected accounts (see Figure 16) dealing with land and ecosystem use (the extent account), the state or health of the ecosystem (the condition account), the supply of ecosystem services including crops and forestry products as well as regulating and cultural services (the physical and monetary ecosystem services accounts) and the monetary ecosystem asset account (depicting the monetary value of the ecosystems).

Figure 16. Basic model of ecosystem stocks and flows



To provide a basis for understanding of the nature of ecosystem accounting, Table 2 presents an example of an ecosystem accounting table. It provides a basis for reporting information on physical flows of ecosystem services for an Ecosystem Accounting Unit (EAU) or a country. The number of different ecosystem services reported will vary depending on the type of ecosystem and its pattern of use. The ecosystem services shown in Table 2 will not be measured using the same physical units and hence totals across different ecosystem services are not shown. The objective from an analytical perspective is to use information on the combinations of ecosystem services within an ecosystem asset (i.e., the observable basket of ecosystem services) to determine what trade-offs may arise from alternative uses. Further, this information can be used to construct scenarios depicting the flows of ecosystem services in response to anticipated activities in an ecosystem asset, activity in neighboring ecosystems, natural changes in ecosystem processes or climate change.

Table 2. Example of physical flows of ecosystem services for an EAU

Type of ecosystem services	Type of Land Cover/Ecosystem Function Unit				
	Forest tree cover	Agricultural land	Urban associated developed area	Open wetlands	…
Provisioning services	i.e. tons of timber	i.e. tons of wheat			
Regulating services	i.e. tons of CO_2 stored/released	i.e. tons of CO_2 stored/released	i.e. tons of CO_2 stored/released	i.e. tons of phosphorus absorbed	
Cultural services	i.e. number of visitors and hikers		i.e. hectares of parkland	i.e. hectares for ducks	

[33] SEEA Experimental Ecosystem Accounting (UN et al., 2014)

[34] SEEA EEA has been produced and was released under the auspices of the United Nations, the European Commission, the Food and Agriculture Organization of the United Nations, the Organization for Economic Co-operation and Development, and the World Bank Group.

[35] A revision of the SEEA-EEA is underway and scheduled to be completed by 2020.

A Deeper Look into the Guatemalan Accounts

4.1. Agriculture Account[36]

The largest crop production in Guatemala was sugar cane (70% of total production), followed by the production of bananas (9%) and maize (8%) The production of beans, a staple food for Guatemalans, was not as large as maize, representing 5% of total supply, similar to wheat (6%) and potatoes (6%). Guatemala also depends on import for several agricultural products. For example, most of the wheat and unprocessed rice was imported in 2010, 99.7% and 70%, respectively. Even maize, that has been a part of the Guatemalan diet for centuries was imported (21%).

Households consumed the largest volume of cultivated products, such as beans (95%) and potatoes (88%), directly from traditional market culture still present in the country. The largest users of agricultural products in 2010 were manufactures (food processing industry, 70.8%), households (21.5%), and the rest of the world (exports, 6.7%). Household consumed 80% of maize production, which was consistent to the 20% used by the food processing industry. Almost all the supply of unprocessed rice and wheat was exclusively used by the food processing industry.

The production of maize used the largest amount of water, exclusively from rain (4.8 million m^3). The production of sugar cane also used the same amount of water; however, since this is a more industrialized production it includes other methods of water provision: 56% rained, 24% aspersion, 17% gravity and other methods. The agriculture account also displays that agriculture production represents only 1% of total energy use in the country.

Crop production contributes around 9% to total GDP, while cattle farming about 2%; the same as other agricultural products, forestry, and fisheries combined (2%). In total, this production represents about 12% of GDP in 2010. Households buy 59% of the crops, 80% of other agricultural products, and only 19% of cattle farming products. As for fisheries, 42% of total output was purchased by households, 37% were exports and 20% intermediate consumption.

4.2. Ecosystems Account[37]

The accounts focused on the country's life zones (or ecosystem types), chosen as the unit of analysis of ecosystems at the national level. The accounts and subsequent analysis focused on forest cover and protected areas, because of the relationship between with the condition indicators for the different life zones and the types of ecosystem services. The main findings of the accounts were the severe depletion of forest ecosystems and not all ecosystem an equally represented in the Guatemalan System of Protected Areas (SIGAP). The account further demonstrated that protected areas provide varying levels of ecosystem services and these were threatened by forest depletion and degradation.

Guatemala's main surface cover was forest at 39% of the total area (4.2 million hectares) in 2003. Land used for agriculture was about 28% of the country's territory, and a combination of pastures, grasslands, shrubs

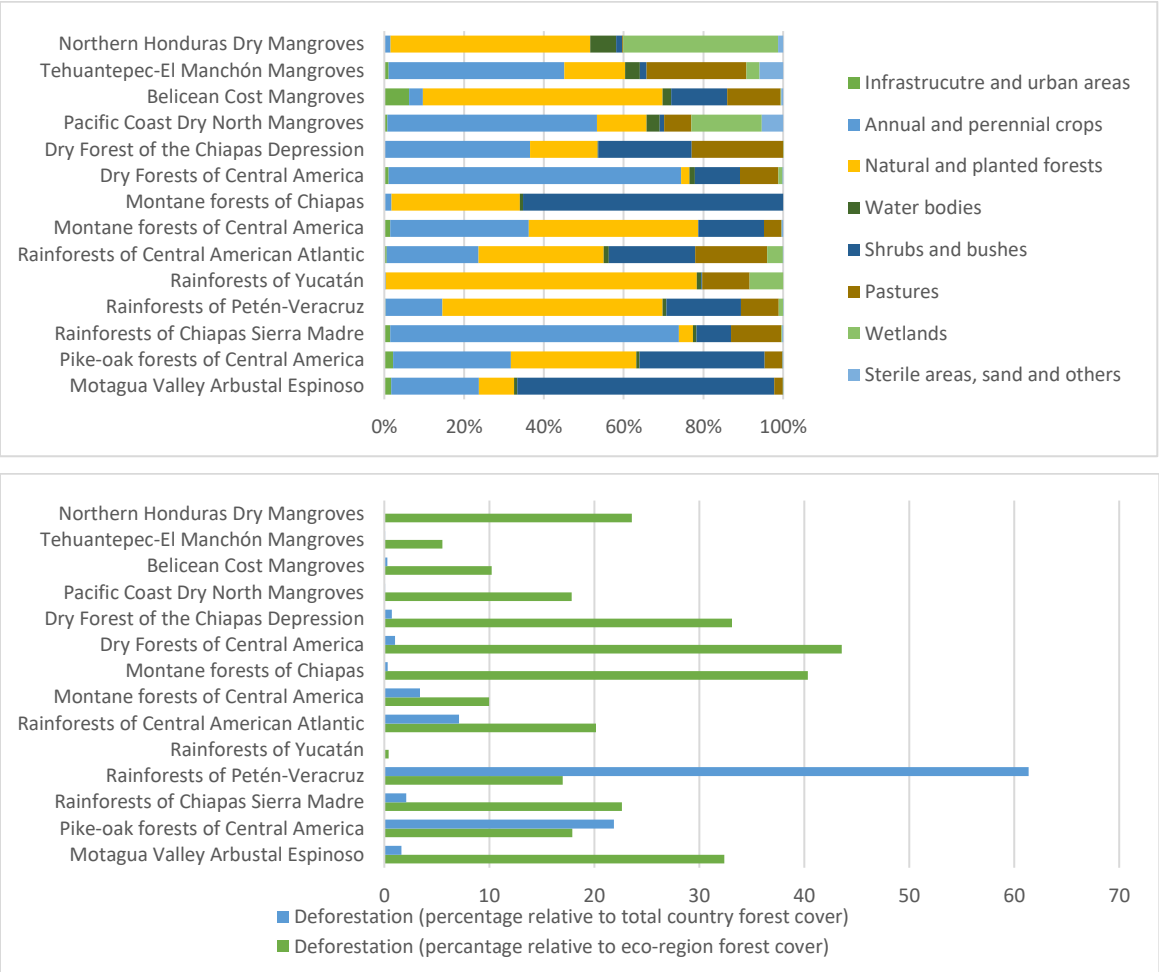
[36] The agriculture account is a framework describing the relationship between the environment and agricultural production. The agriculture account seeks to understand the contribution of the natural environment to agricultural activities. Inputs to production (land, nutrients, water, energy) as well as the potential impacts these activities have on the environment were recorded.

[37] In the compilation of the Ecosystem Accounts, the 2012 SEEA EEA framework was used. Three types of ecosystem accounts were produced: the ecosystem extent; ecosystem condition, and the supply and use of ecosystem services. These accounts were all in physical terms. A first approximation of the supply and use of ecosystem services in monetary terms was also produced, as well as compiling some valuation case studies carried out in Guatemala on ecosystem services and assets.

and bushes at 31%. In Guatemala, there are 14 of these regions and two of them represent 71% of the country's territory: Rainforests of Petén-Veracruz (44%) and Pine-Oak forests of Central América (27%). Distribution of land uses within each eco-region highly varied, with over 30% of the total area used for perennial and annual crops in 7 of the 14 regions.

Agriculture areas expanded at the expense of forests.[38] Guatemala lost 880,220 hectares of forest cover between 1991 to 2203, a deforestation rate of 17.3%, where 73% converted to agricultural land (Figure 17). About 20% converted to perennial crops and pasture land each, and 45% converted to shrubs and bushes. The main affected regions, which account for 82% of total deforestation, were the Rainforests of Petén-Veracruz with 540,215 hectares of forest cover loss, and the Pine-Oak Forests of Central America with 192,628 hectares. However, the most alarming rate of deforestation (44%) was seen in the Dry Forests of Central America region alone. At this rate, total loss of forest cover would occur in less than 20 years.

Figure 17. a) Land use in eco-regions; b) Evolution of deforestation in Guatemala's eco-regions
a) Period: 2003, percent; b) Period: 1991 to 2003, percentage relative to forest cover



[38] To achieve this, maps of forest cover built from satellite images were compared. These maps required the work of several technicians from several institutions working together and were only published every few years. At the time of this comparison, only maps from 1991 and 2003 were available.

Nine out of fourteen eco-regions do not possess the minimum connectivity and fragment size requires to guarantee the provision of environmental services. The eco-regions with less than 10% of forest cover showed the most ecological integrity problems, all of them located in the Pacific Basin. However, there were three regions with fragments large enough to guarantee a minimum ecological integrity, with a surface area of 1.4 million hectares, equivalent to 13% of the country's total area.

Economic costs regarding environmental degradation, such as the ability of forests to control erosion and their capacity to store carbon were equivalent to Q2,919.4 million (~US$374.3 million) between 1991 and 2003. Deforestation in various regions resulted in the loss of 15 million tons of soil in form of erosion, equivalent to Q1,150 million (~ US$147.4 million). The estimates were based on the loss of macro-nutrients (nitrogen, phosphor, and potassium) in every ton of eroded soil, depending to its category. As a consequence of forest cover loss, 368,622,243 tons of CO_2 were released into the atmosphere, with a total cost of Q.1,769.4 million (~ US$226.8 million) at international carbon market prices. Of these, 85% attributed to the loss of forest cover in the Rainforests of Petén-Veracruz and the Pine-Oak Forests of Central America alone.

4.3. Energy Account[39]

The biggest source of energy obtained directly from the environment in Guatemala was biomass (83%), in form of fuelwood (90%) for domestic use, and sugarcane bagasse (10%) as input for electricity generation. The second most important source of energy was coal, mostly imported, used to generate electricity. Hydraulic and geothermal energy were also produced with around 20,534 terajoules (TJ) in 2006. Crude oil and natural gas were produced in some regions, nearly all of which were exported.

A total of 483,947.3 TJ of energy was available to the Guatemalan economy in 2006. The highest consumers of energy were households (47%), slightly surpassing the industry sector (46%). Within the industry sector, the largest consumption of energy (all types) was for the production and distribution of electric power with a total of 61,594 TJ (27% of total) in 2006.

The total human contribution to greenhouse gas emissions (GHG) from the combustion of different energy sources in Guatemala accounted to 45.6 million carbon dioxide metric tons equivalent.[40] Among the top emitters, emissions from the production and distribution of electricity was more than double that of other industries. This was consistent with the high use of fossil fuels in the production of electricity, see Figure 18.[41] The second biggest emitters of GHG were bread producers, mainly due to the intense use of fuelwood.[42] Lastly, due to the intense use of different fuels, the transportation industry was also a relevant emitter of GHG in this context. Households emissions were mainly due to fuelwood, with a considerable use of gasoline.

[39] The energy flow account measured energy supply and use by the different sectors in the economy. This framework allows us to understand the intricate relationship between the environment and economy in terms of energy resources, at the same time as qualifying the emissions that resulted from the combustion of different types of energy sources. The energy account was updated until 2012 and flow charts show physical and monetary use terms. The update to the physical flows for the years 2001 to 2010 was based on the MEM's energy balances and related analysis.

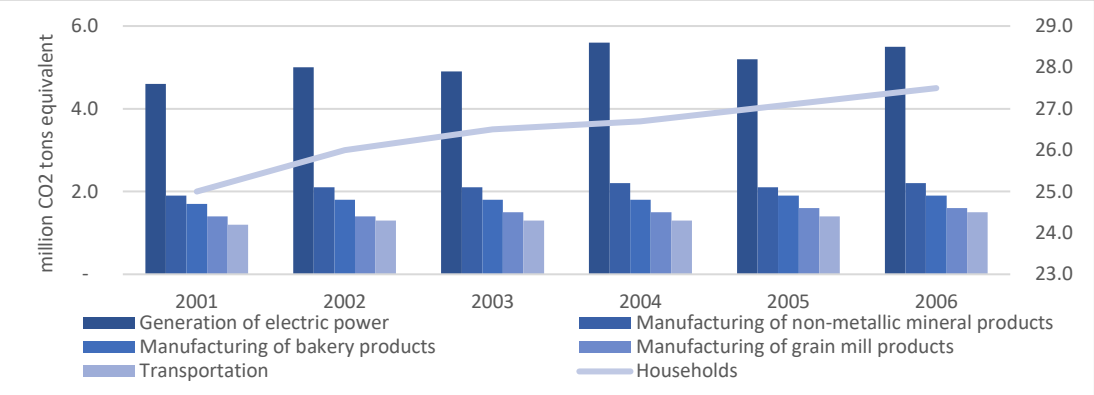
[40] This was less than 1% of total world emissions. Although, this could carry financial consequences or opportunities regarding international treaties on the matter and we need to track its performance.

[41] The figure shows the greenhouse gas emissions of the top five emitting industries on the left of the vertical axis with bars and those of households on the right of the vertical axis with a line.

[42] In a GHG inventory (those advocated by the Inter-Governmental Panel on Climate Change) emissions from biomass do not count toward the total emissions and were left as "memorandum items" to avoid double counting. In the supply and use accounting structure of the SEEA, they were included. If fuelwood and bagasse were excluded, bakeries and mills would exit this list and cement production and retail trade would replace them.

Figure 18. Distribution of emissions among different economic sectors

Period: 2001-2006, CO_2 ton equivalent



Electricity generation sector required 14.2 TJ for every million quetzals (GTQ) that it contributes to GDP, manufacturing sector - 2.9 TJ for every million GTQ, and trade activities - below 1TJ for every million GTQ of value added. Some industries needed less energy to produce their contribution to GDP than others because of their varying reliance on energy to their production processes, for example retail trade requires less than cement production. For this reason, care must be taken with comparisons of energy intensities between industries. In the case of Guatemala, ceramic production has the highest level of energy use and showed erratic behavior over time (2001 to 2006), energy intensity for bread production decreased, whereas transportation and general mills had a more stable energy intensity. This is because technology is less often replaced in certain activities.

4.4. Fisheries Account[43]

Aquaculture activities amplified and reached the same productivity as catchments between 2001 to 2016. The fish production experienced a drastic fall between 2001 and 2004, because of the collapse in fishing on the Pacific coast. From 2001 to 2004, fish production was reduced from 39,220 to 16,537 metric tons., A rebound of the national production was driven starting in 2005 mainly by the development of aquacultures. The results of updating the fishery and aquaculture resource account showed that the supply of shrimp from farming exceeds the supply of catchments.

By 2012, the production of fishery and aquaculture resources amounted to 37,734 metric tons, while imports represented an additional 2,765 metric tons. Together, they made up a total of 40,499 tons of fish products that participated in the national economy, of which 38.5% corresponded to shrimp, 61.5% of various kinds of fish, and the remaining 0.4% to other aquatic products.

Exports accounted for more than half of fishery and aquaculture products, primarily comprised of shrimp and tuna. This dynamic of international trade was undoubtedly one of the causes that has motivated the sustainable development of the production and cultivation of crustacean in the country.

Households demanded around 11,500 metric tons of fish in 2016, 28% of total use. The main products consumed were shrimp, freshwater fish and tilapia. About 20% of the fish supply was for intermediate

[43] The fisheries and aquaculture account present a description of the interrelationships that exist between the Guatemalan economy and the country's fishery and aquaculture resources. The account organized and systematized physical information related to these resources and linked it with economic information, using the SEEA framework. Data presented physical information up to 2016 and monetary and related information up to 2012. Since the Guatemalan economic accounts were not available in a detailed format as Guatemala's SNA, they were updated based on the 2008 manual with 2013 as the reference year.

consumption. The main activities that demanded these products were for the elaboration and conservation of fish and fish products; and restaurants, bars and canteens.

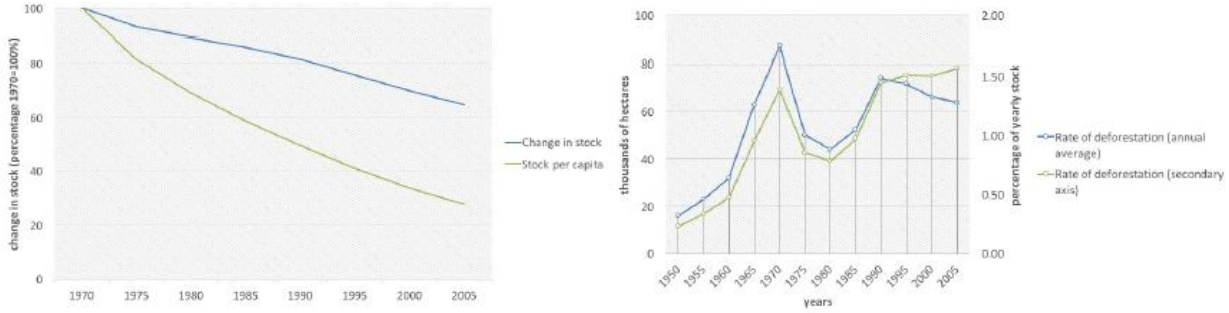
Commercial fishing and other related activities were a source of work for at least 14,113 people.[44] This total was composed mostly of artisanal fishermen (12,400), operators of seafood processing plants (960), industrial fishermen (508) and product marketers (245). For many families in poverty and extreme poverty conditions, these resources are also a fundamental source of food and livelihood**.** A relevant finding of the account was that subsistence fishing and a large part of artisanal fishing were not incorporated into national statistics, so the role that these resources play in the livelihoods of highly vulnerable populations is rendered invisible. This is due to the absence of regular records for these activities. The collection of data related to fishing happens almost exclusively when it is requested by specific projects that are generally financed by international entities and are measurements that reveal the situation at specific moments in time but that do not reflect the behavior over a period.

4.5. Forestry Account[45]

Guatemala lost 40% of forest cover between 1970 to 2005.[46] The availability of forests per capita has dropped as a result of high population growth rates (Figure 19). Deforestation rates stabilized between 60,000 and 70,000 hectares per year. This represented an annual stock loss of about 1.5% per year. This rate was very high, compared to 1970s when population reallocation policies pushed for aggressive conversion of forest land to agricultural land.

Figure 19. (a) Forest change (%); (b) Deforestation rates

Period: 1950-2005. Unit: (thousands of hectares and % of stock relative to previous year)



Uncontrolled logging and selective fuelwood extraction were two of the main reasons for forest reduction. The forest account estimated that more than 95% of forest product flows in the country (30.7 million m^3) occurred outside the control of the forest government authorities (National Institute of Forests, INAB, and the National Council for Protected Areas, CONAP). Forest accounting estimated that 76% of uncontrolled forest use was due to fuelwood extraction and 24% to timber extraction. Up to two thirds of all timber processed by wood processing industries was estimated to come from uncontrolled sources.

[44] According to the Fisheries and Aquaculture Regulations in Guatemala (UNIPESCA, 2005)

[45] The process for updating the forest account was developed with the INAB with the express purpose of institutionalizing the forest account. Information from databases on the forestry sector and the Guatemalan economy was compiled and combined with information on activities that were linked to the goods and services derived from the forest. The forest account is an analytical framework that allows a detailed description of the interrelations between the forest and the economy. While considering the supply and use of goods and services provided by the forest to the Guatemalan economy, the objective was to reveal the impact that economic processes have on the forest as well as the overall contribution of the forest to the economy.

[46] To understand the status of forests in Guatemala, the change of forest land stock (starting base from 1970) and an indicator of this change relative to population (forest land stock per capita) were developed.

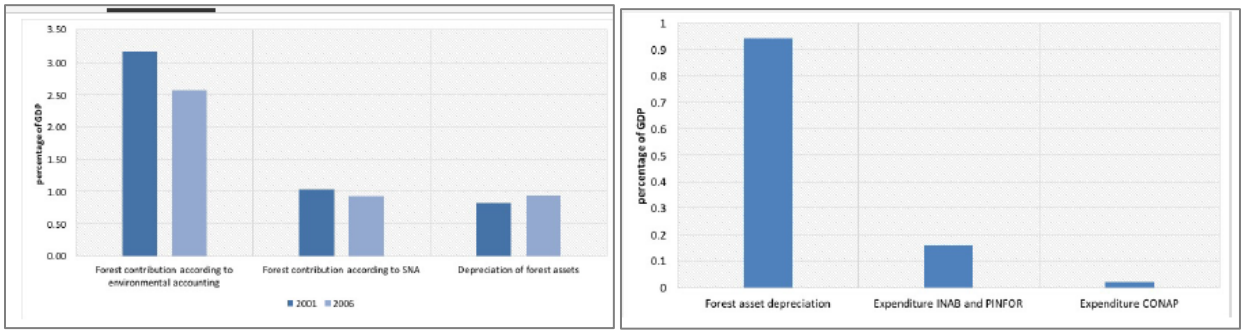
Between 2001 to 2006, the value of forests increased from 56,351.9 million quetzals (GTQ) to 83,467 million. This behavior is more consistent with non-renewables than with renewable resources and hints that forests might be used unsustainably. Under sustainable practices, forest regeneration should provide constant availability at stable prices. Even when valuating at constant prices of 2001, monetary value of forests increased, despite the reduction of forest stock (~ 76 million m^3 between 2001 and 2006). If forest growth and reduction were compared, due to either controlled or uncontrolled logging, it is easy to see that the former does not compensate for the latter. For example, in 2006 this resulted in the loss (or net stock variation) of GTQ2,076 million. On the other hand, uncontrolled logging represented more than GTQ 2 billion, exceeding the value of controlled logging by far.

Households were the largest users of forest products, 22.6 million m^3, about 67% of total national consumption. Most corresponded to fuelwood use (92%), and the remainder was the saw mill industry and production of furniture. In monetary terms, primary output contributes 34% to the total supply of wood products, mostly logging products and fuelwood. Secondary output, consisting of sawn wood and furniture were responsible for the largest numbers in total supply. In 2006, their value reached GTQ 8.2 billion, corresponding to a little over 40% of total supply of forest products.

One important finding of the forest account was the contribution of forest products to the national economy, 3.15% and 2.57% for 2001 and 2006, respectively (Figure 20). While normal GDP measured attribute only 1.02% and 0.93% in the same years, respectively. Another important finding was that the value of resource depreciation was equivalent to 0.9% of GDP for 2006. This implies that if the forestry sector is considered by itself, total contribution to the economy would be zero in practical terms. When adjusting GDP for the depreciation of forests, a small reduction of about 1% can be seen, which is evidence of an over-estimation of the true performance of the economy.

Figure 20. a) Contribution of forests to the economy; b) Comparison between depreciation of forest resources, protection and expenditure

a) Period: 2001 and 2006, percentage



NCA and Policy Dialogue Going Forward

5.1. Policy uptake of NCA

Since its inception, SEEA implementation was designed to ensure its institutionalization. Today the SEEA and account production is endorsed by the INE and the accounts are categorized as part of the official statistics. To implement and monitor account production, a steering committee (SC) and technical committees (TCs) were established. The TCs for each thematic account (water, energy and emissions, forest, land and ecosystems, fisheries and aquaculture, subsoil resources, waste, and environmental expenditures and transactions) were functional for a while, but the activities dwindled as demand for accounting information was slow to emerge.

The accounts have contributed to the policy dialogue in different ways:

- Forest accounts determined the real contribution of forests to the economy was 2.5% of GDP versus the current 1% that was recorded in the national accounts.[47] Forest stocks were declining at a rate greater than 1.5%, with 96% of timber extractions uncontrolled. These results were a key input in the new forest management strategy and the efforts to curb uncontrolled logging.
- From the energy account, the Government identified the highest energy consumption were from burning wood for fuel, leading to increased carbon emissions.[48] The results were instrumental in opening a dialogue on emission controls for greenhouse gases in climate change policies and developing strategies (efficient use of fuel wood while maintaining forest productivity and other environmental and community services that forests provide).
- The water account included national and regional level information and inspired analysis of specific regions.[49] For the metropolitan area of Guatemala City, the accounts helped create the model for estimating household water use and to design a water fund that is currently functioning.
- The land accounts provided information about the relationship between land use, land cover and agricultural production. The land accounts informed the 'Initiative for the Integrated Rural Development Act',[50] which is one of the most important bills to achieve sustainable development over the next decade but has not passed Congress yet.
- The public expenditure accounts showed big variations on expenditures over the period 2006-2010, ranging from US$176.5 million to US$256.5 million.[51] The expenditure account was a key input in the design of the Green Fiscal Strategy set by the Ministry of Finances in 2018.

The opportunity and use of the accounts in Guatemala have begun to travel from a production that prioritized the supply of data to a production driven from the demand and governmental requirements of information. In this sense, the Guatemalan National Development Plan and the Planning Agency (SEGEPLAN) has initiated and led a process of reflection to identify indicators derived from SEEA to follow up the 10 country priorities, the National Development Plan and the Sustainable Development Goals (SDGs).[52] In this context, the compilation of those accounts that ensure the production of key indicators in a systematic and regular way has been prioritized. Among these are some accounts of forest, energy, agriculture, ecosystems, water and expenses and environmental transactions. In general terms, the process seeks to orient the compilation of the SEEA in such a way as to provide timely information for the public policy cycle: i) identification and

[47] Guatemala Forest Account (INE, 2001-2013)
[48] Guatemala Energy and Emissions Account (INE, 2001-2013)
[49] Guatemala Water Account (INE, 2001-2013)
[50] Guatemala Land Account (INE, 2001-2013)
[51] Guatemala Public Expenditure Account (INE, 2001-2013)
[52] (SEGEPLAN, 2018)

understanding of the main environmental problems, II) formulation, valuation and determination of policy alternatives, iii) implementation of policies and IV) follow-up and evaluation. In the last few years, the SEEA has fed the main reports and policy instruments related to the environment generated in Guatemala. Table 3 shows some of the most recent government documents in which the system's information has contributed to the basis of the approaches.

Table 3. Some government documents and public policy instruments using the SCAE

Entity/Dependency	Document	Description/Download
Ministry of Public Finances	Environmental fiscal Strategy 2018	Establishes strategic lines for the implementation of Incentives e Taxes to reduce and manage Environmental impacts. http://www.minfin.gob.gt/index.php/acuerdos-ministeriales/2-uncategorised/3502-estrategia-fiscal-verde
National Institute of Statistics	Environmental statistical Compendium	Provides information on the environmental situation in Guatemala. Https://www.ine.gob.gt/index.php/estadisticas-continuas/estadisticas-ambientales
Ministry of Environment and Natural Resources	Environmental report of the State of Guatemala	Monitoring and evaluation of the situation and environmental trends in Guatemala. Http://www.marn.gob.gt/Multimedios/8879.pdf
	Base Document of the environmental pact in Guatemala 2016-2020	Proposes the general guidelines for the achievement of an environmental pact in Guatemala, considering the public sector, private sector and civil society. Http://www.marn.gob.gt/Multimedios/2547.pdf
Climate Change Science System	First report on climate change knowledge assessment in Guatemala	Systematizes the knowledge produced in Guatemala on climate change and its probable repercussions for the country. Published in 2019 Https://icc.org.gt/wp-content/uploads/2018/06/Infor_reporte_ESP_2018-05-28.pdf

5.2. Looking into the future: Mainstreaming NCA in development policy

Many different elements could help integrate environmental considerations into national economic and development policies in the medium to long-term and strengthen institutional capacity in priority areas in Guatemala. NCA can also help by providing indicators to inform the public policy cycle, particularly if policy objectives are clearly established. NCA can help improve the regular monitoring and periodic review of policy. NCA can also be used to track regional plans or policies, sectoral policies, and the implementation of laws related to environment and natural resources (such as the recently adopted climate change law), the execution of the Public Budget; and the implementation of National Development Plan K'atun. NCA and related analysis can serve as the basis for developing methodological and analytical tools that facilitate the assessment of public projects and programs related to natural resources and the environment. There are several opportunities to incorporate information from NCA in the formulation of specific public policies in Guatemala and these include to:

- **Improve the targeting and implementation of forestry programs to ensure the conservation and recovery of strategic areas and the integrated management of water resources:** there is not enough information to assess the impact of national forestry programs to attain its own and national targets. PANCC considers the strategic role that forests must play in adapting to climate change. Among the strategic actions prioritized in the plan are: i) the restoration of ecosystems and strategic areas for the provision of ecosystem services, and ii) the maintenance and definition of biological corridors that enhance connectivity of ecosystems. These actions are considered in sectoral forestry strategies as the Forest Landscape Restoration Strategy, the Forestry Incentive Programs (PINFOR), and Incentive Program for Small Holders of Forest or Agro-Forest Land (PINPEP). In addition, the need for information systems to monitor and evaluate the effectiveness of the various forest strategies is required. Both the forest account and the ecosystem account provide feedback on forest policy instruments and protected areas.
- **Increase efforts to maintain forest coverage of strategic areas for ecological connectivity and ecosystem services provision**: there is international consensus that healthy and connected

ecosystems have a greater capacity to maintain their structure and functions while facing o changing climatic conditions.

- Implement effective strategies to Improve the water use efficiency in the different industries of the economy, in particular in the agricultural sector: while water will become an increasingly scarce resource and it is essential to take actions that promote its more efficient use.
- Assess international trade using environmental criteria. Guatemala's exports depend heavily on natural capital. Agricultural commodities (coffee, bananas, cardamom, sugar, palm oil), are some of the highest users of natural resources such as land, water and nutrients. These exports have also gained importance over time, from 30% of the value of exports in 2002 to 40% in 2017. The value of mining exports has also increased. The production and export of these goods is directly linked to the environment and went from representing 35% of total exported value in 2002, to more than 50% in 2017. These data are important as the costs linked to resources depletion and environmental degradation are not internalized in the prices of the products nor reflected in GDP.
- Increase actions to stop the dynamics of depletion of natural capital. Both the forest and the experimental ecosystem accounts show large levels of depletion and loss of forest cover between 2001-2014. The very humid montane tropical forest was the only zone to show and increase the depletion of all other forest types was due to extraction of resources at levels higher than which is regenerated. The forest account also identifies that logging takes place outside of the government control and uncontrolled logging accounts for more than 90% of the total. In this case, it is necessary to generate effective strategies to stop deforestation and the consequent loss of goods and services provided by the forests.
- Implement strategies to enhance the use of ecosystem services to support food security and nutrition. The experimental ecosystem account identified that natural areas are providing a set of supporting services for food security and nutrition. the main services provided by protected areas in Guatemala. Among these are several services directly linked to food (capture of plants and wild terrestrial and aquatic animals) and food security (as in the case of medicinal plants and water). It is also important to note that these protected areas also provide fodder for livestock or land for cultivation (both for plants and for aquaculture).
- Implement water management interventions to reduce food vulnerability. The agriculture account shows that the production of food depends on rain. Small producers are the most vulnerable to rainfall changes and food insecurity. Production by small producers depends, among others, on a predictable rainfall regime. Both, water shortages and intense precipitations had negative impacts on food production. Production of corn and beans, where 90% of small producers are located, account for 48% of the rainwater used in rainfed agriculture and is not irrigated.
- Improve strategies for the sustainable us of firewood. Both the forest account and energy account show that firewood is the main source of energy used in Guatemala. Around 30 million m^3 of wood resources are used per year for energy production, and that in the rural area it is the main source of energy for more than 60% of households. Firewood is used for cooking and heating. In rural areas, it plays an important role to boil water.
- Improve sustainable management of natural capital to support food security. The fisheries and aquaculture account show that unsustainable management of natural resources can cause major problems both in terms of production and in terms of food and nutrition security. It is important to develop a system to monitor food security of vulnerable populations related to these resources.

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