# Ecosystem services: A biophysical quantification for Guanacaste Conservation Area in Costa Rica

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## INTRODUCTION

**Fig. 1**. *Different scenarios at Area of Conservation Guanacaste in Costa Rica showing the importance of biodiversity to human well-fare. Source: ACG web page, 2016*

Human populations depend highly from the contributions of nature to well-being. Earth's ecosystems provide a myriad of services that are fundamental for human health, livelihoods, development and survival (Constanza et all, 1997; MEA, 2005; Mcneely et all, 2009; TEEB foundations and synthesis, 2010).

Over the last decades, ecosystems have experienced dramatic changes that compromise its sustainability in the future. The unbalance produced between the over-growing demands of population and the capability of ecosystems to provide a service, has derived in the loose and deterioration of all types of ecosystems around the world (Baskin, 1997). As a result, the importance of protecting ecosystems and the services they provide has gain more weight.

Ecosystem services (ES) are the aspects of natural ecosystems utilized to benefit human populations (Daily, 1997; Constanza, 1997; MEA, 2005; Fisher, 2009) and has emerge as an important milestone in the road to preserve environment as an asset rather than an impediment to socio-economic development, reframing the relation between people and nature (Braat and de Groot, 2012).

Costa Rica has been a pioneer in to the recognition of ecosystem services value, with initiatives like ecotourism industry, medical prospecting rights and carbon sequestration incentives (Mcneely et all, 2009).

Guanacaste is a conservation area located in northwest Costa Rica, and emerges as a backbone in forest restoration history (Allen, 2001). Although forest ecosystem services programs such as Payments for Environmental Services (PES) represent one of the most successful policies in the area, to date is limitedly understood the wide range of ecosystem services that can be provided.

Based on this context, the main goals of this research is to estimate the potential value of ecosystem services in the Area of Conservation Guanacaste (ACG).

## OBJECTIVES

(1) Develop a spatial framework using biophysical indicators to quantify ecosystem services in the ACG.

(2) Identify the contribution of each ecosystem service to local human well-fare expressing their value in monetary terms.

## STUDY AREA

The Area of Conservation Guanacaste (ACG) is located in the Province of Guanacaste, in the lowlands of the Caribbean side of northwest Costa Rica and it comprises 5 major ecosystems: marine, coastal, dry forest, cloud forest and rainforest in a continuous geographical space of 1630 km$^2$ (ACG web page, 2016).

Guanacaste has an old history of forest restauration and implementation of conservation policies. Since tropical forests are one of the most important ecosystems in the planet (Ninan, 2007) in many aspects this has contribute to support a series of fundamental services for human wealth.

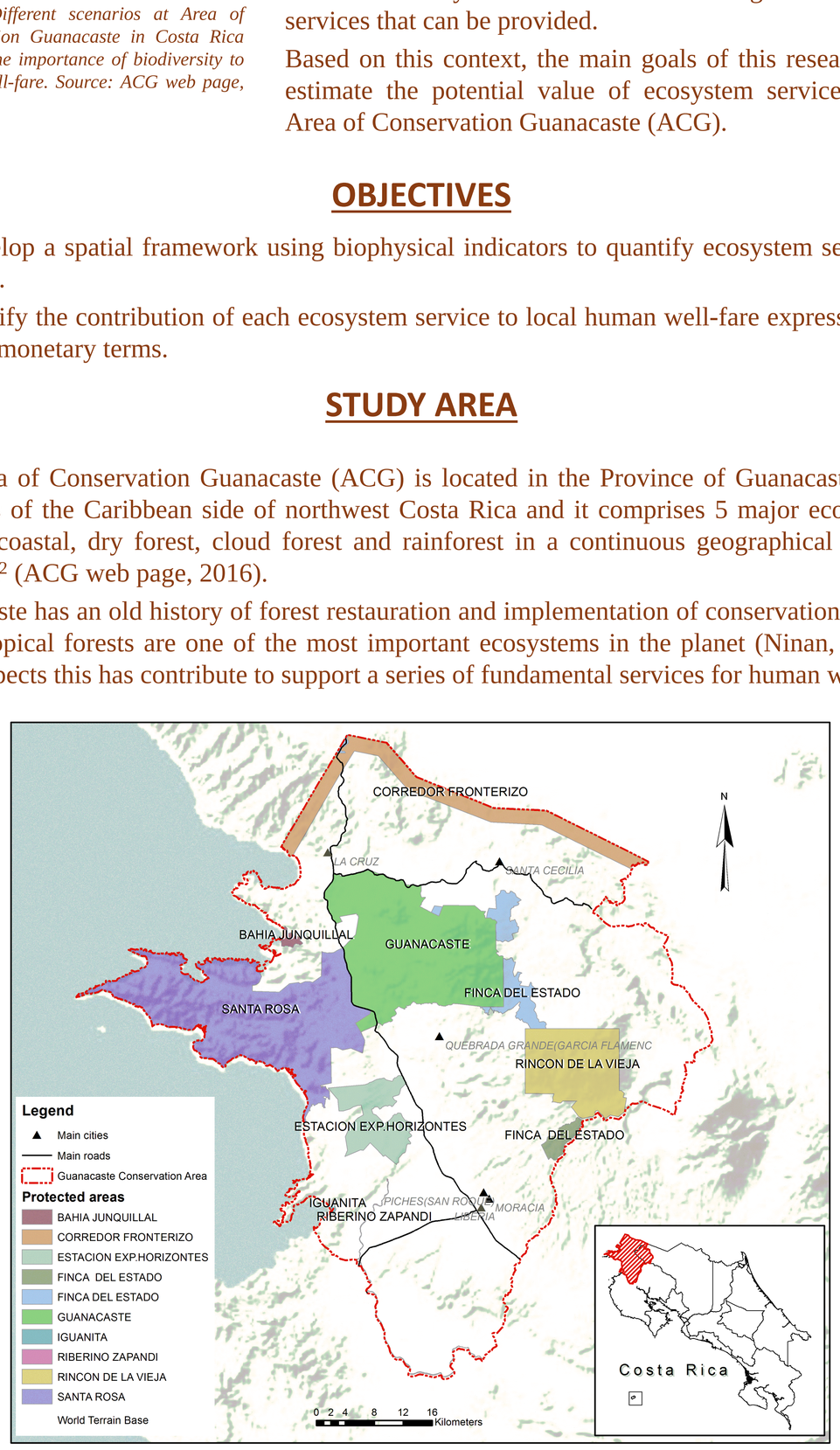


**Fig. 2.** *Location of the Area of Conservation Guanacaste, Province of Guanacaste in Costa Rica.*

## METHODS

Though there been several attempts to establish a framework for ecosystem services assessment, a consistent approach to identified, classified, and then valued ecosystem services has not been defined yet. However, according to Fisher et all (2008) the key to an effective ecosystem services assessment is a clear statement of the objectives.

Two of the most used methods: The Millenium Ecosystem Assesstment (MEA, 2005) and The Economics of Ecosystems and Biodiversity (TEEB, 2010) grouped ecosystem services into four broad categories: provisioning, regulating, supporting and cultural.

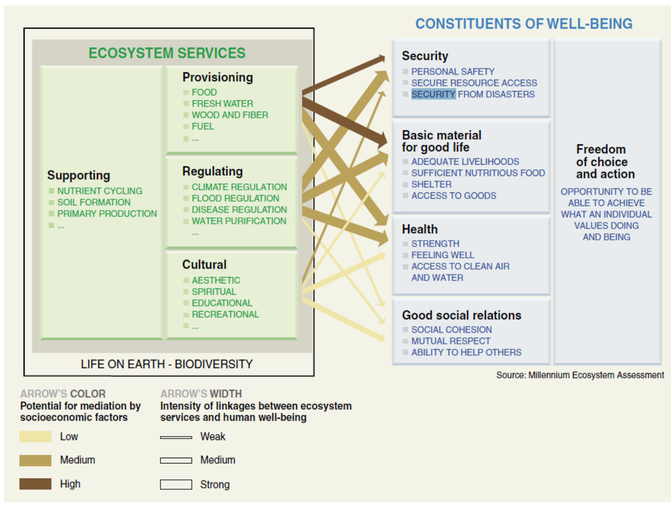


**Fig. 3.** *Millenium Ecosystem Assestment overview diagram (MEA, 2005).*

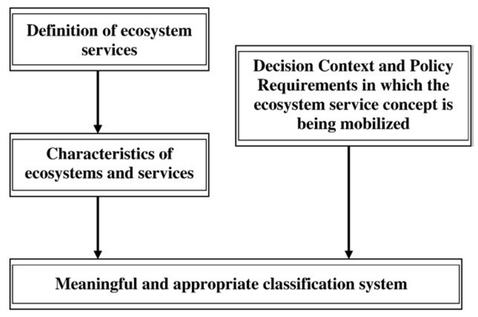


**Fig. 4.** *Classification system proposed by Fisher et all (2008).*

Other authors suggest to difference between "services" and "benefits" (Fisher et all, 2008; Boyd and Banzhaf, 2007). Services are considered as process of ecosystems related to human wealth, while benefits are outcomes of ecosystem services that have a direct relationship to human welfare (Ninan, 2014).

**Question 1:** How can ecosystem services been classified at the ACG?

**Approach:** I propose to test both classification methods (Figures 3 and 4) based on an inventory of sources of well-being related to nature at ACG. A detail analysis of ecosystem properties, functions and interactions also will be made.

**Question 2:** What is the current contribution of ecosystems services to local human welfare?

**Approach:** A complete characterization of each ecosystem service based on biophysical indicators per year will be determined. Since ecosystem services are spatially explicit I also propose to use land cover/use units as proxies for the actual ecosystem services and to express numerically and spatially its contribution to human well-fare. This will be made with Geographic Information Systems tools and specific ecosystem services modelling tools like InVEST.

## SIGNIFICANCE

Expressing the value of ecosystem services has a series of implicit benefits. Through this study I expect to inform to stakeholders, government agencies, researchers, and NGOs about the total contribution of Guanacaste Conservation Area to human well-fare in ecosystem services terms.

## EXPECTED RESULTS

- The main result of this research will be a series of model-outputs that will include the spatial representation, approximate quantities and values for each ecosystem service at the ACG.
- In terms of quantification, the selected framework along with statistic tables and metrics will generate a detail inventory of ecosystem services.
- This scenarios will preform a starting point for future risk analysis and to determine the capacity of the ACG to optimize the provision of specific services flows, prevent climate change impacts and future loss among others.
- Results will be shared with stakeholders and scientific community through the submission of scientific papers in scientific journals.

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