FINAL REPORT OF PROECOSERV TECHNICAL CONSULTANCY 2

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Environmentally adjusted National Accounts for Trinidad and Tobago's sustainable future

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Contents

LIST OF ACRONYMS

CICES	Common international Classification of Ecosystem services
CSO	Central stastical office
EAGDP	Environmetnally adjusted GDP
EANA	Environmentally adjusted national accounts
EMA	Environmental Management Authority
ESP	the Ecosystem Services Partnership
EVES	Economic Valuation of Ecosystem Services
EVRI	Environmental Valuation Resource inventory
FAO	Food and Agriculture Organziation
FRA	Forest Resource Assessment
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information Systems
IPCC	Intergovernmental Panel on Climate Change
MA	Millennium Assessment
MEA	Millennium Ecosystem Assessment
MPE	Ministry of Planning and the Economy
ProEcoServ	Project for Ecosystem Services
SCC	Social Cost of Carbon
SEEA	System of Environmental-Economic Accounts
SIDS	Small Island Developing States
SNA	System of National Accounts
SWOT	Strengths Weaknesses Opportunities Threats
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
TTD	Trinidad and Tobago Dollars
UNESCAP	United Nations Economic and Social Commision for Asia and the Pacicfic
UNSD	United Nations Statistical Division
USD	United States dollars
UWI	the University of the West Indies
WAVES	Wealth accounting and Valuation of ecosystem Services
WB	World Bank
WRA	Water Resources Agency

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ENVIRONMENTALLY ADJUSTED NATIONAL ACCOUNTS FOR MESURING AND MONITORING TRINIDAD AND TOBAGOS SUTAINABLE FUTURE

INTRODUCTION

The services and goods produced from nature, also known as ecosystem services, are vital to human well being. Yet we see a continued decline in the health and quality of numerous ecosystems and losses of biodiversity globally and locally. This conflict can be partially attributed to the poor inclusion thus far of the value of ecosystem services in to decision making process at all scales , as the economic benefits of nature and the costs of its degradation are often excluded from such calculations. It is therefore necessary to explore novel methods of maximising economic returns while simultaneously maximising the delivery of these services – particularly in the developing world and in small island developing states. The GEF-sponsored "Project for Ecosystem Services" aims to provide a number of 'decision support tools' (ecosystem services value maps and environmentally adjusted national accounts) to policy makers with the aim of mainstreaming ecosystem services into the development planning of Trinidad and Tobago's future.

The United nation System of National Accounts (SNA) which produces the economic aggregate of Gross domestic product is one of the most familiar and influential economic and development indicators not only to policy and decision-makers but also to the general public (Boyd, 2007). However, these and other indicators do not account for a wide variety of benefits that ecosystem services bring to human well being, as well as damages caused by pollution associated with economic activities (Smith, 2007). They can also misrepresent income earned from depletable renewable resources (Hecht, 2007)(United Nations, 2003).Due to these shortcomings, significant effort is being placed in international research and policy circles on the generation of new and/or modified macroeconomic indicators in order to incorporate the true value of nature into the day to day decisions of policymakers and development planners.

One such effort is the system of Environmentally Adjusted National Accounts (EANA). These represent complementary sets of accounts to the SNA, incorporating the considerations of ecosystem degradation , ecosystem services and expenditure spent on environmental protection in order to reflect in a more

accurate manner the impact economic activities have on long term sustainability. EANA present a great opportunity to local planning policymakers in a variety of institutions and at a number of decision-making levels for enhancing the sustainability of ecosystem management. A number of uses of these accounts are, but not limited to; an improved national understanding of the value of ecosystems and their services, and an enhanced monitoring and evaluation of environmental initiatives/policies and 'targeted' environmental spending through cost benefit analyses.

EANA and economic valuation are relatively low cost , high impact tools for mainstreaming of ecosystem services into development planning as they translate complex and often incomparable environmental statistics and research into the "economic" language that dominates policymaking. Ideally, with this methodology, the definition of ecosystems as key developmental assets will suggest less conflict between economic growth and sustainable management of local ecosystems.

This report outlines a pilot study of the valuation of ecosystem services and the incorporation of these values into environmentally adjusted national accounts, with a focus on the Northern Range ecosystem of Trinidad. The United Nations Statistic Division developed System of Economic and Environmental Accounts (SEEA) is used as the primary guidance framework for the development of EANA in the context of ProEcoServ Trinidad and Tobago and it is necessary to build partnerships with the various global efforts in developing robust EANA methods such as the World Bank Wealth Accounting for the Valuation of Ecosystem Services (WAVES) partnership and the SEEA network.

In addition to fostering collaboration with cutting edge international EANA efforts, maintaining and expanding where possible the partnerships with final users of EANA such as the Ministry of Planning and Sustainable Development is essential for uptake and preservation of the ProEcoServ research and outputs.

1. WHAT ARE ECOSYSTEM SERVICES?

The Millennium Ecosystem Assessment forwarded a new conceptual framework for the identification and assessment of the relationship between the ecosystems and human well being. Core to this conceptual framework was the concept of Ecosystem services defined as;

" …*the benefits people obtain from ecosystems*"

As Figure 1 indicates, the MEA forwarded four (4) key types or classes of ecosystem services, defined by their links to human welling being: Provisioning, Regulating, Cultural, and Supporting Services.

Provisioning services," …are the products or goods people receive from ecosystems" (MEA, 2005) for final consumption as inputs into other productive activates or for investment. These services are typically hold some physical form and may be marked as products for exchange sale such as food, timber, water and fibers.

Regulating services "… are the benefits humans derive from the regulation of ecosystem processes' (MEA, 2005). Essentially these services regulate processes which enhance human being in a less tangible way than provisioning services such as water purification and climate regulation.

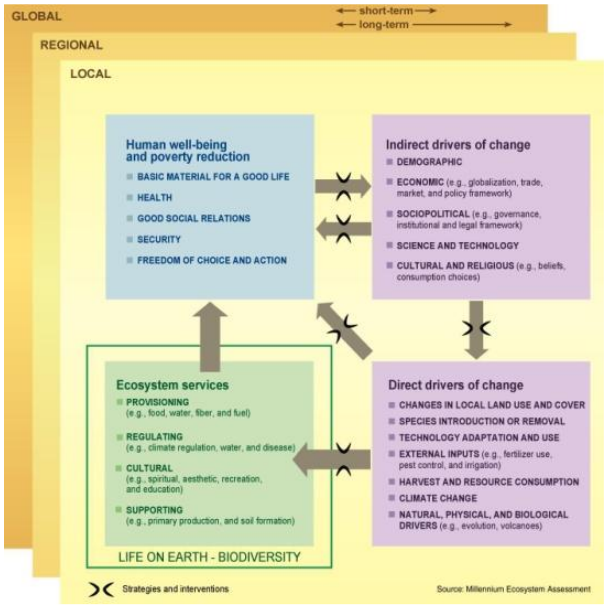

FIGURE 1 MA CONCEPTUAL FRAMEWORK LINKING ECOSYSTEM SERVICES AND HUMAN WELL BEING (MEA, 2005)

Cultural services, "…are the non material benefits people obtain form ecosystems through, spiritual enrichment, cognitive development, reflection and recreation" (MEA, 2005). The importance of spiritual/religious cultural services in the northern range is extremely limited, however numerous domestic and to a lesser extent international tourist attractions exist.

Supporting services, "…are those services necessary for the production of all other ecosystem services" (MEA, 2005). Each of the services described above requires a mix of numerous supporting services in order to function efficiently and thus it is nearly impossible to construct even a remotely complete list of regulating services, especially as there are some supporting services which are not even identified by the scientific community. For illustrative purposes, examples of supporting services include; seed dispersal, primary production and nutrient cycling.

By focusing on the links between ecosystem assets and the benefits they bring to human well being, instead of focusing solely on the assets themselves, this thinking has had a significant impact on the methodologies utilized within the academic and policy settings to identify, assess and quantify the interaction between humans and the natural environment.

1.1 Classification of Ecosystem services

Since this initial framework of classifying ecosystem services was proposed in 2005, significant debate has continued in the scientific community on the ways in which specific services and goods were grouped and classified as well as other typologies to deal with some of the shortcoming of the MEA (Fisher, 2008) (Wallace, 2008). The emergence of new and or modified classification systems has complicated the comparison between studies and made the integration of ecosystem service assessments into other data sets such as national accounts more difficult. To deal with these issues a common international classification of ecosystem services has been proposed to facilitate the translation of statistical information between applications and to prepare for the forthcoming revision of the 2003 SEEA (Haines-Young & Potschin, 2011).To ensure compatibility of results and to facilitate possible application of the Revised SEEA, this report utilizes the ecosystem service classification methodology of the CICES which proposes various service groups and services types (Table 1).

TABLE 1 CICES PROPOSED CLASSIFICATION OF ECOSYSTEM SERVICES

Theme	Class	Group
Provisioning	Nutrition	Terrestrial plant and animal foodstuffs
		Freshwater plant and animal foodstuffs
		Marine plant and animal foodstuffs
		Potable water
	Materials	Biotic materials
		Abiotic materials
	Energy	Renewable biofuels
		Renewable abiotic energy sources
Regulation and Maintenance	Regulation of wastes	Bioremediation
		Dilution and sequestration
	Flow regulation	Air flow regulation
		Water flow regulation
		Mass flow regulation
	Regulation of physical environment	Atmospheric regulation
		Water quality regulation
		Pedogenesis and soil quality regulation
	Regulation of biotic environment	Lifecycle maintenance & habitat protection
		Pest and disease control
		Gene pool protection
Cultural	Symbolic	Aesthetic, Heritage
		Religious and spiritual
	Intellectual and Experiential	Recreation and community activities
		Information & knowledge

1.2. Ecosystem Services provided by the Study Sites of the ProEcoServ Project.

In Trinidad and Tobago the ProEcoServ focuses on three study sites, the Tobago Coral reefs, The Nariva Swamp, and the Eastern Northern range of Trinidad. Here we briefly describe each site and some of the services provided.

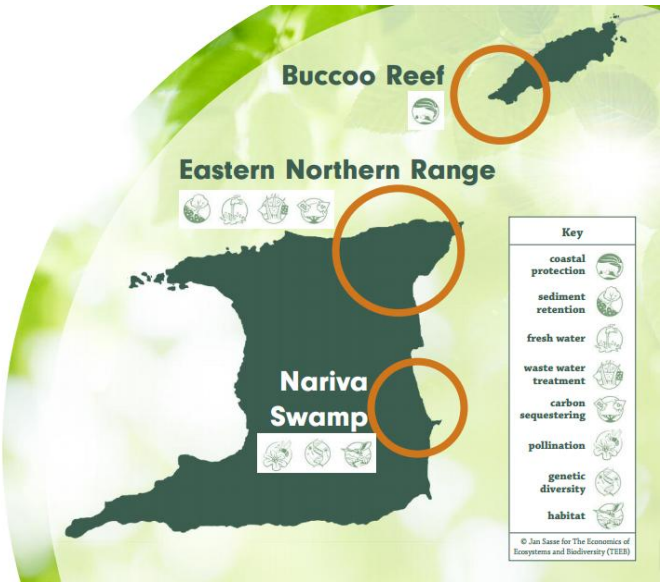

FIGURE 2 PROJECT SITES OF PROECOSERV TRINIDAD AND TOBAGO

The Buccoo Reef/Bon Accord complex is characterized by five insular emergent fringing reefs (Buccoo Reef) (Laydoo, 1991) to the north protecting a shallow sandy lagoon with a patchy distribution of coral communities, and the mangrove-fringed Bon Accord Lagoon in which a sea grass community is present. The Buccoo Reef and Bon Accord Lagoon system is located at the south-western end of the island of Tobago. The complex represents the best example of contiguous reef, sea grass, and mangrove wetland in Trinidad and Tobago. As an ecosystem, coral reefs are known to provide a host of services ranging from fisheries nurseries to provision of biochemical compounds for medicine (Moberg & Folke, 1999). In the context of Tobago, this project has chosen to focus on the key services of Coastal Erosion protection , Carbon sequestration (Blue carbon) and Aesthetic quality or landscape character.

The Northern Range, covering approximately 25% of Trinidad's land mass presents the most dominant relief feature on the island and is covered by a variety of tropical forests, principally seasonal evergreen tropical forest (Environmental Management Authority , 2004). The watershed areas of this range are the most important nationally in terms of freshwater supply as 60 to 80% of surface freshwater sources exploited in Trinidad and Tobago are supplied by the range (Water Resources

Agency , 2002). This forest range also provides habitat area to countless species and produces commercial timber resources. The services of Erosion protection, Carbon sequestration, crop production and Aesthetic Quality are being studied by this project.

The Nariva Swamp, covering approximately 90 km^2 in a 450 km^2 catchment area (Bacon & Kenny, 1979)), is the largest freshwater wetland in the country. It lies at the eastern end of the Naparima Fold Belt immediately south of the Central Range. A sand barrier covered largely by coconut trees separates the swamp from the ocean and prevents salinization; however, some degree of seepage into the swamp does occur. The swamp additionally receives water from several rivers and streams from the Central Range (Carbonell & Nathai-Gyan, 2005). This particular swamp has been designated as a wetland of international importance under the Ramsar Convention in 1992. The ecosystem services targeted at this site are Pollination, Biodiversity (habitat quality and Rarity), Crop Production, Carbon Sequestration, and Climate Gas regulation.

2. HOW ECOSYSTEM SERVICES ARE VALUED

2.1 Linking Ecosystems and economic value conceptually

While the conceptual framework of the Millennium Ecosystem Assessment links biodiversity and natural landscapes to human well being, expressing the benefits that we receive from nature in monetary terms is a vital additional step for the effective incorporation of Ecosystem services into decision-making at all levels.

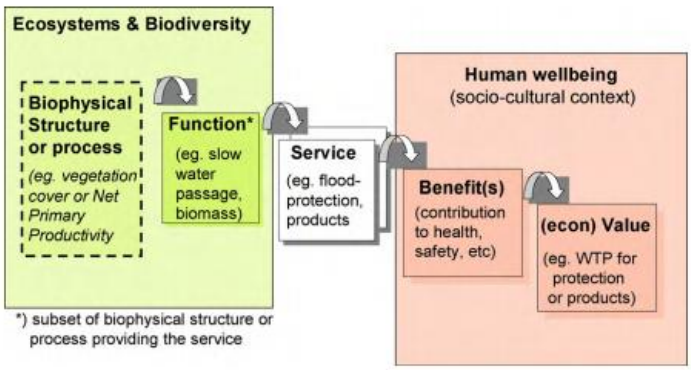

TABLE 2 A FRAMEWORK FOR LINKING HUMAN WELL BEING AND ECOSYSTEM SERVICES (DE GROOT, ALKEMADE, BRATT, HEIN, & WILLEMEN, 2008)

In order to arrive at monetary figures for the value of ecosystems, a number of links must be articulated. Figure 2illustrates the pathway linking a biophysical structure such as an ecosystem to human well being, finally arriving at an economic value. In order to arrive at robust monetary estimates of the value of services, the links between ecosystem functions, services and benefits must be well understood and in most cases quantitatively defined. As such one of the first steps in the monetization of service values is the quantification of the relationship between landscapes and the delivery of ecosystem services. For example in order to monetize the regulation of erosion provided by a forest , the relationship between various forest and landscape characteristics such as vegetation type , slope , soil type and the volume of erosion prevented must ideally be quantitatively defined by an equation or set of equations. These equations provide the answer to the question "How much of this service is being delivered?". It must then be understood how the delivery of this service enhances human well being, and if it does, which stakeholder groups benefit from this service. This provides an economist with the raw material necessary to determine the quantity of benefits provided to human well being which ideally may be converted into an economic and or monetary value.

Before illustrating the variety of methods that can be used to arrive at a dollar value for ecosystem services, the various concepts of value and systems linking nature to value must be explored. Within the economic literature two main values are articulated, **use values** and **non-use values** explaining the value of services depending on the way they are incorporated into the formal economy. Use values are simply the goods and services which can be used by the economy as final goods or as a resource in the production of final good. This value can be further broken down into direct use values such as fish, timber and food products or indirect use values use values such as purification of water, erosion protection and pollination of crops.

Non-use value essentially describes the value people place on the exisistence of nature, such as the cultural or spiritual values people place on landscapes. Another non use value is the option value or the value placed on having the option of using or enjoying the services of nature in the future. When the use and non use values of an ecosystem are aggregated, we are provided with the Total Economic Value (TEV) of an ecosystem or resource.

2.2. Valuation methodologies [1]

Here we introduce a number of tools used by economist to value ecosystems and their services, with some of the advantages and disadvantages of each method.

Certain ecosystem services are traded with buyers and sellers in existing markets. The **Market price** method, or the use of the prices at which these services are traded in existing markets is the simplest way in which to enumerate the economic value of these services. This method is typically applied to **provisioning services.** Unfortunately many ecosystem services do not have readily observable market prices (TEEB, 2010) and even when a market price is observable, distortions in the market such as subsidies, price regulations and taxes can result in misrepresentation of the value and as such must be accounted for to ensure effective market analysis (TEEB, 2010).

Before using economic valuation tools to arrive at a dollar value for ecosystem service, the following questions should be answered in this order;

1. *What processes are occurring in this ecosystem ?*
2. *What are the Biophysical functions of the ecosystems that support these processes?*
3. *What services are these processes providing to human beings?*
4. *Who is benefitting from these services and how ?*
5. *What Valuation method is most appropriate for these services?*

Market alternatives use indirect market prices adjusted to reflect the delivery of specific service. Of this valuation method, three main types exist;

Replacement cost, which investigates the costs of replacing the services with an appropriate substitute. For example the cost replacing eroded topsoil from northern range forests with topsoil purchased from local markets or the additional cost of filtering silted water from northern range streams due to deforestation. This method is suited to services which have human constructed alternatives, typically **regulating** and **supporting services**.

Damage cost avoided, which looks at the cost of damages that would be caused if protective ecosystem services are removed, or alternatively the damages currently being prevented by the existence of certain ecosystem services.

Production function. This method looks at services which act as an input into production in the economy and the impact of the change in marginal delivery on these services to the production function. This method requires a detailed understanding of not only how these services impact production but how the change in ecosystem quality influences the marginal delivery of ecosystem services.

Where appropriate market prices or market alternative prices don't exist, **Surrogate Markets,** or the study of individuals preferences and actions in similar (surrogate) markets, may be utilized for valuation. Within this valuation grouping, two main methods exist;

The **Hedonic pricing** method looks at price differentials caused by certain environmental characteristics/ services. For example houses near denuded landslip prone areas generally cost less that similar houses in

[1] This section draws on expiations of valuation methodologies developed in the Economics Of ecosystems and Biodiversity TEEB 2010 study available at - http://www.teebweb.org/InformationMaterial/TEEBReports/tabid/1278/Default.aspx

areas with pristine forest and strongly supported slopes. This method is ideally suited to cultural services and in some cases regulating services.

Travel cost method as it suggest uses the costs incurred by visitors to an area to enjoy that area's unique ecosystem service. In principle the greater the value of such service the greater the cost an individual is willing to incur to enjoy the benefits. Like Hedonic pricing this method is generally used for cultural services and in some cases regulating services.

Stated preference investigates individual "willingness to pay" for services which are difficult to quantify and value, typically cultural and spiritual values. Two broad categories of this method exist;

Contingent valuation, which utilizes survey questions and scenarios to extract what an individual may hypothetically pay for the sustained delivery of a service such as an agouti existence.

The **Choice modeling** method also uses surveys and targeted questions but instead of asking what an individual is willing to pay , it presents alternatives situations between which an individual may choose and derives the value of an ecosystem service from the understating of the value of these alternatives.

The **Benefit or Value Transfer** takes values from other valuation study sites termed 'study site' to another site of policy interest termed 'Policy site'. While the transfer of valuation data requires careful consideration due to environmental , social and economic differences between the study site and the policy site , this method has a the major advantage of requiring less data time and expense to produce results. Also value transfer allows for the development of values at a scale which is not possible for primary research.

2.4 Valuation in the Northern Range Context

Table 3 summarises the suggested valuation methods for estimating the economic value of services provided by the various ProEcoServ study sites.

Here ,Here, using the some of the ecosystem services provided by the northern range , we provided illustrative examples of how different valuation methods suit different services. In the case of the Northern range timber resources are actively sold in open markets, both locally and globally, thus the market price method is most appropriate, as the economic value of these resources is reflected in the prices used in markets.

The regulation of mass flow (erosion) and overland flow of rainfall are ecosystem processes that occur within the northern range which contribute to the regulation of flood damage to infrastructure within the hills of the range and downstream areas. This regulating service is best valued by using the damage cost avoided, by analyzing the cost that would incur if the vegetation of the northern range were removed.

The northern range provides a variety of cultural services to residents of and visitors to Trinidad and Tobago. Attractions such as the Caura valley , Three Pools Waterfall and the Asa Wright bird watching nature center contribute both to local livelihoods and the welfare of individual visitors. These attractions may be valued using the travel cost method, where the expenditure on travel, accommodation and equipment used to enjoy these cultural services can be used to reflect the value people place on the attractions supported/provided by Northern Range ecosystems.

Study site	Ecosystem service	MEA service type	CITIES service class	CITES service group	CITES service type	Local Indicative benefits	Applicable Account in SEEA 2003	Potential Biophysical metrics	Suggested valuation method
NR	Carbon sequestration / storage	Regulating	Regulation of Physical environment	Atmospheric regulation	Global climate Regulation		National Carbon accounts Indirectly in Forest asset account	CO2 Stored /CO2 sequestered annual basis	Social Cost of Carbon
NR	Erosion Regulation	Regulating	Flow Regulation	Mass flow regulation	Erosion protection	Reduction of flood damage, reduction of Erosion	Indirectly in Forest asset account	Tonnes erosion prevented vs. alternate land use	Clean up cost , Replacement Cost
NR	Aesthetic Quality	Cultural	Symbolic	Aesthetic/heritage	landscape character	Tourism,	N/A	N/A	Choice Modelling & or Willingness to Pay
TCR	Coastal Erosion Protection	Regulating	Regulation of Physical environment	Mass flow regulation	Erosion protection	Reduction of coastal erosion damage	N/A	Erosion damage prevented vs. unprotected areas	Replacement Cost & or Hedonic Pricing
TCR	Carbon sequestration / storage	Regulating	Regulation of Physical environment	Atmospheric regulation	Global climate Regulation		National Carbon accounts	CO2 Stored /CO2 sequestered annual basis	Hedonic Pricing
TCR	Aesthetic Quality	Cultural	Symbolic	Aesthetic/heritage	landscape character	Tourism,	Land and/or Ecosystem Asset accounts	N/A	Choice Modelling & or Willingness to Pay
NS	Pollination	Regulating	Regulation of Biotic environment	Lifecycle Maintenance and Habitat Protection	Pollination	Improved Agricultural productivity	Land and/or Ecosystem Asset accounts	dependence of Crops on natural pollination	Production Function
NS	Carbon sequestration / storage	Regulating	Regulation of Physical environment	Atmospheric regulation	Global climate Regulation		National carbon accounts / Land and ecosystem asset accounts	CO2 Stored /CO2 sequestered annual basis	Social cost of carbon

TABLE 3 ECOSYSTEM SERVICES OF PROECOSERV STUDY SITES AND RECOMMENDED VALUATION METHODS.

3. WHAT ARE ENVIRONMENTALLY ADJUSTED NATIONAL ACCOUNTS?

3.1. Shortcomings of traditional wealth measures

The United Nations System of national accounts (SNA) is a statistical framework that provides a set of macroeconomic accounts for use by policymakers, scientists and governments. The general goal of the SNA is to provide a comprehensive, consistent and flexible set of macroeconomic accounts for use by a variety of actors and all countries in the world, facilitating international comparisons of all significant economic activity. Essentially the SNA records economic flows and stocks of economically 'significant activities" , it provides a formal structure for the answering of the complex and at times bewildering question of "who does what with whom in exchange for what, by what means for what purpose, with what changes in stocks? By compiling detailed data on the flows per unit time (eg. Annual income) and stocks at a specific point in time (e.g. Physical production capital at the end of a year) in monetary units, the SNA produces a number of economic indicators of which Gross Domestic Product (GDP) is the primary aggregate measure of overall economic return to human and physical capital (World Bank , 2006). Gross Domestic Product (GDP) is one of the most familiar and influential economic and development indicators not only to policy and decision makers but also the general public (Boyd, 2007) .

However GDP has failed in a number of respects namely in its failure to account for a wide variety of benefits that ecosystem services bring to human well being, as well as for damages caused by pollution associated with economic activities (Smith, 2007) and the treatment of the value of asset liquidation as party of the national product. Essentially, when assets such as minerals or forest resources are depleted, they contribute directly to growth in GDP figures. Thus a country could theoretically grow its GDP in the short term by liquidating natural assets in a short period of time, but thereby risking medium to long term economic sustainability.

Specifically the shortcomings and criticism of the SNA are as follows;

1. Lack of representation of the degradation of ecosystems caused by economic activity which impact human well being (Hecht, 2007)

2. The failure to account for the value of the various ways in which the environment enhances human well being, specifically through various ecosystem services not traded (bought or sold) in formal markets namely regulating ecosystem services such as flood protection , purified air , water supply.

3. Treatment of natural assets such as forest and fisheries differently from capital assets such as factories and tractors. In the SNA income earned from the harvesting of an entire forest is reflected as a large one-time income, despite the fact that regeneration of resources and thus future income from harvest cannot occur in following time periods (Hecht, 2007).

4. Failure to capture the importance of the quality of human health (Gundimeda, Sukhdev, Sinha, & Sanyal, 2007).

Broadly speaking the SNA is criticized as a poor measure of long term wealth and social well being (welfare) and conceals the lack of sustainability of current economic practices and paradigms. Environmentally adjusted National Accounts (ENA) also known as 'Green' National Accounts aim to deal

with some of the shortcomings of traditional accounts, to improve the incorporation of environmental considerations into the day to day decisions of policymakers and political processes.

3.2. United Nations Statistics Division System of Environmental-Economic Accounts

Globally the need to address suitability issues surrounding the use of the SNA was formally recognized at the Rio 1992 earth summit with a proposal to develop national systems of integrated environmental accounting (Bartelmus, 2007). In response to this call United Nations Statistic Division (UNSD) produced an interim handbook titled "System of Environmental and Economic Accounting" (SEEA) alongside the 1993 update of the SNA. The SEEA is meant to act as an "internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics on the environment and its relationship with the economy" (United Nations, 2003)

"Environmental economic accounting is a response to the need for integrated environmental policies into the overall system of decision making" ***- Jean Louis Webber 2007***

The SEEA compliments and expands on the SNA by sowing some of the interactions between the economy and the environment, extending the SNA asset boundary to incorporate environmental assets, monitoring the stock of some environmental assets and providing where possible financial values on non-economic assets (UNESCAP, 1994). This system presents a number of accounts which may be developed and utilized individually for a variety of ecosystem services provided by nature. The accounts of the Central framework of the SEEA include;

- *Asset accounts* of natural resources such as water, forest, soil and land, describing the change in stock of environmental assets over accounting periods in physical or monetary terms.
- *Physical and Hybrid flow accounts* describing how natural resource inputs flow into the economy and how residuals (waste and by-products) flow from the economy to the environment. The flow of products, natural resources, ecosystem inputs and residuals may be described in physical (Physical flow accounts) and monetary terms (Hybrid flow accounts)
- *Environmental Protection Expenditure Satellite Accounts* illustrating expenditure made within the economy for environmental protection such as investment in 'greener' production techniques and government expenditure on protection of environmental resources.
- *Environmental modified macroeconomic aggregates*, an account focusing on the adjustment of traditional economic SNA accounts to reflect the impact of the economy of the environment with the aim of developing Greened macroeconomic indicators such as Green Gross domestic product and Green Gross national product.

The SEEA central framework was first published as the interim handbook in 1993 and then as an official handbook in 2003 this system is currently being updated by a group of experts for publication in 2012 with an additional 'experimental' handbook on land and ecosystem accounts expected in 2013.

This Experimental handbook develops three new accounts; Water accounts, Land and Ecosystem accounts (natural capital accounts), and Energy accounts. These accounts also cover the value of changes in ecosystem assents and ecosystem health, that is, the ability of ecosystems to deliver services that benefit human well being. The development of these accounts is being done in close association with the **Wealth accounting and Valuation of Ecosystem Services (WAVES)** a partnership lead by the World Bank.

While a variety of approaches and methods have been developed to address some of the shortcomings of the SNA and GDP,(See table 4 for summary of concepts) , the SEEA presents an important step forward in Environmental accounting. The harmonization of historical methods and concepts (PRECEE, 2006), the ability to adapt methods and accounts to suit data availability, the compatibility of the SEEA with the well established and familiar SNA, the drive towards the development of a international standard " on par with the SNA" (UNSD, 2012), and a well established framework for continued revision all make this system ideal for the piloting of national accounts in the context of ProEcoServ Trinidad and Tobago.

TABLE 4 KEY ENVIRONMENTAL ACCOUNTING TERMS ENVIRONMENTAL ACCOUNTING TERMS (WORLD BANK , 2006)

Term	Definition
Environmental Accounting	The Compilation of Physical and monetary accounts of environmental assets and the costs of their depletion and degradation.
Green Accounting	Systematic presentation of data on environmentally important stocks and flows (e.g. stocks of life-sustaining natural resources, flows of pollutants), accompanying conventional economic accounts(e.g. measures of gross domestic product) with the ultimate objective of providing a comprehensive measure of the environmental consequences of economic activity
Natural Resource Accounting	A system of monitoring based on methodically organized accounts representing the size of economically viable and limited reserves of natural resources and using physical quantifiers such as tones or cubic meters
Adjusted net savings (genuine savings)	A sustainability indicator building on the concepts of green national accounts adjusted net savings measure the true rate of savings in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution.
Green GDP	A measurement of national output that includes effects on the environment and natural resources

3. 3. How are environmentally adjusted National accounts useful to local policymakers?

Despite the existence of a large and growing body of knowledge and data on the functioning of ecosystems and the services that they provide, there has been a limited uptake and use of this information in the policymaking arena. Specifically with reference to environmental data and statistics this is largely due to;

- Complexity- environmental statistics and data are often overly complex and difficult to understand requiring advanced background knowledge in specific fields.
- Incomparability – due to differences in methods and metrics used it is difficult and at times impossible to compare between datasets, time periods, and other fields such as economics.

The development of Environmentally Adjusted National Accounts such as the SEEA seeks to address some of these issues with environmental statistics by organizing environmental statistics into integrated accounts and developing highly aggregated indicators to address the gamut of issues associated with environmental statistics. As figure 4 illustrates, environmental accounts structure large amounts of environmental, economic and socio-demographic statistics and data by quantifying data/statistics to make their significance more apparent, simplifying data/statistics for enhanced communication and understanding and in many cases **converting** them to monetary terms for enhanced comparison - ideally allowing for the use of environmental research by policymakers, governments, and citizens to optimise decision-making and ultimately improve human well being.

How does a policy maker…

- *Compare the impact on the well being of the national population of 30 tonnes of liquid waste emitted into a river with 30 cubic meters of gaseous emissions?*
- *Compare the cost of increased flood damage due to hillside development with the economic benefits of increased construction employment?*
- *Unfamiliar with environmental biology use Mean species abundance or mean tropic level to understand the implications of physical development policy on biodiversity?*

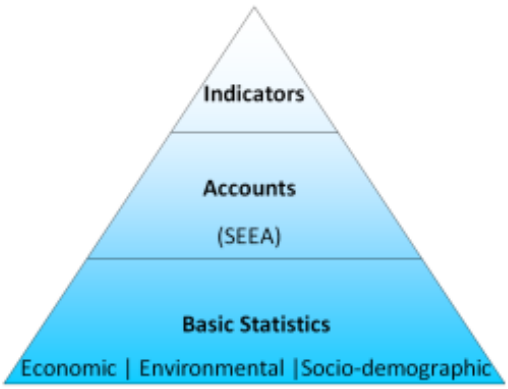

FIGURE 4 THE INFORMATION PYRAMID (UNSD,2012)

In order to maximise buy-in by local stakeholders, it is crucial to articulate the various ways in which environmentally adjusted national accounts may be used to maximise national welfare. Here we briefly outline some of the ways in which physical asset accounts , monetary asset accounts and Ecosystem accounts for the study sites of ProEcoServ and Environmentally adjusted national aggregates may be used by policymakers.

Environmentally Adjusted National Accounts may be used by policy makers to help answer the following questions;

- *How much should we send to prevent pollution?*
- *How much we spend on environmental protection?*
- *What prices should be used in payment for ecosystem services schemes?*
- *How much are we sacrificing future well being for current income?*
- *Who benefits from natural resource use?**
- *Are current trends in production and consumption of resources sustainable?**
- *What economic instruments are in place to mange natural resources? Are they effective?**
- *How does the depletion degradation of natural resources affect measures of the real income of a nation? **

**Adapted from SEEA brochure Titled "Measurement Framework in Support of Sustainable development and Green Economy Policy" - http://unstats.un.org/unsd/envaccounting/Brochure.pdf*

- *Measuring the sustainability of national development*; by taking into account all types of capital , social , physical and natural (ignored in SNA) EANA provide an indication of whether government policy is producing increases in current and future , national welfare (World Bank , 2006)

- *Enhancing national understanding of nature's true value*; this is arguably the most important benefit, as it enhances local consciousness of how ecosystems contribute to their well being and health in the familiar yardstick of money. This understanding changes the perception of the population towards various environmental policies that may perhaps otherwise be viewed in a negative manner due to the impact on local livelihoods, thereby easing the implementation of existing policies and development of new polices.

- *Enhanced efficiency of Environmental policies*; by providing accounts indicating in comparable terms the way in which the services provided by ecosystems enhance local well being, policymakers are able to allocate resources for environmental protection in a more efficient manner. Policies that enhance local welfare the greatest at the least cost can be prioritized for action.

- *Adaptive management of policies and monitoring and evaluation*; By providing information on the sate of various ecosystem assets consistently over a set time period , policymakers can determine trends in service delivery and thus track the effectiveness of deployed polices. This enables the identification of which policies are most successful and alternatively where they are failing. This also makes adaptive management possible i.e. the adjustment of policies based on impact.

- *Cost benefit analysis of decisions*; by providing the value of ecosystem services in monetary terms, true cost benefit analysis of policy decisions is enabled. For example Policy makers may now

compare the costs of land use decisions that require the clearing of ecosystems in terms of the services lost with the benefits the alternative use provides.

- *Assessment of long term sustainability of economy*; EANA take into account the depreciation of natural assets such as forests and fisheries, this improves policymakers understanding of the long term impact of current economic practices.
- *Compensation*; by making the economic value of the environmental costs of various actors in society more explicit, EANA provides information for a variety of compensation mechanisms. This not only internalizes the externality[2] but provides an economic deterrent to environmentally damaging actions.

Economic valuation of Ecosystem services coupled with Environmentally Adjusted National Accounts present useful tools which seek to address pervasive environmental issues by applying economic thinking to environmental issues in order to prevent (and in some cases reverse) damage caused by traditional economic activities and paradigms. In order to improve the potential uptake of this tool, it is necessary to engage local project stakeholders and assess needs and gaps in current systems of potential users.

4. PILOT APPLICATION OF ENVIRONMENTALLY ADJUSTED NATIONAL ACCOUNTS

As a precursor to the valuation exercise to be conducted in ProEcoServ , this report pilots the application of Environmentally adjusted national accounts in order to present early results to policymakers , academics and other stakeholders. These early results will be used to illustrate the variety of ways in which the outputs of an EANA system may be used to improve tradeoffs decisions related to national planning initiatives namely the national physical development plan. This activity also aims to identify some of the strengths, weaknesses, opportunities and threats to the valuation exercises to be conducted in ProEcoServ as well as the application of the revised SEEA in the future.

4.1 Selection of Services for inclusion

Before attempting to quantify and eventually value how an ecosystem enhances human well being it is necessary to identify the services provided and select those to be quantified in this study (Troy, 2006) (MEA, 2005)(MEA, 2005). The process of selection started by developing a list of services identified in the Northern Range Assessment - a sub-global component of the 2005 Millennium Ecosystem Assessment -

[2] An economic externality is a cost or benefit that is not transmitted through prices and not borne by the party creating that cost or benefit.

and the Forestry Division of Trinidad and Tobago annual reports. This list was (shown in table 5 then augmented by meeting with the Project Team leader as well as the various biophysical research clusters associated with ProEcoServ, to ensure all services were considered.

Provisioning Services	Regulating services	Cultural Services
1. Commercial Hard wood Timber 2. Game Animals 3. Animals for wild sale as pets	1. Flood Regulation 2. Carbon Sequestration 3. Erosion Regulation 4. Water Purification	1. Tourism (Local /International) 2. Hiking 3. Bird watching 4. Recreational Hunting

TABLE 5 LIST OF NOTHERN RANGE ECOSYSTEM SERVICES

Service(s) to be assessed were then selected using the following criteria

- Availability of physical data.
- Potential for monetization/ valuation.
- Perceived importance to national wellbeing by Project lead and other stakeholders
- Other constraints such as time, and financial resources.

From this process, the service of **Carbon Storage** was selected largely due to the availability of detailed data in the form of the Forest Resources Assessment 2010 (FRA 2010) published by the Food and Agriculture Organization and compiled by Seepersad Ramnarine. The service of carbon storage has a strategic importance considering Trinidad and Tobago's unique position as a hydrocarbon producer and 2nd highest per capita emitter of Carbon dioxide globally (CDIAC, 2012) and the fact that it faces a high risk of feeling negative impacts of anthropogenic Climate Change as a small island state. Information on the carbon stored and sequestered by local ecosystems is essential to understand holistically the national impact on the global climate.

4.2 Development of Physical Asset accounts

Physical asset accounts are used to describe the changes in the stock of an asset between accounting periods. These accounts enable the monitoring of the depletion or restoration of specific assets and may be used to determine the sustainability of the use of that resource (UNSD, 2012). Depending on the nature of the resource these accounts may be reflected in quantitative or qualitative terms. In this case the resources of timber and carbon storage may be measured in quantitative biophysical units and these are used. In the case of ecosystems, the debate continues on the units used to value the degradation of the resource.

Of the four main accounts developed in the SEEA system physical asset accounts and monetary asset accounts were selected for this exercise. As Carbon dioxide is not a major input in any economic activity in Trinidad and Tobago , and data on the sources of CO_2 was unavailable , it was not possible to construct Physical or Hybrid flow accounts. The Environmental Protection Expenditure satellite accounts were also not constructed again due to lack of data.

Available data taken from the Food and Agriculture organization Forest Resources assessment Country report 2010 was used to populate physical asset accounts and monetary asset accounts for Carbon. Unfortunately due to the lack of data and non-concordance of datasets, details of the activities that lead to changes in stocks of the time periods could not be developed and only opening and closing stock figures could be obtained. A partial account was developed for the period 1990-2010 for illustrative purposes and is shown in the results section.

In order to fill in data gaps qualitatively, research was conducted on the state of Trinidad and Tobago's forest resources using available literature.

Opening stock levels		
	Increases in stocks	
		Due to Economic Activity
		Due to regular natural processes
	Decreases in stocks	
		Due to Economic Activity
		Due to regular natural processes
		Due to natural disasters (net decrease)
	Changes due to reclassificaiton	
Closing Stock levels		
	Changes due to environmental quality	
		Due to natural processes
		Due to economic activity

FIGURE 5 AN EXAMPLE OF AN ASSET ACCOUNT TAKEN FROM SOURCE: GUNDIMEDA (2007)

Figure 5 illustrates a generic assect account for physical assets which was used as a template for the development of the asset accounts developed.

4.3 Development of Monetary asset accounts.

Where possible, physical asset accounts are converted into monetary terms in order to facilitate the aggregation of the value of assets across different classes and comparison between assets both environmental and non-environmental in terms of their relative contribution to national wellbeing, using a variety of methods employed in peer reviewed literature and international studies.

4.4 Adjustment of national Aggregates

As indicated by several studies (Alfsen & Greaker, 2007) (Everett & Wilks, 1999) (WRI, 1995) it is difficult to devise a comprehensive measure that deals with the sustainability of income and economic activities. The SEEA does provide descriptions of a number of suitability indicators that can be derived from environmental accounts, however as full accounts were not developed there is insufficient information for the application of these indicators. Therefore the values of the assets were simply compared to GDP figures for the years in which they were applicable to illustrate to policymakers the comparative value of unconsidered ecosystem services.

5. RESULTS, DISCUSSION, AND IMPLICATIONS OF FINDINGS

5.1 Physical accounts

Using data from the FRA 2010 asset accounts indicating the closing and opening balances of the stock of total forested area for five time periods from 1970 to 2010 as shown in figure 5 were constructed. Similar asset accounts for Carbon stored in above and below ground biomass were constructed for 3 time periods from 1990-2010 as show in Table 6.

TABLE 6 CHANGE IN TOTAL CARBON STORED IN VEGETATIVE BIOMASS

Time Period	Opening stock (Thousands Metric tonnes)	Closing stock (Thousands Metric tonnes)
1990-2000	20540	19750
2000-2005	19750	19620
2005-2010	19620	19170

Carbon accounts showed a decline of 1370 thousand metric tonnes between the 1990 and 2010. Total national Carbon emissions from non-land use sources amounted to 13573 thousand metric tonnes in 2008 (CDIAC, 2012) increasing from 8440 thousand metric tonnes in 2005. When compared with the increase in carbon emissions from 2005-2008 of 5133 metric tonnes the decrease in carbon stored for the period 2005-2010 of 450 thousand metric tonnes may not seem significant , but is notable, as maintaining carbon stores improves the position of a nation in global carbon negotiations.

Forest area accounts revealed an 11% decline in the stock of Trinidad and Tobago's forest between 1970-2010, with the most significant decline occurring between 1994 and 2005 and a slight increase

between 2005-2010 (see table 7 below) . If plotted as a linear decline an average loss forested area occurs at a rate of approximately 1000 ha per annum. Primary drivers of the change in total forested area are assumed to be primarily anthropocentric, namely land use change for housing, agriculture and quarrying (Environmental Management Authority , 2004).

TABLE 7 CHANGE IN AREA OF TRINIDAD AND TOBAGOS FOREST ECOSYTEMS FOR THE PERIOD 1970-2010

Time Period	Opening Stock (Ha)	Closing Stock (Ha)
1970-1990	256346	237863
1990-1994	237863	240726
1994-2000	240726	233570
2000-2005	233570	220080
2005-2010	220080	226413

Table 8 shows the partially developed asset accounts for carbon dioxide for Trinidad and Tobago for the period 1990 to 1994 as shown; significant gaps exist in available data on the sources of change in carbon dioxide stored in natural forest. While data is available on natural disturbances due to forest fires, and reforestation and afforestation programmes by the government, no data was available on natural re growth process and timber harvested commercially for this period.

TABLE 8 PARTIALLY DEVELOPED ASSET ACCOUNTS FOR TRINIDAD AND TOBAGOS FOREST ECOSYSTEMS (ALL VALUES IN HA)

Opening stock	237863
Increases due to Economic activity	3720
Increases due to Natural process[3]	-
Decreases due to Economic activity[4]	-
Dec natural process	31219
Closing stock (Estimated)	210364
Closing stock (Actual)	240726
Actual - Estimated	30362

[3] Data for Increases due to natural processes was unavailable and the lack of inclusion of this data contributes to the difference between estimated and actual closing stock , these increases are likely significant as actually closing stock is significantly greater than the estimated

[4] Data on decreases due to economic activity was unavailable, yet these extractions/removals were likely overshadowed in area by the natural increase since actual closing stock exceeded estimated closing stock

5.2 Monetary accounts

Experimentally area accounts developed under this work were monetized using an adjusted unit value transfer methodology to scale up values to the national level. This method was selected largely due to the lack of primary data on the value of ecosystems and their services in Trinidad and Tobago. As indicated in section '2.2 Valuation methodologies' value transfer is the process of estimating the economic value of an ecosystem or its services by using economic information captured from another palace and or time (Wilson & Hoehn, 2006). This method uses an adjusted unit value transfer which estimates the value of forest ecosystem services in Trinidad and Tobago (policy site) by adjusting mean unit values of ecosystems and/or services from original valuation studies conducted internationally (study sites) and multiplying by the quantity of that ecosystem service provided locally (EEA , European Environment Agency , 2010).

The method utilized for the monetization of area accounts involved 3 general steps which will be explained below (these steps are an adaptation of the methods employed in (Troy & Wilson, 2006) (Torras M. , 2000);

1. Literature review and selection of study site values
2. Adjustment of study site unit values for differences income, local conditions
3. Scale up of unit values to national level and monetization of area accounts

5.2.1 LITERATURE REVIEW AND SELECTION OF STUDY SITE VALUES

In order to extract unit values for these activity primary values from other valuation studies were collected from peer reviewed journal articles. One of the primary considerations in the value transfer is the possible differences in unit values between study and policy site (Spash & Vatn, 2006). The value individuals and by extension populations place on ecosystem services is influenced by a number of factors such as (Ready & Navrud, 2006);

1. Characteristics of environmental good, Quality and Quantity
2. Characteristics of final users- age , income , culture
3. Availability of substitutes

These factors were considered when conducting the literature review so as to select study site values for benefit transfer and scaling up which are most similar to the policy site conditions. Theoretically, the selection of study sites which have similar characteristics to that if the policy site reduces the transfer error, associated with the benefit transfer activity (Ready & Navrud, 2006).

Table 9 indicates the data drawn from a search of online valuation databases[5] and peer reviewed journals for selected ecosystem services, it important to note that this is summary table of data collected and not all

[5] Data bases utilized included the EVRI - Environmental valuation reference inventory ,Ecosystem services partnership- Ecosystem Services valuation Database (ESVD) and the FAO Forest Valuation Database

values indicated in this table were considered in the final calculation of ES value. Following the development of this short list , each study considered in the final analysis of unit values for Trinidad and Tobago's forest and excludes some studies drawn which were excluded due to large differences in income (not in the same World bank income class as Trinidad and Tobago). In order to exert some control on the differences between the biophysical characteristics in study sites and Trinidad and Tobago, only studies from tropical forests were considered for inclusion in this Table.

Notably excluded from data collection, were tourism/recreation values and non-timber forest products (NTFP). While a large number of valuation studies were available for these services, the significant physical differences between study sites and Trinidad and Tobago resulted in their non inclusion. Non timber forest products were not included in this study as valuation on these products focus on very specific products and services such as, latex, resins , species, fuel wood and fibers , which are either not preset in Trinidad and Tobago or hold little economic importance to citizens. Similarly the tourism product in the study sites examined was focused primarily on prominent and unique ecotourism destinations such as the Monte Verde Cloud Forest reserve in Costa Rica , the Galapagos islands and African National Parks (Tobias & Mendelsohn, 1991) (Ruitenbeek, 1992) (Edwards, 1991).

As indicated above, the unit values placed on various ecosystem services are influenced profoundly by a number of characteristics of the biophysical environment supplying the service, the socio-economic characteristics of the population, and the local economic availability of good/service substitutes.

While the selection of studies conducted only in tropical forest aims to control for some of the biophysical differences, some adjustment of the values to reflect the economic conditions of Trinidad and Tobago is also necessary.

5.2.2 ADJUSTMENT OF STUDY SITE UNIT VALUES TO REFLECT DIFFERENCES IN INCOME

For the selected study sites, the level of income varies from that of Trinidad and Tobago, thus individual willingness to pay (WTP), economic importance to production and all other values are reflective of local levels of income.

In order to adjust for these differences in income and cost of living, the ratio of per capita GDP and the income elasticity of demand for that good are used in the following formula which was taken from (Nilsson, Valuation of some environmental costs within the GMS energy sector strategy, 2006);

$$V_p = V_s(Y_p/Y_s)^{\beta}$$

Where;

V_p= Adjusted unit value of Ecosystem service at policy site (T&T)

V_s= Value of Ecosystem Service at Study site

Y_p= GDP Per Capita at policy site (T&T)

Y_s= GDP per capita at study site

B= income elasticity of demand for environmental good/service

TABLE 9 SURVEY OF TROPICAL FOREST VALUES

Service	Country	Unit Value (UD$ per ha per year)	Income and inflation Adjusted unit Value (2010 USD per ha per year)	year	Method	Author
Carbon Storage	Trinidad and Tobago	1088	N/A		Market price- authors calculations	
Climate Regulation	Mexico	100	130	1989	Shadow Price	Adger, N., K. Brown, R. Cervigni, and D. Moran",1989,
Climate Regulation	Brazil	200	288	1994	Avoided Cost	Pearce and Moran 1994
Climate Regulation	Malaysia	336	526	1991	Avoided Cost	Krutilla
Climate Regulation	Paraguay	378	1944	2005	Avoided Cost	Naidoo, R. and T.H. Ricketts
Erosion Control	Brazil	238	346	1993	Avoided Cost	Torras
Erosion prevention	Philippines	268	1188	1988	Avoided Cost	Hodgson G. and J. Dixon
Erosion prevention	Philippines	213	1522	2007	Avoided Cost	Chomitz, K.M. and K. Kumari
Flood Prevention	Brazil	4	5	1993	Benefit Transfer	Torras, M.
TEV	Brazil	1175	1710	1993	Benefit Transfer	Torras, M.
TEV	World	2007	3251	1997	Benefit Transfer	Costanza
Water Purification	USA	1022	359	2000	Replacement Cost	Kaiser, B. and J. Roumasset
Water Purification	Cameroon	162	1234	2001	Benefit Transfer	Lescuyer, G.
Water regulation	Brazil	19	28	1997		Fearnside
Wild Meat	Paraguay	16	28	2005	Direct market pricing	Naidoo, R. and T.H. Ricketts
Sustainable Timber	Brazil	307	457(inflation adjusted only)	1993	Market pricing- sustainable harvest	
Sustainable Timber	Trinidad and Tobago	397	N/A	2010	Authors' calculations	

In the case of this study, purchasing power parity estimates of GDP were used as recommended by (Navrud S. , 2004), as these take into account price differences and supply of goods and services. Unfortunately due to lack of primary studies on income elasticity of demand for the services valued, a β of 0 was used, meaning that no adjustment was made for differences in demand of good due to income levels.

It is important to note that this method assumes that willingness to pay for ecosystem goods and services varies proportionally with income which may tend to overcorrect for income idffrences in cases where income levels are significantly different between policy and study sites (Navrud R. R., 2006)

5.2.3 ESTIMATING THE VALUE OF SUSTAINABLE TIMBER

The value of sustainable timber harvest from Trinidad and Tobago is estimated by using a method derived from (Torras, 2000) and (Gundimeda, Sukhdev, Sinha, & Sanyal, 2007) using the following equation;

$$V_{Tim} = MIA * P_{net}$$

Where

V_{Tim}= The value of sustainable Timber (USD/ ha per year)

MIA= Mean annual volume increment (m^3 / ha per year)

P_{net}= Timber net price or the value added to GDP (USD/ m^3)

The lower bound average MIA[6] of the two most common commercially exploited species by growing stock (Forestry Department FAO , 2010) (Teak and Caribbean pine[7]) in Trinidad and Tobago was found to be 7 m^3/ha per year and was used as to represent the average MIA of the timber species in Trinidad and Tobago's forest.

Net timber[8] prices was determined to be $93 USD per m^3 (2010 dollars) by dividing the value added to GDP by timber (CSO data querry), by the volume of timber extracted in that year, and averaging over the period $2000-$2008 . With the sale price of teak averaging between $200-400 USD/$m^3$ and pine averaging between $100-$300 USD/m^3 on the global market [9] this is likely a fair estimate of net timber price locally.

This calculation yielded an estimate of $397 USD/ha per year for the value of potential sustainable timber harvest from Trinidad and Tobago's Forest Ecosystems.

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[6] MIA taken from (Ugalde & Perez, 2001), a FAO Forestry department report titled "Mean annual volume Increment of selected industrial forest plantation species"

[7] Data on commercially exploited species in Trinidad and Tobago Taken from Forestry Division Records 2011

[8] Net timber price is the "…difference between average market value per unit of resource and the per unit marginal cost of harvest, development and extraction" (Gundimeda, Sukhdev, Sinha, & Sanyal, 2007)

[9] The global market figures for Teak and pine were determined by a review of market price indicators provide by www.asiatimber.net the largest online database of timber supply and demand conditions

5.2.4 ESTIMATING THE VALUE OF CARBON STORAGE

Under CITES, carbon storage and sequestration services fall into the Global Climate regulation 'service type' , indicating that the benefits provided by the maintenance of this service are not only enjoyed by Trinidad and Tobago. Unfortunately carbon does not fall into any of the asset categories outlined by the SEEA 2003 and no guidance is provided on how to value this service in the SEEA 2003 or the central framework of the SEEA 2012 (United Nations, 2003) (UNSD, 2012). Thus resulting in a review of literature on methods employed by other researchers for the estimation of the value of Carbon storage services provided by tropical forests

A large body of literature exists discussing the cost of carbon storage to global wellbeing (Pearce, 2003), within the literature, with significant debate on climate sensitivity, human adaptive capacity , possibility of climatic tipping points , use of discount rates , climatic response lag and the possibility of chaning social values, large ranges of estimates of the social cost of carbon exist (IPCC AR4 WG3, 2007). The Intergovernmental Panel on Climate Change IPCC(2007b, Chapter 20) reviewed peer reviewed literature to produce a SCC range of between 4-95 US$/t$CO_2$ using this range not only produces an extremely large range of values of CO_2 storage in tropical forest , but extremely high estimates of per hectare value of forest exceeding the value of all other services combined .

In order to develop estimates of Carbon stored in I ha of forest in Trinidad and Tobago , area accounts and carbon asset accounts were used to find the average storage of carbon , by dividing total area , by total carbon in each year for which data is available , and averaging over all years. This yielded an average carbon storage of 85 Metric tons (mt) per hectare (85mt/ha).

As mentioned above, use of the IPCC literature review range of SCC produces a large range of estimates of the value of carbon stored in Trinidad and Tobago's forest, for this reason we guide our estimates for carbon value based on what value is placed on carbon in open markets as suggested by (Zhang, 1999) and (Pearce, 2003).

Here we use the average price of a tone of carbon sold in the largest carbon trading scheme the European Union Emissions Trading scheme in 2011, a value of US$ 12.8/ton (World Bank , 2012) which is multiplied by the average carbon storage within a ha of forest calculated above. This yields an estimated value of 1088 $USD per ha for the delivery of carbon storage services by Trinidad and Tobago's Tropical Forest.

TABLE 10 VALUE OF SLECTED ECOSYSTEM SERVICES PROVIDED BY ONE HA OF FOREST PER YEAR -ATHOURS VALUE TRANSER CALCULATIONS

Ecosystem Service	ES Value (2010 USD per Ha per year
Climate Regulation	1088
Erosion Control	346
Flood Prevention	5
Water Purification	359
Sustainable timber	397
Total value	**2195**

TABLE 11

VALUE OF SELECTED ECOSYSTEM SERVICES PROVIDED BY ONE HA OF TROPICAL FOREST PER YEAR ADAPTED FROM (TORRAS, 2000)

Ecosystem Service	ES Value (2010 USD per Ha per year)	ES value Adjusted for Income differences[10]
Climate Regulation	227	330
Erosion Control	254	370
Disturbance Regulation*	5	7
Water Regulation*	28	41
Sustainable timber	457	665
Total value	**971**	**1413**

TABLE 12

VALUE OF SELECTED ECOSYSTEM SERVICES PROVIDED BY ONE HA OF TROPICAL FOREST PER YEAR ADAPTED FROM (COSTANZA, 1997)

Ecosystem Service	ES Value (2010 USD per Ha per year)	ES value Adjusted for Income differences
Climate Regulation	323	517
Erosion Control	355	568
Disturbance Regulation*	7	11
Water Regulation*	8	13
Raw materials*	348	557
Total value	1041	**1666**

[10] Ecosystem Service value Adjusted for income differences uses the PPP method indicated in section 3.2.2

5.3 Scale up of unit values

Following the literature review and compilation of relevant study site values, the final list of studies to be used for value transfer were selected by removing studies done in areas with significant differences in income from Trinidad and Tobago in the year of the study (countries outside of the world bank income classification in the year of the study were excluded).

Scaling up of values was done using a method proposed in Troy and Wilson (2006) whereby per-hectare adjusted unit values from the study site , is applied to the total hectare area of the 'policy site' which in this case is Trinidad and Tobago , shown below;

$$V_{TTF(USD)} = V_{LIT} * A_{TTF}$$

$V_{TTF\ (USD)}$ = Total economic value of ecosystem services of Trinidad and Tobago's forest vegetation

$V_{LIT(USD/ha}$)=Economic value of forest ecosystem services per hectare taken from literature. (inflation adjusted)

$A_{TTF(ha)}$ =Total area in hectares of Trinidad and Tobago's Forest vegetation

This scale up method was applied to individual service values and then summed to give the total value of key ecosystem services for Trinidad and Tobago's forest vegetation. This scale of ecosystem service values was done for the opening area of Forest in 1997 and the closing area of forest 2010 in order to determine the average loss of ecosystem service value for this time period. The method was also applied to two of the most prominent total economic value (TEV) estimates of tropical forest vegetation from Costanza (1997) and Torras (2002) to provide estimates of the TEV of forest vegetation when all services are considered for a similar time period.

From this activity the services of Climate Regulation, Erosion Control, Flood prevention , Water purification, water regulation and sustainable timber are estimated to have a value of $2195 usd/ha/yr (see table 10). Summing values from comparable ecosystem services[11] from Torras[12] (1993) who developed a TEV figure for Amazonian Forest in Brazil yield a value of $1413 usd/ha/yr (USD 2010 dollars) (see table 11), and a similar summing of values form Costanza[13] 1997 yields a value of $1666 usd/ha/yr (USD 2010 dollars) (see table12) both comparable in magnitude to the estimate values developed.

Table 13 shows the monetization of area accounts and adjustment of national aggregates for the key ecosystem services used in this study, for simplicity the average of the upper bound and lower bound of key ecosystem services was used to develop these estimates. The selected services of Climate Regulation,

[11] Care was given to select the most comparable Ecosystem services, an * is used to denote where comparable services with different names were used.
[12] This study included the services of sustainable timber, food , non-food raw materials , recreation, climate regulation disturbance regulation, water regulation, erosion control, unkown future medical benefits, existence benefits
[13]This study included the services of Climate Regulation , disturbance regulation, water regulation , water supply , erosion control, soil formation , nutrient cycling , waste treatment , food production , raw materials , genetic resource , recreation , cultural.

Erosion Control, Flood prevention, Water purification, water regulation and sustainable timber are estimated to be worth a $497 US million to the residents of Trinidad and Tobago in 2010, around 2.4 % of current GDP.

Using the adjusted Total Economic Value studies of Costanza 1997 and Troy 2000 the value provided by forest ecosystems when numerous other ecosystem services are considered is estimated to be between 387 and 672 US million per year in 2010 or between 1.8% to 3.2% of GDP per year. Accepting the limitations of the a value trasfer methodology, this study indicates that Trinidad and tobagos forests contribute singifcantly to human welfare in economic terms, exceeding value added by agriculture which is 0.6% GDP in 2010 (World Bank databank) and with upper bound estiamtes nearly comparable in manginude to value added by manufaturing which is 5.3% of GDP in 2010 (World Bank databank)

The 11% decline in total forested area between 1970 and 2011 resulted in a value loss of aproximately $65 million USD for slected services and up to $97 million USD when the litrature derived TEV figures are used.

These losses in ecosystem service dilivery are likely underestimates of the losses to the nation economy due as the value of one ha of forest increses as total forest area decreses as many ecosystem services exibit diminshing returts to scale (EEA , European Environment Agency , 2010)

5.4 Adjustment of National Aggregates

Following the development of monetized area accounts for ecosystem services provided by forest ecosystems the estimates were used to adjust national GDP aggregates by developing an environmentally adjusted GDP (EAGDP) using a method employed by Gundimeda et al 2007 in the paper "Natural resource Accounting for Indian states- Illustrating the case of forest resources".

The EAGDP is developed by subtracting the value of average annual loss of ecosystem services from GDP in the Closing balance year using the following equation;

$$\mathbf{EAGDP_y = GDP_y + \Delta ESV}$$

Where;

$EAGDP_y$ = EAGDP in year Y of closing balance for period area account developed

GDP_y = GDP in year Y of closing balance for period area account developed

ΔESV = Average annual change in ecosystem service value for period area account developed

The results of this adjustment is show in tables 13, 14 and 15 for the selected services used in the value transfer protocol , TEV developed by Costanza and TEV developed by Torras respectively.

TABLE 13 MONETIZED AREA ACCOUNTS USING VALUE TRANSFER AND SCALE UP OF SELECTED ECOSYSTEM SERVICES

Time Period	Opening Stock (Ha)	Closing Stock (Ha)	Area Change	Value change (M 2010 US$)	Average annual Value change (M 2010 US$)	Total value of selected ES in Closing balance Year	GDP closing year (Current USD)	EAGDP (Closing year)	EAGDP/GDP
1970-1984	256346	237863	-18483	-40.6	-2.9	522.1	N/A	N/A	N/A
1984-1990	237863	240726	2863	6.3	0.4	528.4	5068.1	5061.8	0.99876
1990-2000	240726	233570	-7156	-15.7	-1.6	512.7	8154.0	8169.7	1.00193
2000-2005	233570	220080	-13490	-29.6	-5.9	483.1	15982.0	16011.6	1.00185
2005-2010	220080	226413	6333	13.9	2.8	497.0	20603.0	20589.1	0.99933

TABLE 14 MONENTIZED AREA ACCOUNTS AND ENVIRONMENTALLY ADJUSTED GDP USING TEV DEVELOPED IN (COSTANZA, 1997)

Time Period	Opening Stock (Ha)	Closing Stock (Ha)	Area Change	Value change (M 2010 US$)	Average annual Value change (M 2010 US$)	Total value of ES in Closing balance Year	GDP closing year Current USD)	EAGDP (Closing year)	EAGDP/GDP
1970-1984	256346	237863	-18483	-54.9	-3.9	706.5	N/A	N/A	N/A
1984-1990	237863	240726	2863	8.5	1.4	715.0	5362	5353.5	0.99841
1990-2000	240726	233570	-7156	-21.25	-2.1	693.8	8154	8175.3	1.00261
2000-2005	233570	220080	-13490	-40.07	-8.0	653.7	15982	16022.1	1.00251
2005-2010	220080	226413	6333	18.81	3.8	672.5	20603	20584.2	0.99909

TABLE 15 MONENTIZED AREA ACCOUNTS AND ENVIRONMENTALLY ADJUSTED GDP USING TEV DEVELOPED IN (TORRAS, THE TOTAL ECONOMIC VALUE OF AMAZONIAN DEFORORESTATION 1978-1993, 2000)

Time Period	Opening Stock (Ha)	Closing Stock (Ha)	Area Change	Value change (M 2010 US$)	Average annual Value change (M 2010 US$)	Total value of ES in Closing balance Year	GDP closing year Current USD)	EAGDP (Closing year)	EAGDP/GDP
1970-1984	256346	237863	-18483	-31.6	-2.3	406.7	N/A	N/A	N/A
1984-1990	237863	240726	2863	4.9	0.3	411.6	5362	5357.1	0.99909
1990-2000	240726	233570	-7156	-12.2	-1.2	399.4	8154	8166.2	1.0015
2000-2005	233570	220080	-13490	-23.1	-4.6	376.3	15982	16005.1	1.00144
2005-2010	220080	226413	6333	10.8	2.2	387.2	20603	20592.2	0.99947

5.5 Implications of EAGDP/GDP ratios

This ratio illustrates the way in which the change in area of forest resources is not accounted for in national GDP figures. Where this ratio is greater than one, national income is understated i.e. the value/economic contributions of forests is ignored. Where this ratio is greater than one, therefore, growth and economic activity for the period can be considered to be 'sustainable' with respect to forests i.e. growth is not as a result of depletion/degradation of forest resources (Gundimeda, Sukhdev, Sinha, & Sanyal, 2007). The converse is true for years when the ratio is below one; this means that growth has partially come at the expense of the net depletion of natural resources, and this depletion is not accounted for in national figures. As the economic importance of these resources is not accurately reflected in national accounts, and data on the values of these resources are largely unavailable, economically informed policy decisions are more difficult to make. As we can see for the most recent period (2005-2010) the EAGDP/GDP ratio is below one, indicating that within this period the rate of depletion of forest resources is coming at a cost to national welfare. Ideally, government should be examining these ratios as key figures for policy formation, monitoring and evaluation of policy effectives and aim to maximize EAGDP, in order to maintain vitally important ecosystems and ensure the delivery of the services they provide, for the residents of Trinidad and Tobago.

5.6 Limitations

It is important to identify the limitations of this primary study as they must be considered when these values are used for consideration of ecosystem value. Here we note some of the primary limitations of this method and likely sources of error.

Differences between Study site and Policy site

As indicated above, the value placed on an ecosystem service is affected by numerous factors which vary significantly from country to country. Biophysical differences, such as presence/absence specific forest flora and fauna, differences in tropical forest subtype and microclimate, can all influence ecosystem service delivery. Socio economic factors, such as income distribution, cultural views of ecosystem services and availability of local technological alternatives also influence local ecosystem service value profoundly.

Aggregation of Services

The aggregation of ecosystem services values provided by a hectare unit of forest up to the level of an whole ecosystem assumes that these services aggregate in a linear manner, which is likely untrue. For certain services such as provision of habitat for 'wild meat', minimum areas of forest are necessary for delivery for service delivery. Other ecosystem service values may exhibit diminishing returns to sale (EEA , European Environment Agency , 2010) , i.e. Each additional hectare of forest to a large ecosystem such as the northern range will contribute comparatively less than each additional hectare to a smaller forest ecosystem such as Trinidad's central range. This not only affects estimates of the value of the current stock of forest ecosystems but also the assessment of the value of stock losses, as when the area of an ecosystem declines, the unit value of remaining ecosystem increases. As a result of this estimated total values of ecosystem services provide by forest may be over-estimates, and values of the loss of value due to declining forest extent are likely under-estimates.

Distribution of benefits

The distribution of these benefits amongst various must also be considered, since the benefits of ecosystems and the costs of their degradation are borne by specific actors. For example certain services such as the aesthetic service of a pleasant view from a hillside home, are enjoyed only by those situated near to forests. The uneven distribution of benefits and costs to various stakeholder groups may result in underestimates of the value of lost ecosystem services and must be considered in the context of this study.

Data and Primary study reliability

The accuracy of estimates produced in this report depends largely on the accuracy of the Forest Resource assessment and other biophysical assessments on forest resources as well as the reliability of primary studies done in study sites from which values were transferred. These estimates are only as accurate as the lest accurate piece of data that is used in this study.

Assumed Homogenous nature of tropical forest

This study assumes that the delivery of ecosystem services is equivalent for one square kilometer of tropical forest anywhere in Trinidad which is likely a rather unrealistic representation (Fotheringham, 2000). For example, the importance of flood protection services provided by forest vegetation is likely significantly greater on and up course step sloped river valley than similar vegetation on a local floodplain. This is why the Project for Ecosystem services is aiming to refine and provide improved data on the biophysical delivery of ecosystem services. It is difficult to tell whether this would lead to an under or over-estimation of Ecosystem service value.

These are but a few limitations that should be considered with these estimations of ecosystem service value.

6. POLICY LESSONS FOR ENVIRONMENTALLY ADJUSTED NATIONAL ACCOUNTS IN TRINIDAD AND TOBAGO

6.1 Proposed method for incorporating ecosystem services into national accounts for Trinidad and Tobago

While a variety of methods for adjusting national accounts for environmental considerations exist, the United Nations SEEA presents a relatively holistic set of accounts and well advanced methods of compiling these accounts. This combined with a strong move to elevate it to a standard on par with the SNA, and a strong framework for revision and improvement in the foreseeable future, makes this method one of the most promising for utilization in ProEcoServ Trinidad and Tobago

Figure 7 outlines the general proposed method of developing environmentally adjusted National accounts for ProEcoServ Trinidad and Tobago; here we briefly outline the steps involved in that proposed method.

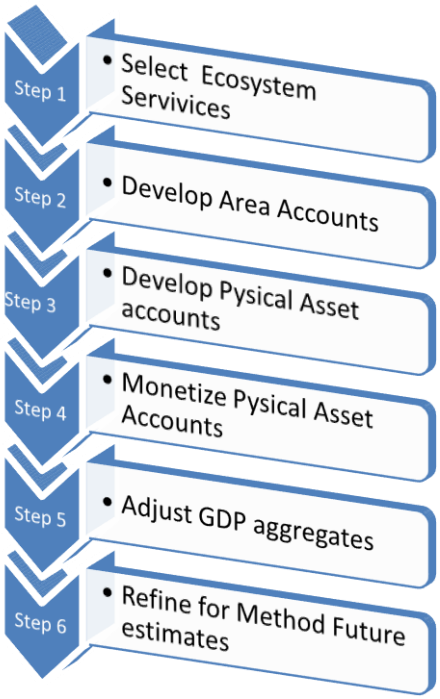

FIGURE 6 RECOMMENDED METHOD FOR DEVELOPING ENVIRONMENTALLY ADJUSTED NATIONAL ACCCOUNTS

Selection of Ecosystem Services; Before attempting to value how an ecosystem enhances human well being it is necessary to identify the services provided (Troy, 2006)(MEA, 2005) and select those to be quantified This process has already been initiated by the project team and is largely complete for the 3 study sites of this project..

Development of Area accounts (land cover accounts) ; This entails the physical mapping of the extent and quality of the ecosystems being studied and is arguably one of the most important steps in the context of this project, due to the paucity of GIS data on ecosystems in Trinidad and Tobago. The method to be used for these ecosystems should be in keeping with the methods used by the updated UN SEEA. Essentially these accounts specify the opening and closing balances of ecosystem extent, and thus the changes in area/extent of the ecosystems on an annual basis (or any other accounting period selected). A GIS based method for this step is recommended as this allows for periodic updates of accounts and the assessment of trends over time

Development of Asset accounts; These accounts are developed for a number of specific environmental assets such as carbon, timber, biomass and soil by building on area accounts. Like area accounts, these accounts indicate the stock and changes in stock of assets, answering the question; how much of asset X has been lost or gained in the last year (or any other accounting period selected) .

Monetization of Accounts; Using asset specific valuation methods, develop per unit values for each asset and scale up the value of each account. As these accounts are developed alongside 'physical' asset accounts they indicate the change in value of the assets over the accounting period selected.

Experimentally, area accounts (land cover accounts) should also be valued again using valuation methods specific to the ecosystems services provided by each land cover type. These accounts are dependent on the physical outputs or ecosystem assessments of ProEcoServ and thus will have to be developed in close association with the physical scientists working at the respective sites. .

Adjustment of National Aggregates; As indicated by several studies (Alfsen & Greaker, 2007) (Everett & Wilks, 1999) (WRI, 1995) it is difficult to devise a comprehensive measure that deals with the sustainability of income and economic activities. As such it is recommended that an adjustment to GDP method , outlined in the guidelines provided in the SEEA 2003 and that will be indicated in the newly updated SEEA 2012, be used to develop adjusted national aggregate figures. The indicators of GDP and GNP are the most widely used in policy circles and thus have the advantage of being well understood and available, especially for the historical periods being studied. Values derived from the various monetary accounts will be subtracted from the total GDP for the relevant periods.

6.2 Data needs for Improved EANA and deployment of the SEEA

While this activity provided valuable estimates on the changes in the value of carbon stored in Northern range forests and the change in value ecosystem services provided , data gaps prevent the deployment of full accounts as dictated in the UN SEEA. Significant limitations also exist with respect to the valuation method used, largely due to time restrictions and again data availability. In order for a more robust deployment of environmentally adjusted national accounts within the UN SEEA framework, a significant improvement in both biophysical and economic data is needed. Here we discuss these gaps and the research needs for this proposed use of EANA.

Biophysical data is needed on supply response functions that indicate the delivery of ecosystem services based on the unique conditions of specific areas of ecosystems, such as slope vegetation type, soil type etc and address issues of ecosystem thresholds and aggregation (scaling up) of ecosystem service benefits.

Ecosystem scale GIS data on the changes in ecosystem area and the causes of change in ecosystem area. As indicated in the partial area account developed for carbon, data is needed on the various drivers of change in total forest area , such as deforestation , afforestation , natural re-growth , harvest , removal for development , economic removals etc. It is necessary to determine the various sources of change in total vegetated area in order to devise targeted policy responses and also the specific impact on ecosystem service delivery. As an example the reduction of carbon stored in forested area depends on the type of disturbance: clear cutting of forest and the tilling of soil for agricultural purposes result in significantly greater releases of stored carbon when compared with partial felling timber removals. Ecosystem scale data is critically important for the ecosystems such as coral reefs and the freshwater swamp of Nariva as limited data currently exists for these ecosystems.

Local economic valuation studies based on supply response equations are key for the development of monetary accounts, as value transfer methods involve transferring information from study sites with different social , economic and environmental characteristics from Trinidad and Tobago. Valuation studies on the importance of local services are vitally needed in order to ensure robust monetary accounts.

7. RECOMMENDATIONS AND SWOT ANALYSIS

Positive	Internal	External
	Strengths	Opportunities
	▪ Parallel involvement with ProEcoServ environmental assessment provides targeted inputs for EANA ▪ Strong partnership with relevant users namely Ministry of Planning and the Economy , illustrated by request to prepare materials for RIO+20 conference	▪ Close involvement with MPE and interest in deployment of method to meet medium term challenges of Flooding , ecosystem degradation and biodiversity loss ▪ Strong interest and growing partnership with Trinidad and Tobago Green Fund (end user) ▪ Developing links with global EANA networks such as the United nations Statistic Division SEEA and the world bank waves project
Negative	Weaknesses	Threats
	▪ Lack of needs assessment to target outputs ▪ Limited data currently available on state of ecosystem resources ▪ Delivery of Ecosystem assessments towards the middle of project ▪ Lack of valuation studies locally on ecosystems and their services	▪ Departure of key point persons of involvement ▪ Post project sustainability of data collection and development of accounts ▪ Limited engagement with Ministry of Finance ▪ Limited engagement with the central statistical office of Trinidad and Tobago

FIGURE 7 SWOT ANALYSIS OF APPLICATION OF ENVIRONMENTALLY ADJUSTED NATONAL ACCOUNTS

Figure 8 illustrates a "strength weaknesses opportunities and treats" (SWOT) analysis of the environmentally adjusted national accounts portion of the ProEcoServ project. Using this analysis we here provide a number of recommendations on how to capitalize on strengths and opportunities, and methods of addressing threats and weaknesses.

Fostering collaboration with global networks. Conversations have already begun with the ProEcoServ global project management team on fostering intellectual links between local EANA research and the global SEEA network . As this engagement develops a number of key opportunities exist, namely; exchange of best practice experiences on the construction and use of EANA, improved compatibility of local EANA with emerging global standards, knowledge of cutting edge methods in the field of EANA. Access to updated SEEA materials, meetings, and discussions at the expert level by the ProEcoServ team would enable the project capitalize on this key opportunity.

Optimization of Ecosystem Assessments for EANA use. The parallel development of biophysical assessments of the delivery of ecosystem services by key ecosystems in Trinidad and Tobago is a key portion of this project. In order to fully capitalize on this strength, the individual (or teams) working on each ecosystem should collaborate closely on the development of EANA and valuation maps. This collaboration ideally should be formalized in the form of regular meetings between the teams working in each ecosystem. This will enable the team to produce outputs that may be easily valued using environmental valuation and then further incorporated into the proposed EANA.

Needs assessment. As the many of expected final users of the EANA and valuation work have been identified and their needs expressed through various meetings , a formalized needs assessment and continued formal interaction with final users will ensure that the outputs produced have the greatest value added and meet user needs. Close consultation with the Ministry of Planning and the Economy is necessary.

Sustainability of EANA . In order to address the threat of limited post project sustainability of efforts, it is recommended that the project engage with the relevant agencies that may be charged with developing annual EANA and value maps , namely the national statistics generating agency of the government of Trinidad and Tobago the Central Statistical Office. There may be a need to train relevant individuals in the construction of such accounts and familiarize the agency on a whole with environmental issues, and the thinking behind the development of EANA.

The lack of comprehensive ecosystem service delivery surveys continues to be an issue in the developing regions, and this remains true in Trinidad and Tobago. This is being addressed by the comprehensive assessments underway at the University of the West Indies for the 3 key ecosystems in Trinidad and Tobago. Two key recommendations emerge . The first recommendation is the continuation of value transfer studies, providing initial estimates of the value of various ecosystem services , for illustrative purposes and to inform early decision support models to be developed. The Second recommendation is a close collaboration between the economics team and researchers conducting the various Ecosystem assessments to ensure compatibility between research outputs and currently available valuation methodologies.

8. CONCLUSION

This pilot exercise has indicated that the estimated lower-band value of the ecosystem services provided by the northern range is undeniably significant to national welling being in economic terms, exceeding in magnitude activities such as agriculture and comparable in magnitude to manufacturing. The extent of the importance of this single ecosystem suggest that the value of ecosystem services provide to the residents of Trinidad and Tobago by all ecosystems is likely quite considerable relative to annual GDP.

Unfortunately, we continue to see a decline the quality and extent of ecosystems. These trends, coupled with the pilot values obtained in this exercise support the hypothesis that the 'true' value of ecosystems is poorly integrated into decision making processes at the national and sub national levels.

EANA and economic valuation present innovative and potent tools for addressing the weak sustainability of the management of T&Ts ecosystems through the improved understanding of nature's 'true' value as well as the costs of current actions (in some cases inaction) on future well being. The coupling of these tools with intensive research to improve the understanding of the physical processes that deliver ecosystem services have great potential for forwarding the objective of the ProEcoServ: the mainstreaming of ecosystem services into development planning.

There is however a need for the advancement of research collaborations at the local level with physical scientist and final users and at the international level, with Environmental economists to improve the robustness of the method used and to enhance the stability of EANA in the Trinidad and Tobago ProEcoServ. The current exploration of partnerships and relationships with global Environmental accounts networks such as the SEEA is promising Also increased collaboration between the teams working on the biophysical assessment of ecosystem processes is necessary to ensure outputs are compatible with the SEEA system of accounts, and lend themselves to valuation tools within the capacity of the project.

If the recommended methods of addressing the weaknesses and treats while capitalizing on the opportunities and strengths of this portion of the project are utilized, with the continued and improving collaboration between the research team and the local and international partners, the tool of EANA and valuation presents an excellent prospect to improve the management of local ecosystems and their services to enhance long term human well being in Trinidad and Tobago ,with the potential for expansion to other small island states in the region and rest of the world.

It is important to note that EANA present a promising opportunity to other Small island developing states (SIDS) for a number of reasons, namely limited resources for environmental protection, increasing importance of ecosystem services and relatively manageable scales for tool application.

Increasing environmental hazards such as hurricanes and associated flooding , increased rainfall uncertainly , worsening coastal erosion due to rising sea levels are but a but a few concerning risks to vulnerable SIDS associated with anthropogenic climate change which are modulated by regulating ecosystem services , such as forest watershed services and coral reef costal protection.

With this increasing importance of already vital Ecosystem services to SIDS and the limited financial, technical and technological resources of these states, EANA could be used to optimize spending decisions, allocation of limited resources, and identification of priority areas for action. Also due to their relatively small size and

geo-physical similarities, implementing these measures have a relatively low cost for implementation with high potential benefits and strong potential for the transfer and replication of experiences. The SIDS of the Caribbean region represent ideal testing grounds for these methods, due to the relatively small size of ecosystems which reduces the errors associated with value transfer and scaling up of ecosystem service values (EEA , European Environment Agency , 2010)

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