Restoring Balance in Laguna Lake Region

2013 Ecological Footprint Report

Global Footprint Network
U.S. Office
312 Clay Street, Suite 300
Oakland, California 94607-3510 USA
+1-510-839-8879
www.footprintnetwork.org

Europe Offices
Brussels, Belgium
Geneva, Switzerland

The cover and pages of this book were printed on 9lives Offset paper, which is manufactured from 100% recycled fibre. It is FSC and ISO 14001 certified.

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Message from the President

Benigno Simeon C. Aquino III
President, Republic of the Philippines
Chairperson, Climate Change Commission

MALACAÑAN PALACE
MANILA

FOREWORD

The Philippines is blessed with unparalleled natural wealth that has become the pillar of industry, commerce, and tourism in our country. But the pressures of environmental degradation, an expanding population, and a growing economy threaten not only our chief source of livelihood and sustenance but also the very security of our people. Moreover, the problems posed by climate change compound the various challenges we face in the task of nation-building.

The efforts of Global Footprint Network and the Climate Change Commission, together with the Laguna Lake Development Authority and the Metro Manila Development Authority, to account for the ecological capacity of the largest inland body of water in the country—the Laguna Lake Basin—is not only welcome but also highly praiseworthy. Stemming from the initial report on the Ecological Footprint of the Philippines, this initiative provides a baseline from which to comprehend the value of the lake vis-a-vis resource consumption, livelihood security, as well as climate change mitigation and adaptation. We extend our gratitude to the organizers, staff, and volunteers who have made this project a reality, especially the Australian Agency for International Development, for their valuable support of this endeavor.

This report affirms our conviction that our natural resources must be sustainably managed not only for the sake of our country's economic and social development but also for the greater resiliency of our people and the integrity of our ecosystems. May the findings of this report guide our decisions going forward as we realize our goal of achieving a more balanced, inclusive, and sustainable society for the Filipino people.

BENIGNO S. AQUINO III

MANILA
August 2013

Message from the AusAID

The Australian Government is pleased to support the efforts of the Government of the Philippines to address the challenges arising from increased demands on the country's natural resources.

Many Filipinos depend on natural resources for their income, and the effects of climate change such as droughts and floods, as well as resource degradation such as deforestation and overstressed fisheries, are putting the country at economic risk. Those least able to cope with this risk are often the 26 million Filipinos (as of 2012) living in poverty.

Without intervention, stresses on the environment have the potential to erode development gains and jeopardise the livelihoods of the most vulnerable. Australia is pleased to support the *National Ecological Footprint and Biocapacity Collaboration for Laguna Lake and Metro Manila*, including the production of the "Restoring Balance in Laguna Lake Region: 2013 Ecological Footprint Report."

The Report is an important step in understanding the ecological state of the Laguna Lake Region, a basin rich in resources which are essential to a number of provinces and municipalities, including Metro Manila. The report provides a comprehensive assessment of this key region's resource opportunities and limitations. It establishes a framework through which local government units can guide current practices, evaluate planned initiatives and investments, and promote environmental management and balanced growth to their constituents.

Australia commends the Laguna Lake Development Authority and the Global Footprint Network, along with the Climate Change Commission and Metro Manila Development Authority on producing this key document, which successfully builds on the 2012 Report on the Ecological Footprint of the Philippines. This initiative, along with a technical training program on integrating ecological footprint in policy-making, aligns with our goal of making resource accounting as a central part of decision-making processes.

It is our hope that this collaboration will mark the beginning of a new era – one in which understanding of natural resource stocks, management and protection can help efforts to maintain ecological, social and economic balance in the Laguna Lake Region and the Philippines as a whole.

Bill Tweddell
Australian Ambassador to the Philippines

Message from Global Footprint Network

Ecological constraints have become a significant determinant of economic success in the 21st century. The trends of each component of the food-energy-climate nexus is amplified by their interconnection. Each country is affected by these trends, but not equally. It matters tremendously for each country how it prepares itself. Therefore, it is Global Footprint Network's mission to help decision-makers to address this nexus so they can choose successful strategies. We do this by offering decision-tools that incorporate the reality of ecological limits. We want these tools to support countries in making their policies and investments most effective in this new era of ecological constraints.

I am particularly thrilled with the Philippines' commitment to sustainable development. With the leadership of the Office of the President's Climate Change Commission and the French Agency for Development, in 2012 the Philippines became the first Southeast Asian country to adopt the Ecological Footprint. Phase I, documented in "A Measure for Resilience: 2012 Report on the Ecological Footprint of the Philippines", laid the foundation for ecological resource accounting in the Philippines.

With support from AusAID in collaboration with the Laguna Lake Development Authority, this 2013 report delineates Phase II, an in-depth look at resource availability and consumption patterns for the Laguna Lake region. Not only does this region encompass the nation's economic epicentre, Metro Manila, it also houses the most vulnerable provinces and municipalities to climate change and resource degradation.

Indeed, the Philippines is developing quickly as its economy shifts from agriculture to industry and services, and its population grows. Though the UN's Human Development Index has measured major gains in the Philippines' human development, large portions of the population have yet to benefit. Furthermore, the country has moved into a significant biocapacity deficit, which could reverse human development advancement, particularly as the global competition for dwindling resources is accelerating

Yet we can sustain progress by prioritizing development that works with nature's budget. Such development requires decision-making that focuses on strengthening natural assets, rather than generating short-term income from liquidating them. In an ecologically constrained world, not having sufficient access to natural capital can leave a country economically, politically and socially vulnerable.

We are confident the Philippines can build a resilient economy with Ecological Footprint accounting. We look forward to Phase III, a national sectorial analysis that will illustrate how different sectors depend on resources both within and beyond the country's borders– and identify where economic risks and opportunities exist. As it strives to live within the means of nature, the Philippine government is forging an innovative path for other countries to follow.

Dr. Mathis Wackernagel
President
Global Footprint Network

Rich natural resources and rapid development

Rising incomes and populations at risk

A life-giving lake and flood-prone communities

The Laguna Lake region has it all...

How can it restore balance?

Laguna Lake Development Authority

Message from the Laguna Lake Development Authority

The story of resource use in the Philippines has taken on two different realities. The Philippines is endowed with an abundance of natural resources, which have provided for the livelihood and sustenance of the Filipino people. On the one hand, the country's development path over decades has been heavily resource-dependent and unsustainable. Over-extraction and over-consumption of the country's natural resources have made the country more vulnerable to environmental degradation and climate change-related calamities. Such vulnerability further threatens sustainable development, especially in critical ecosystems that include highly populated urban centers like that of the Laguna Lake Basin.

The "Restoring Balance in Laguna Lake Region: 2013 Report on the Ecological Footprint of the Region", a collaborative undertaking of the Laguna Lake Development Authority, AusAID, the Climate Change Commission, the Metro Manila Development Authority, and Global Footprint Network, seeks to determine the biocapacity of the Laguna Lake region, which is among the richest, most productive natural resources in the Philippines. It provides key stakeholders, especially local governments, an understanding of the Ecological Footprint approach and how their decisions can have profound implications to the overall health of the lake basin and the communities who directly rely on it.

The accounting for the biocapacity and Ecological Footprint of the Laguna Lake region marks a paradigm shift in the country's deeper appreciation and wise utilization of its resource-rich ecosystems. With this new lens with which to view and shape policy on sustainable growth and natural resource management, the country can move towards not only a more sustainable development track but a more resilient and climate-adaptive future.

Secretary JR Nereus O. Acosta, Ph.D.
General Manager
Laguna Lake Development Authority /
Presidential Adviser for Environmental Protection

Provinces & Municipalities in the Laguna Lake Region

NATIONAL CAPITAL REGION

CITIES

Manila
Mandaluyong
Marikina
Pasig
Quezon City
Caloocan
San Juan
Muntinlupa
Pasay
Malabon
Pateros
Navotas
Taguig
Valenzuela
Las Piñas
Makati
Paranaque

LLDA JURISDICTION

Manila
Marikina
Pasig
Quezon City
Caloocan
Muntinlupa
Pasay
Pateros
Taguig

REGION IV A, CALABARZON

PROVINCES	LLDA JURISDICTION
Batangas *31 municipalities, 3 cities*	*Municipalities: Malvar, Sto. Tomas* *City: Tanauan*
Cavite *17 municipalities, 6 cities*	*Municipalities: Carmona, GMA, Silang* *City: Tagaytay*
Laguna *25 municipalities, 5 cities*	*All 25 municipalities* *All 5 cities*
Quezon *39 municipalities, 2 cities*	*Municipalities: Lucban*
Rizal *13 municipalities, 1 city*	*All 13 municipalities* *1 city*

Recognizing the vast potentials of the lake and its environs for further development and the perceived threats from the rapidly changing character of the lake region, the political leaders of the provinces of Rizal and Laguna moved to enact in the early 60s a legislation that was geared towards the management of the lake and its resources, and to control environmental degradation. Their initiative was intended to facilitate rational utilization of the lake resources. They envisioned that the creation of an "Authority" would facilitate cooperation, coordination and pooling of resources among national government agencies, local governments and the private sector (Francisco 1985).

On July 18, 1966, the Laguna Lake Development Authority was created through Republic Act 4850: An Act Creating the Laguna Lake Development Authority, Prescribing Its Powers, Functions, and Duties, Providing Funds Thereof and for Other Purposes. As stated in the law, its mandate is "to promote and accelerate the development and balanced growth of the Laguna Lake area and the surrounding provinces, cities and towns…with due regard and adequate provisions for environmental management and control, preservation of the quality of human life and ecological systems, and the prevention of undue ecological disturbances, deterioration and pollution." It also reflects the wisdom of the lawmakers in creating a separate agency to manage the lake amidst the multiple political jurisdictions in the watershed.

Three years after the enactment of R.A.4850, the LLDA was organized as a semi-government corporation. Presidential Decree (P.D.) 813 of 1975 further expanded LLDA's mandate to address environmental concerns and conflicts over jurisdiction and control of the lake. This was followed by Executive Order (E.O.) 927 of 1983, which further strengthened the institutional, financial and administrative responsibilities of the Authority including its regulatory functions in industrial pollution.

The LLDA coordinates with over 30 environment and natural resources and water-related agencies/ offices and the 66 local government units (LGUs) within the watershed, each with their policy and planning, regulation and infrastructure development, environment and fishery-related functions.

Policy Coordination Through the LLDA Board of Directors. At the policy level, the LLDA Board of Directors acts as a Collegial Body for Participative Policy Decision Making. The LLDA Board is composed of representatives of the following agencies and organizations: Office of the President, Department of Environment and Natural Resources, National Economic and Development Authority, Department of Trade and Industry, Metropolitan

Manila Development Authority, Province of Rizal, Province of Laguna, Leagues of Mayors of Rizal and Laguna Provinces, private investors, and the LLDA through the General Manager as ex-officio member.

The lake watershed encompasses 66 local government units in five provinces, hence active coordination between the LLDA and LGUs in lake sustainability through the representatives of the Mayors' Leagues of Rizal and Laguna in the Board, Governors of Rizal and Laguna provinces and the Federation of River Basin Councils, Inc., and at the operating level.

However, the LLDA Board is not all-inclusive in terms of representation of key players in policy and program decision-making. There are more than 30 water-related government agencies, non-governmental and private organizations operating in the Laguna de Bay Region, which are not represented in the current Board, each with separately formulated and implemented policies, mandates, and programs and striving to meet relatively narrow and stand-alone goals.

Co-Financing Arrangements

Committed to continually espouse the sustainable development of the Laguna de Bay basin, the LLDA developed the Laguna de Bay Institutional Strengthening and Community Participation (LISCOP) Project. Implemented since 2004, the project finances out of loan proceeds from the World Bank and an equivalent grant from the Netherlands

government. With this initiative, the LLDA optimizes the level of interaction of the environmental, economic, and institutional dimensions of resource use and management, through a combination the following strategic interventions, which also form the integral components of the LISCOP. These are a) co-managed investments for watershed development (component 1); and b) strengthening institutions and instruments (component 2). The end-goal is to secure sustainability in effective basin water resources management, institutional building, and poverty alleviation in the area. The project has been effective since March 2004 and will close in April 2014.

LLDA's Ecological Footprint project in partnership with Global Footprint Network, funded by AusAID, is a natural evolution of these efforts to manage and protect the natural assets of the Laguna Lake region. Through use of the Ecological Footprint, LLDA will continue to work with its multi-stakeholders – from numerous natural resources agencies, to local government units, to communities and households within the region – to bring resource limits to the core of our policy and investment decisions.

Santos-Borja, Adelina and Dolora Nepomuceno. Laguna Lake Brief: Experience and Lessons Learned Sharing, World Bank-ILEC: 2004
LLDA. Integrated Policy and Institutional Framework for the Laguna de Bay Region. 2003.
LLDA-Tetra Tech EM, Inc. Institutional Re-engineering Studies Report. 2001.
Nepomuceno, Dolora. River Basin Study Visit in Spain: Discussion Paper for the Laguna de Bay Basin, 2010.
Palma, A., Diamante, A. and Pol, R. (1997) Stock assessment of the major fishery resources of the Laguna de Bay. Bureau of Fisheries and Aquatic Resources, Tanay, Rizal, Philippines.
Jaraula C.M.B. (2001) Changes in Slinity and Sediment Supply in Laguna de Bay During the Past 6,000 years. Master's Thesis. College of Science. niversity of the Philippines.

Stakeholders of Laguna de Bay

Stakeholders of the Laguna de Bay watershed are grouped into the following categories: (i) regulators; (ii) policy makers, planners and coordinators; (iii) developers (land and water) including those into infrastructure development and provision of basic services; (iv) research and development institutions; (v) resource users; (vi) LGUs; and (vii) informal stakeholders.

Ecological Footprint, Biocapacity, and Overshoot

In 2012, Global Footprint Network and the Climate Change Commission of the Philippines released “A Measure for Resilience”, a report on the Ecological Footprint of the country. The most recent data at the time reflected a stark reality: At the global level, humanity’s demand was exceeding what the Earth could renewably provide. This is what we call “ecological overshoot” – a situation humanity has been in year after year since the 1970s. Unfortunately, this year is no different.

From deforestation to climate change, physical symptoms of overshoot continue to increase in frequency and magnitude. Why? Because we can only live in ecological overshoot for so long before we see signs of collapse. There are only so many fish we can harvest, so many trees we can cut down, and so many tonnes of CO_2 we can emit before the Earth’s ecosystems can no longer keep up. We have long reached that point.

In a finite world, overshoot means greater competition for limited resources. If a country is low-income and running an ecological deficit, it will be more challenging to secure resources from the world, and more likely that the world will secure resources from it. Sadly, the most vulnerable populations will be impacted the most: Without adequate access to resources for basic needs such as food, shelter and clothing, sustainable development cannot be achieved. That is why it is in the self-interest of nations to take action by placing resource limits at the core of their decision-making. This requires tools to track and manage valuable natural assets.

The Ecological Footprint can help us live within our ecological budget. It measures the biologically productive land and marine area required, using prevailing technology and resource management practices, to provide the renewable resources—food, fiber and timber—that a population consumes, to absorb its emitted wastes (particularly carbon dioxide emissions from fossil fuel use), and to locate its infrastructure. This demand in turn can be compared with the productive area available, or the Earth’s biocapacity.

Different types of area-- forest, fisheries, cropland and grazing land—vary in their inherent productivity. Within each type, some areas are more productive or higher yielding than others. After adjusting for these differences, a hectare with world average productivity, or global hectare (gha), is used to measure both the Ecological Footprint and biocapacity. This unit is similar to using a standardized monetary unit, such as the U.S. dollar or Philippine peso, for financial accounts.

In 2009, the last year for which data are currently available, the Earth’s biocapacity was almost 12 billion ha. This is equal to 12 billion gha since global hectares represent world average hectares. At the same time, humanity’s Ecological Footprint was, according to Global Footprint Network’s calculations, over 17.6 billion gha, more than 1.5 times the planet’s capacity to keep up with this demand.

This means that biological resources were being harvested faster than they could be regenerated, and that carbon was being emitted faster than plants could remove it from the atmosphere.

Ecological Footprint accounts are based on international statistics from the United Nations, the International Energy Agency, and other sources, using about 6000 data points per country and year. They begin in 1961, when humanity’s Footprint was only about two-thirds of the planet’s biocapacity. To date, Global Footprint Network has the Ecological Footprint and biocapacity trends of 241 countries. While global biocapacity has been growing slowly, largely due to increasing agricultural yields, humanity’s Footprint has been growing much more rapidly, primarily as a result of an expanding world population and increasing per capita consumption in some regions. Around 1970, humanity’s Footprint began exceeding global biocapacity, and this overshoot has been increasing ever since.

Biocapacity

Biological capacity, the ability of an ecosystem to regenerate and provide services that compete for space. This includes producing useful biological materials and absorbing waste such as carbon dioxide emissions from fossil fuel.

Biocapacity Deficit

The difference between the Ecological Footprint and biocapacity of a region or country. An ecological deficit occurs when the Footprint of a population exceeds the biocapacity of the area available to that population.

Ecological Footprint

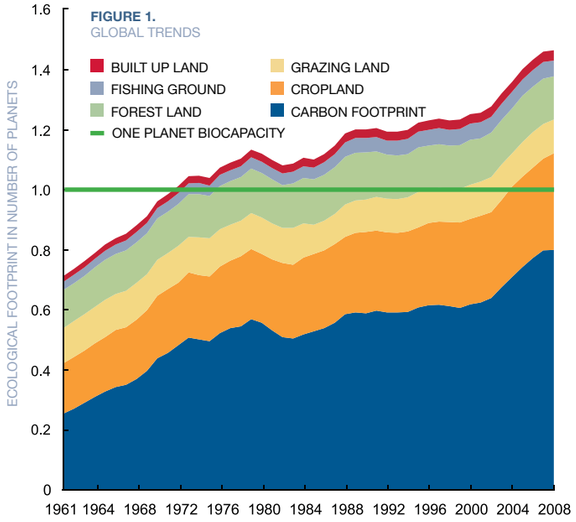
A measure of how much area of biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to sequester its waste. Because of data limitations, the main waste included in the presented national Footprint calculations is carbon dioxide from fossil fuel burning. Both Ecological Footprint and biocapacity results are expressed in a globally comparable, standardized unit called “global hectare” - hectare of biologically productive land or sea area with world average bioproductivity in a given year.

Ecological Overshoot

When a population’s demand on an ecosystem exceeds the capacity of that ecosystem to regenerate the demand. Overshoot results in ecological assets being diminished, including carbon waste being accumulated in the atmosphere.

The Ecological Footprint can be applied to human activity at different scales. At the national level, it is assumed that everything that is produced in a country is consumed in that country, less that which is exported plus what is imported. That Ecological Footprint of Consumption is the most commonly reported part of the Footprint calculation, and is commonly referred to as “The Ecological Footprint” or “The Footprint”. National biocapacity, in turn, is based on the yield-adjusted resource productivity of the forest, fisheries, cropland, grazing land and built-up areas within the country’s borders.

The Ecological Footprint enables governments to identify risks and opportunities associated with their population’s resource consumption, and allows them to base policies and investments on this key data. It also allows them to track and manage resources over time, helping to ensure the stability of their economies, and the well-being of their people.



Humanity’s Ecological Footprint by land area, 1961-2008. The largest component of humanity’s Ecological Footprint today is the carbon Footprint (55 percent). This component represents more than half the Ecological Footprint for one-quarter of the countries tracked, and it is the largest component for nearly half of the 241 countries, regions and territories assessed by the National Footprint Accounts.

$$EF_C = EF_P + (EF_I - EF_E)$$

Ecological Footprint of Consumption

The Ecological Footprint of consumption indicates the consumption of biocapacity by a country’s inhabitants.

In order to assess the total domestic demand for resources and ecological services of a population, we use the Ecological Footprint of consumption (EFc). EFc accounts for both the export of national resources and ecological services for use in other countries, and the import of resources and ecological services for domestic consumption.

EFc is most amenable to change by individuals through changes in their consumption behavior

Ecological Footprint of Production

The Ecological Footprint of production indicates the consumption of biocapacity resulting from production processes within a given geographic area, such as a country or region.

It is the sum of all the bioproductive areas within a country necessary for supporting the actual harvest of primary products (cropland, pasture land, forestland and fishing grounds), the country’s built-up area (roads, factories, cities), and the area needed to absorb all fossil fuel carbon emissions generated within the country.

This measure mirrors the gross domestic product (GDP), which represents the sum of the values of all goods and services produced within a country’s borders.

Net Ecological Footprint of Trade

The Ecological Footprint of imports and exports indicate the use of biocapacity within international trade.

Embedded in trade between countries is a use of biocapacity, the net Ecological Footprint of trade (the Ecological Footprint of imports minus the Ecological Footprint of exports). If the Ecological Footprint embodied in exports is higher than that of imports, then a country is a net exporter of renewable resources and ecological services.

Conversely, a country whose Footprint of imports is higher than that embodied in exports depends on the renewable resources and ecological services generated by ecological assets from outside its geographical boundaries.

The Philippines: Key Findings

Since the 1960s, the Philippines' total Ecological Footprint has nearly tripled.

In 2009, the last year for which data are currently available, the nation demanded more than twice what it had in available capacity.

The average Footprint of people in the Asia-Pacific region is 1.6 global hectares per person. The Ecological Footprint of the average Philippines resident was 1.2 gha in 2009, within the limits of the world average available biocapacity of 1.8 gha. However, there was only 0.6 gha of biocapacity available per resident, meaning that the average citizen's demands exceeded what the country's ecosystem could provide for them.

The largest component of the country's Ecological Footprint is cropland (35 percent); followed by fishing grounds (24 percent), carbon (22 percent), forest land (8 percent) and built-up land (5 percent).

The Philippines is a country that is facing rapid change, with an economy that has shifted – and continues to shift – from agriculture to industry and services. This change, along with the needs of a growing population, means that the country is more dependent on biocapacity from other countries than ever before. While this is not uncommon in a global

FIGURE 2.
GLOBAL ECOLOGICAL FOOTPRINT OF CONSUMPTION AND BIOCAPACITY

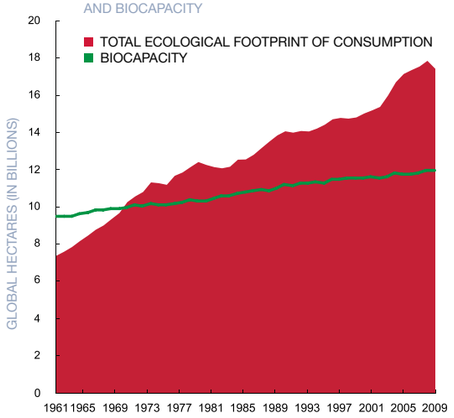
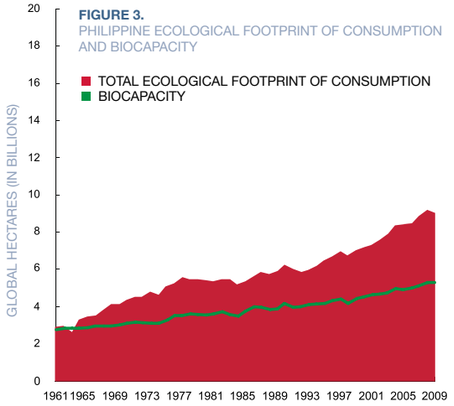
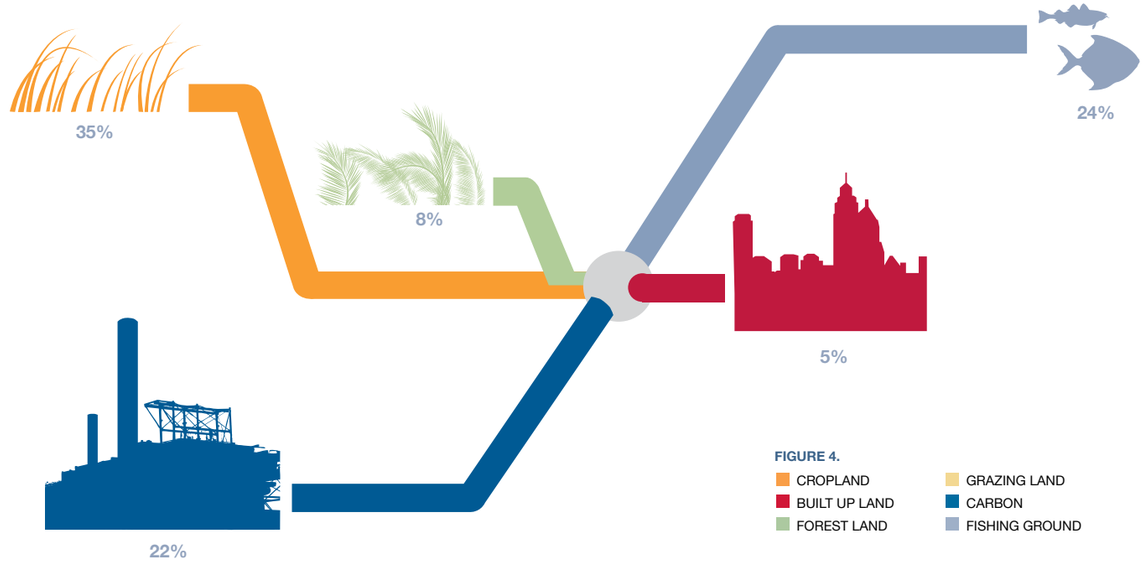


FIGURE 3.
PHILIPPINE ECOLOGICAL FOOTPRINT OF CONSUMPTION AND BIOCAPACITY



Composition

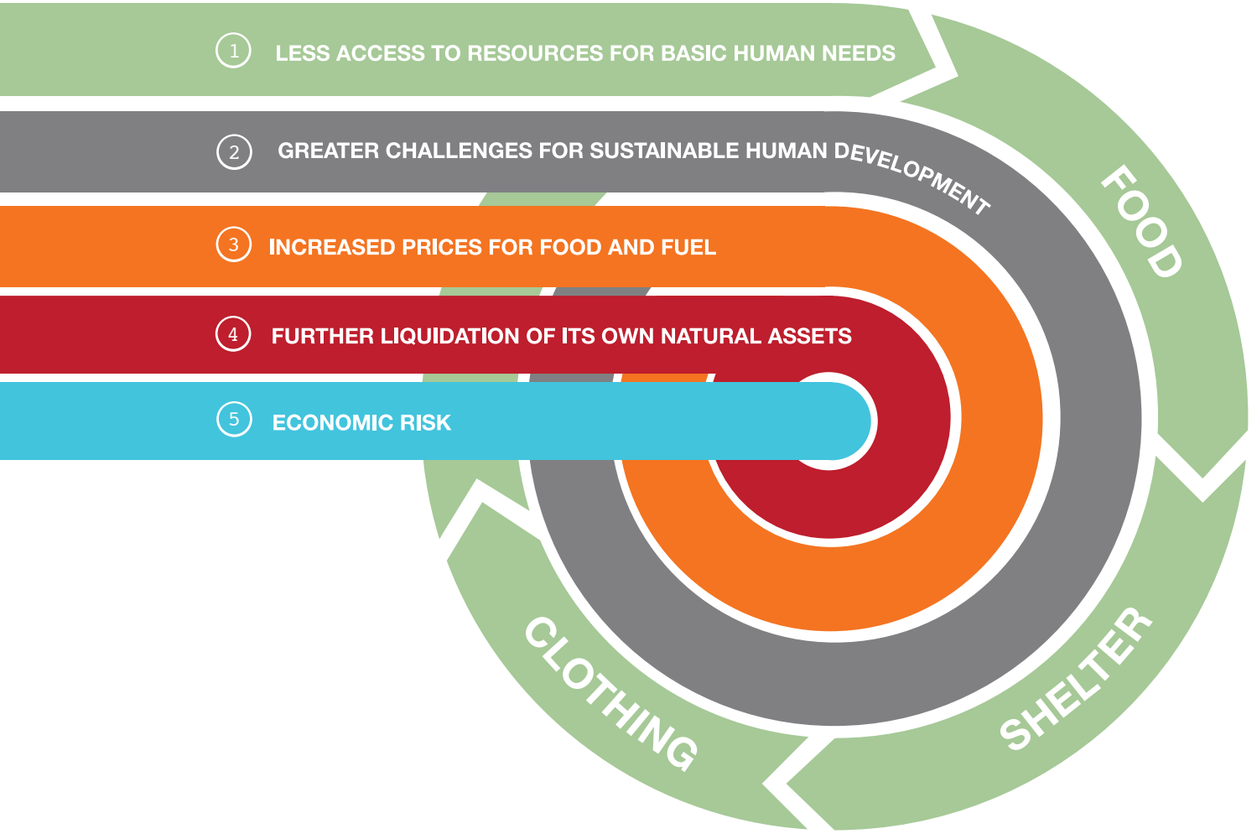
of the Ecological Footprint in the Philippines



economy, this growing dependence poses risks in a resource-constrained world.

For example, other results show that food is a major component of the average household's ecological budget in the Philippines. Since food is directly linked to world food prices and is exposed to volatility, this creates a food security risk for the nation. In these situations, it is the most vulnerable among the population – those who cannot afford to pay higher prices – who will suffer the most.

Without adequate resources, any progress in human development or the economy cannot last. As the Philippines strives toward increasing economic security and improving lives of its residents, incorporating environmental realities in all its planning will help ensure continued success.



Biocapacity Deficit

What does it mean for the Philippines?

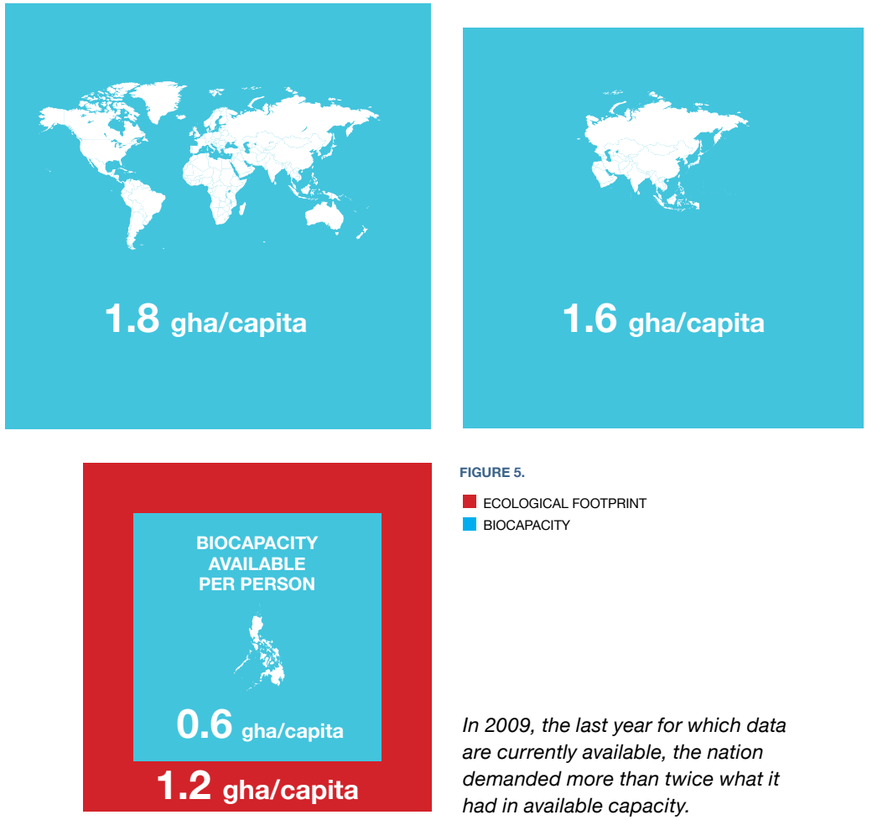


FIGURE 5.

ECOLOGICAL FOOTPRINT
BIOCAPACITY

In 2009, the last year for which data are currently available, the nation demanded more than twice what it had in available capacity.

Laguna Lake Region: Four Decades of Ecological Change

The Laguna Lake Region is one of the most important and dynamic natural resource in the country. The region, which more or less corresponds to the basin, is among the fastest growing economic bases in the Philippines. Because of its unique features, multiplicity of uses and strategic location, economic activities, population increase, rapid industrialization and urbanization have led to changes in the ecological milieu of the lake and its surrounding region over the past decades.

Land Use Changes

During the last 30 years, the Laguna Lake watershed has experienced land-use changes characterized by rapid deforestation and urbanization. Large areas of the watershed were converted to industrial, commercial and residential uses as a result of peri-urban expansion of Manila. In rural areas, population pressure and lack of alternative livelihood opportunities led to the cleaning and cultivation of uplands and over harvesting of forest products (e.g. subsistence logging, firewood gathering and charcoal production), causing denudation of the lake's micro watersheds. The need is quite evident to reforest the denuded forest lands and the steeply sloping grasslands. There is also a need to maintain at least the remaining agricultural lands for food security and food self-sufficiency target considerations. And urban expansion has to be rationalized and regulated in terms of minimizing the random leapfrogging behavior of residential and other urban activities (LLDA Spatial Development Masterplan for the Laguna de Bay Basin, 2011).

Implications to Water Quality

Increased sedimentation from denuded uplands, contaminants from agricultural activities, domestic wastes, industrial discharges, effluents from dumpsites and intensification of fish production take their toll on the water quality of the lake. There are no treatment systems for domestic waste and most industries and agricultural operations do not have adequate pollution abatement systems. Until recently most of solid wastes collected by LGUs end up in open dumpsites whose effluents flow into the lake. The observed levels of water quality parameters confirmed the present condition of the lake as polluted and stressed aquatic ecosystem. This poor water quality has severely diminished Laguna Lake's potential for transport and recreational uses and as source for domestic water. The lake water quality is currently classified as Class C or fit for fishing, but not for swimming and contact recreation (Class B). With appropriate technologies, the lake water may be treated for drinking.

Laguna de Bay

SURFACE WATER
Its surface waters cover approximately 900 square kilometers.

2,250 million m³
The lake can hold up to 2,250 million cubic meters of water.

WATERSHED
The lake is replenished every eight months by waters flowing through a watershed area of around 282 square kilometers, clearly delineating three distinct bays: West Bay, Central Bay and East Bay.

LAND AREA
The total land area of the lake region (administrative jurisdiction) is 3,880 km², which is approximately 1.3% of the country's land area of 300,000 km².

PROVINCES
The watershed is occupied by the provinces of Rizal and Laguna and partly by the National Capital Region, and the provinces of Cavite, Batangas and Quezon, consisting of 8 cities and 49 municipalities.

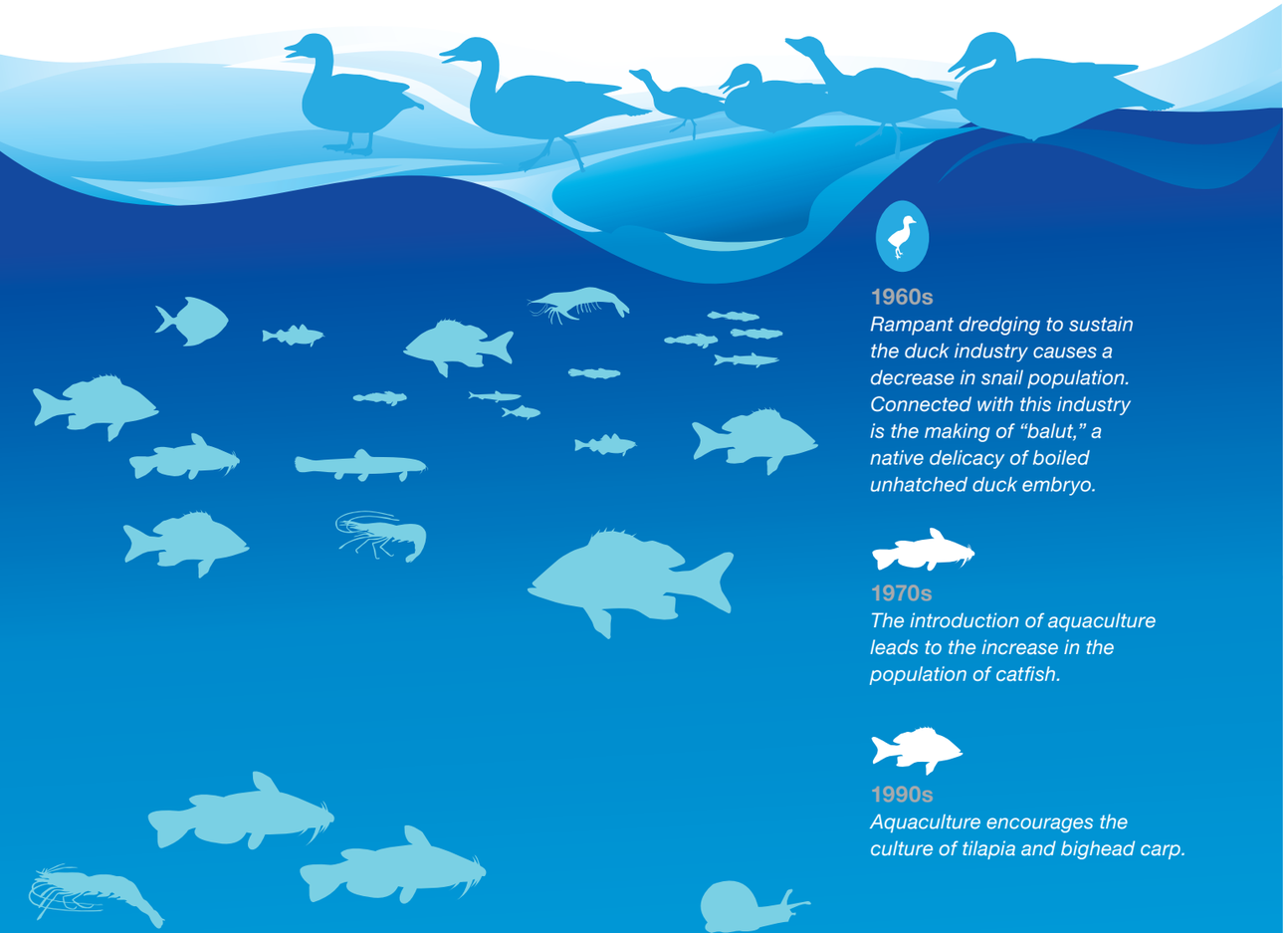
RIVERS & STREAMS
Roughly 100 rivers and streams drain into the lake.

Over one-third of the lake waters come from the Pagsanjan-Lumban River, 18-20% from the Sta. Cruz River, and half from the remaining tributaries.

The lake's only outlet is the Napindan Channel, which links the Pasig and Marikina Rivers. The Pasig River connects the lake to Manila Bay.

Biodiversity and Fishery

Laguna de Bay is classified as a Class C inland water, which means it is suitable for fishery.



In Laguna de Bay, there were 23 species of fish belonging to 16 families and 19 genera. The most dominant and important species were *Therapon plumbeus* and *Glossogobius giurus* (white goby) (Delmendo and Bustillo 1968). Most of the stock were migratory species but scarce in distribution due to the pollution of the Pasig River, suggesting high mortality of migrating fry. Stocking the lake with milkfish was reported to be in practice since 1959. This was one of the reasons for the accidental introduction of other species. The practice went on since milkfish command a higher price in the market (Santos-Borja and Nepomuceno, 2004).

During the same period, there was a significant decrease in snail population due to rampant dredging to sustain the duck industry notably in the eastern towns of Rizal Province. Connected with this industry is the making of “balut,” a native delicacy of boiled unhatched duck embryo. Almost twenty years after, there was a tremendous decrease in the number of duck farms. Snail dredging was also one cause of the alarming decline in the population of the sea catfish (Arius manilensis) which used to constitute the fishery of Laguna de Bay.

A few years after the introduction of aquaculture in the early seventies, the population of catfish started to increase. It has slowly increased its population mostly near the fish pen areas where they seek shelter. The decline in population in the previous years could be more due to habitat destruction than the decline in the snail population (Santos-Borja and Nepomuceno, 2004).

Aquaculture remained a very lucrative business in the lake and this encouraged the culture of other species like tilapia and the bighead carp. The stock assessment of major fishery resources done by Palma and Pol (1997) showed that the open water catch was composed of 13 species, including the shrimp commonly found in the lake. Of the fish species, the most commonly caught were *Tilapia sp., H. nobilis* and *A. manilensis*.

At present, there are no recorded endemic species in Laguna de Bay, probably because it is a very young lake, formed some 6,000 years ago (Jaraula, 2001). Likewise, its link to Manila Bay and the introduction of non-native species could have contributed to this phenomenon.

Water Quality

Laguna de Bay is classified as a Class C inland water (DENR 1990), which means it is suitable for fishery. Critical levels of pollution were already detected in 1973 (SOGREAH 1974). About 5,000 tons of nitrogen were estimated to have entered the lake, 26 percent of which was domestic, 36 percent from livestock and poultry, 5 percent from industrial sources, 11 percent from fertilizers and 22 percent from the Pasig River backflow. In 1995, of about 66,305 tons/year of BOD loading, estimates show that the main source had shifted from industrial (21 percent) to domestic (65 percent), while the contributions from agricultural sources (13 percent) and forest areas (1 percent) did not manifest significant changes. This trend continued into the next decade such that in 2000, out of 74,300 metric tons/year of BOD loading, around 69 percent came from domestic and 19 percent from industrial sources, while agriculture manifested slightly lower loading (11.5 percent) and forest areas (1 percent) the same level (LLDA-DSS 2005). In 2010, calculated 81,701 metric tons/year of BOD loading into the Laguna Lake was contributed by domestic sources (about 78 percent) ,industrial sources 11 percent, agricultural sources 10 percent and 1 percent from denuded forest (LLDA-DSS 2012; LISCOP M&E Report). On the other hand, for the same period (1995-2010) dissolved oxygen levels have consistently been much better (from 7 to more than 9 mg/L) than the 5 mg/L Class C criterion. The current state of the lake is eutrophic. Several factors contributed to this present condition: population pressures, industries mostly found in the densely populated west bay area, and intensive agriculture and land-use conversion, which increased sediment loading in the lake.

History of Flood Disasters

Because of its location and ecological challenges, the Laguna Lake Region is among the most vulnerable to natural disasters in the country. There were historical records of flood disasters occurring in the lake region for many years. The most recent and most damaging flood events were typhoon Milenyo (September 2006), typhoon Ondoy (September 2009), typhoon Pepeng (October 2009), and typhoon Santi (October 2009). Overall, the damages and losses inflicted by these typhoons in 2006 and 2009 in the Laguna Lake Region were 1,233 dead, injured and missing, 318,055 damaged residences, PhP 2.12 billion damage to agriculture (PDNA, 2009).
A 2010 synthesis report of the World Bank (WB), Asian Development Bank (ADB), and Japan International Cooperation Agency (JICA) estimates that the costs of flooding ranged from PhP 15 billion ($337 million without climate change, 1-in-10-year floods) to PhP 111 billion ($2.5 billion with climate change, 1-in-100-year floods.) These impacts

translate to roughly 3 to 24 percent of greater Metro Manila and Laguna Lake Region's Gross Domestic Product (GDP).

The report notes that flooding in Metro Manila is caused by the limited capacity of most upstream river channels draining into the Laguna Lake to confine floodwaters, the slow-flow capacity of the outlet channel from the Laguna Lake, and the declining capacity of the Laguna Lake itself to serve as a detention reservoir for floodwaters.

As LLDA celebrates 44 years of existence, it is mindful of the four decades of human activities that have changed and shaped the landscape of this region. It remains committed to restoring ecological balance to the lake, the region and its people, and transforming this all-important resource as a focal center of climate-resilient and sustainable development for the region and the country as a whole. The Ecological Footprint will play a major role in these efforts, now, and well into the future.

Biocapacity of Laguna Lake Region

Biocapacity

What is it?

GRAZING LAND

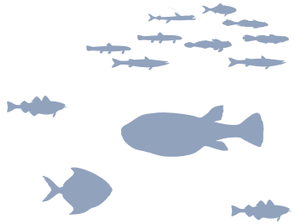
The area of grassland used, in addition to crop feeds, to raise livestock for meat, dairy, hide and wool products.

CROPLAND

The area required to produce food and fiber for human consumption, feed for livestock, oil crops and rubber.

FISHING GROUNDS*

The area of marine and inland waters used to harvest fish and other seafood.



FOREST LAND

FOR PRODUCTS

The area of forest required to support the harvest of fuel wood, pulp and timber products.

FOR SEQUESTRATION

The forest area required to sequester human-produced CO_2 emissions, primarily from fossil fuels burning, that are not absorbed by oceans.

BUILT-UP LAND

The biologically productive areas covered by human infrastructure, including transportation, housing and industrial structure.

Biocapacity is a measure of the amount of biologically productive land and sea area available to provide the ecosystem services humanity uses. We could call it “the supply side of our ecological budget.” It is nature’s regenerative capacity. (See appendix for methodology.) The amount of biocapacity varies over time. This is driven by changes in managing practices, agricultural inputs, water supply, climate and soil conditions.

Overuse can also degrade biocapacity. Per capita biocapacity, or the amount of biocapacity available per person, declines as populations increase. For centuries, we have treated biocapacity as a provider of an essentially limitless flow. Today, though, humanity’s demand for biocapacity outstrips global supply by 50 percent. In the Asia-Pacific region, demands on biocapacity now exceed the region’s supply by 90 percent. Japan and South Korea demand six to seven times more from nature than their ecosystems can provide. China demands 2.4 times more ecological resources and services than China's ecosystems regenerate. In a world of growing ecological overshoot—when humanity’s demands for nature’s products and services exceed the planet’s ability to renew them—this dependence on external biocapacity becomes a significant risk. It means that humanity’s economic activities are fuelled by depleting the planet’s ecological assets—a strategy that cannot last. Cities and countries trapped in energy- and resource-intensive infrastructure and economic activities will become fragile. If they cannot minimize their dependence, they will not be able to adapt in time to meet emerging challenges.

* These calculations did not take biocapacity from fishing grounds into account due to insufficient data.

How Much Can Laguna Lake Region Provide Per Person?

The Laguna Lake region spans 370,000 hectares. But because these hectares are biologically far more productive than world average, they correspond to 810,000 global hectares (gha). On average, hectares in the Laguna Lake region are even 10 percent more productive than the rest of the country. More than half (53 percent) of this biocapacity comes from Laguna province, which has 390,000 gha of biocapacity. This is because it is both a large portion of the region, and contains fertile land close to the Laguna Lake. In comparison, Rizal province, with the second highest biocapacity in the region, has 180,000 gha.

In 2009, the most recent year for which data were available, built-up land was the largest portion (37 percent) of Laguna Lake region's total biocapacity – a reflection of the rapid development in the region, particularly in Metro Manila. Built-up land includes biologically productive areas covered by human infrastructure. It is counted proportional to its agricultural potential – not for what it is producing now. These areas are considered exclusively occupied by infrastructure, and thus not available for other use. The second largest portion was cropland at 34 percent; followed by grazing land at 15 percent, and forest land at 14 percent (FIG.6).[1]

While Laguna province is an ecological powerhouse, and the region is more productive than the rest of the country, its biocapacity is insufficient to meet the needs of the region's growing population, which was 14,600,000 in 2009. Biocapacity per capita in Laguna Lake region is 0.06 gha, only one-twelfth of the average biocapacity per person for a Philippine resident (FIG.7).

When looking at the biocapacity breakdown for Laguna Lake region, the 0.06 gha per person translates to approximately: 0.02 gha of cropland; 0.008 gha of grazing land; 0.008 gha of forest land; and built-up land. Imagine if these 0.02 gha of cropland were dedicated to only growing rice; if the grazing portion of the individual's biocapacity only provided beef, and if the forest land only produced timber.

1 These calculations did not take biocapacity from fishing grounds into account due to insufficient data.

FIGURE 6.
THE PHILIPPINES HOUSEHOLD FOOTPRINT BY CONSUMPTION LAND USE CATEGORIES

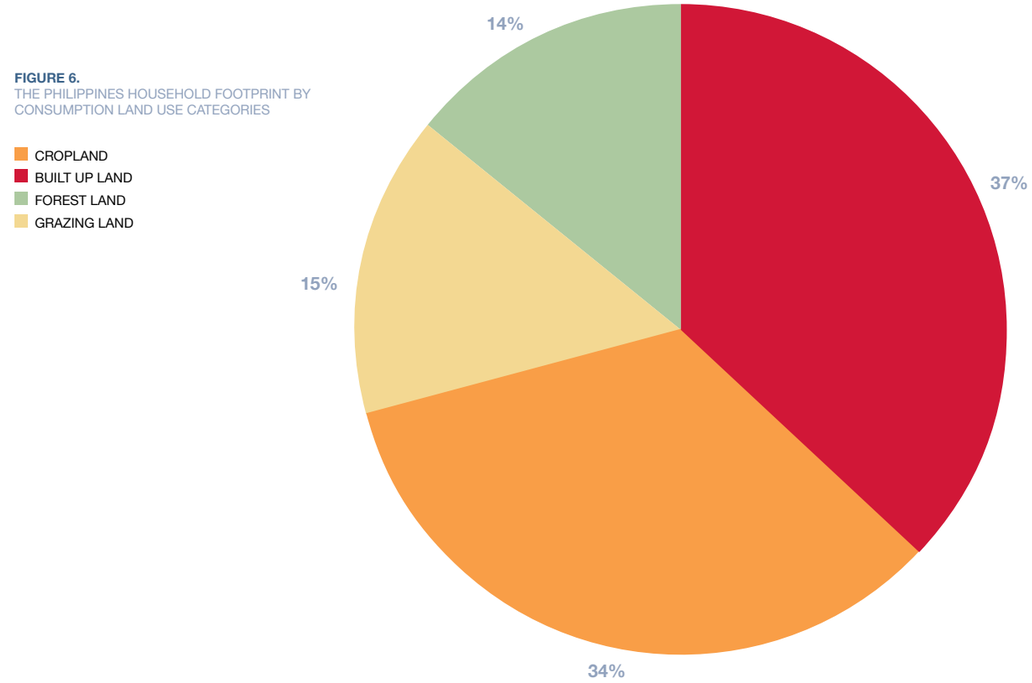
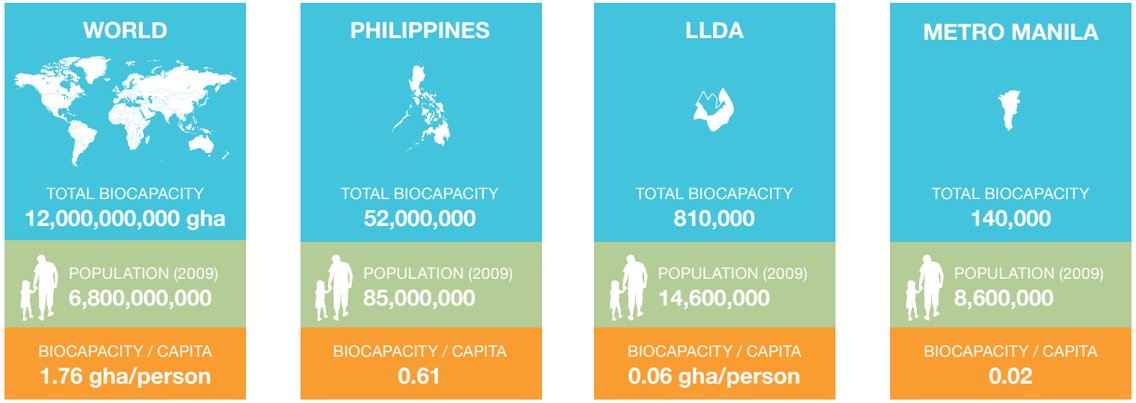


FIGURE 7.



What can 0.06 gha provide per person in Laguna Lake Region – compared to what is available in other regions and the world?

FIGURE 8.

REGION	CROPLAND		GRAZING LAND	FORESTS	
	LAND AREA (SQM)	TOTAL FOOD ENERGY[1] (KCAL/PERSON/DAY)	TOTAL FOOD ENERGY[2]	LAND AREA (SQM)	IF ONLY TIMBER WAS GROWN[3] (CM)
METRO MANILA	1	7	1	1	0.03
LAGUNA LAKE REGION	60	300	20	67	2
PHILIPPINES	1100	6000	36	800	20
WORLD	1700	9200	500	6400	160

[1] If only rice were grown (kcal/person/day)
[2] If only beef were raised (kcal/person/day)
[3] length of a 2"x4" piece of wood per day per person (in cm)

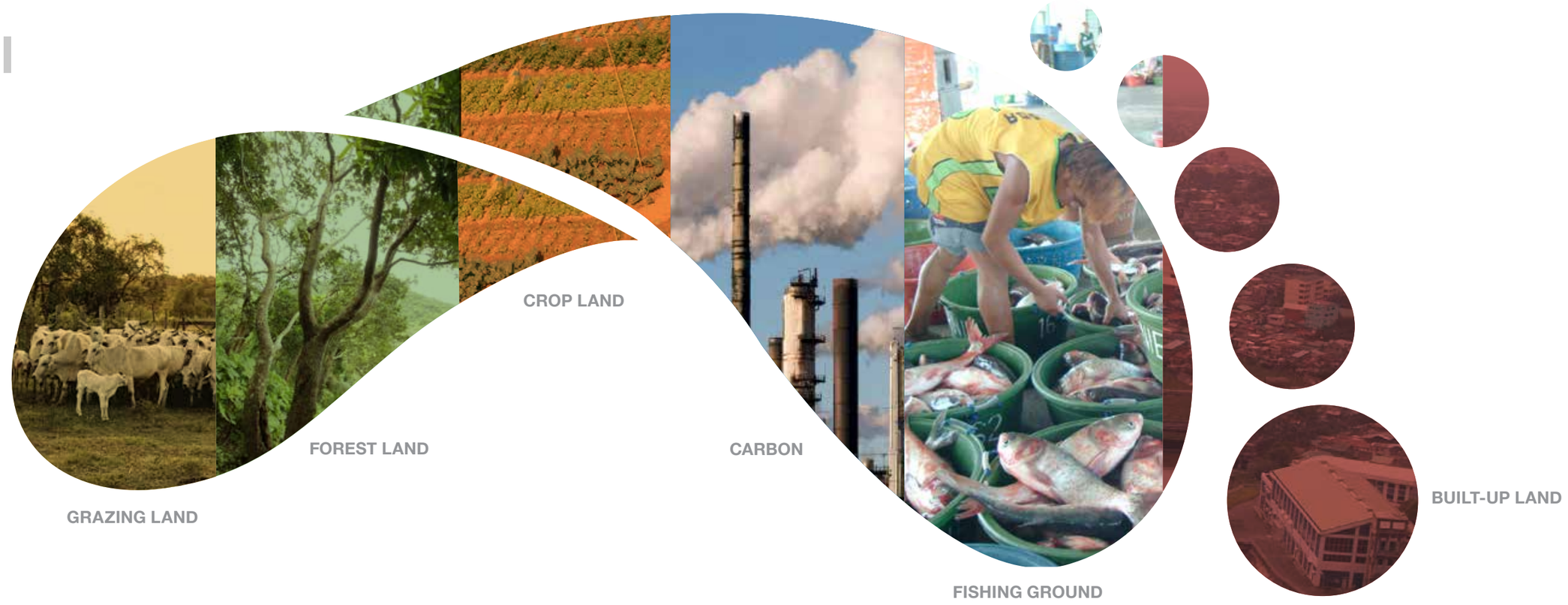
For example, there is about 1 sq. meter of cropland in the Metro Manila area per person. This area, if dedicated entirely to rice production, would provide on average 7 kcal of rice per day (or about 65 grains of rice).

Of course, most regions do not depend solely on natural resources from within their own borders, though many, such as Laguna Lake region, provide resources to other regions. So the question is: Do they, in net terms, need more than what they have? To compensate for their biocapacity deficit, residents from Laguna Lake region must depend more on resources outside the region, as well as beyond the Philippines. However, as resources become more scarce and the world more crowded, it will become more difficult to do so; and the most vulnerable – those who cannot afford to pay the higher prices for basic needs such as food, shelter, clothing – will suffer the most.

Laguna Lake region, rich in biocapacity, has an opportunity to seek development that works with nature's budget, rather than overextending themselves and liquidating nature. If this balance can be achieved, advances in human development, and economic progress can be sustained.

Ecological Footprint of Laguna Lake Region

The Ecological Footprint



While biocapacity measures the supply of ecological assets, the Ecological Footprint measures humanity's demand on them. More specifically, the Ecological Footprint is an accounting tool that measures the amount of biologically productive land and sea area required to produce the renewable resources a population (or an activity) consumes and to absorb its waste, using prevailing technology and management practices. (Due to constraints in globally consistent data, national calculations only take CO_2 into account when looking at waste.) A population's Ecological Footprint can be compared with the biocapacity that is available—domestically or globally—to support that population, just as expenditure is compared with income in financial assessments. If a population's demand for ecological assets exceeds the country's supply, that country is running a biocapacity deficit. Conversely, when demand for ecological assets is less than the biocapacity available within a country's borders, the country has a biocapacity reserve. A national biocapacity deficit means that the country is either importing embedded biocapacity through trade, liquidating its own ecological assets, or turning to the global commons. In contrast to biocapacity deficits at the national scale, the global biocapacity deficit cannot be compensated for through trade or using distant commons. Global biocapacity deficits therefore are by definition the same as "overshoot."

The Global Hectare Metric

As mentioned earlier in this report, both Ecological Footprint and biocapacity results are expressed in global hectares (gha)—standardized hectares of productive area with world average biological productivity of a given year. This makes hectares globally comparable. Actual areas of different land use types (in hectares) are converted into their global hectare equivalents by using yield factors and equivalence factors as explained in the appendix.

Different types of area—forest, fisheries, cropland and grazing land— vary in their biological productivity. In general, croplands occupy the most productive areas: They are typically flat, endowed with good soils, and have access to sufficient water. Global Footprint Network assessments estimate world average biological productivity for each area type. Yields also differ widely within each area type. For example, some forests—such as a tropical forest—are highly productive, while other forests can be very low in productivity—such as a tundra where trees grow very slowly and winters are harsh, or forests on the edge of savannas with sparse trees and dry conditions. Global hectares therefore adjust the physical hectare for its productivity. For example, a hectare of fertile cropland would represent more global hectares than one hectare of grazing land, since cropland is able to generate and renew more biological activity than is typical grazing land.

Conversely, a larger physical area in grazing land would be needed to provide the same biocapacity as the same physical area of cropland. Because world bioproductivity varies slightly over time, the value of a global hectare changes from year to year.

Using global hectares as a unit to measure biocapacity is similar to using a standardized monetary unit, such as the U.S. dollar or Philippine peso, for financial accounting.

As mentioned previously, since the 1970s, humanity has been in ecological overshoot, meaning that its annual demand on ecosystems exceeds what Earth is able to provide in any given year. Before, individual cities and countries ran biocapacity deficits. But now humanity's aggregate demand exceeds what Earth can renew.

According to Global Footprint Network's most recent National Footprint Accounts, an ecological accounting data set that tracks global resource and consumption trends, in 2008 humanity consumed ecological resources and services 1.5 times faster than Earth could renew them—a 100 percent jump from 1961, when people used approximately three quarters of the planet's biocapacity. If trends follow even the more moderate projections of UN agencies, humanity would require the resources of almost three Earths by mid-century.

Earth cannot sustain such levels of overshoot. For a limited time, overshoot is possible, but at the cost of depletion and degradation. Weaker natural capital stocks erode economic opportunities and increase social pressure, as already experienced in a number of lower income countries. Examples include Egypt, El Salvador, and Pakistan, all facing severe economic burdens imposed by their biocapacity deficits.

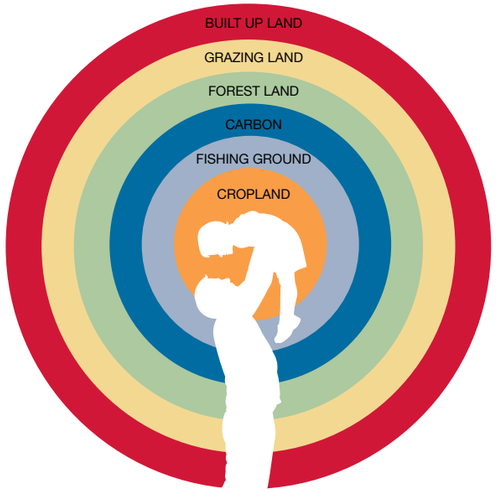
Signs of decline can be seen today through carbon accumulation in the atmosphere, depleted fisheries, deforestation, and soaring food costs. This means that costs of everyday inputs such as food and water will increase, while the value of economic assets that depend on cheap resource inputs (such as airplanes and airports, hotels in distant locations, aluminium smelters, or artificially heated spas) will decline as they are over-proportionally more expensive to operate.

Fossil fuel use is now a prominent driver. Today, the largest component of humanity's Ecological Footprint—55 percent—is the carbon Footprint. In contrast, the carbon component was only 35 percent of humanity's total Footprint in 1961. For all the world's technological gains, development in energy efficiency has not kept pace with the growth in population and the increase of demand for energy used in transportation, electricity, heating and cooling.

FIGURE 9.

If a hectare of, for example, cropland is twice as productive as a world average biologically productive hectare, it is worth 2 gha.

If a particular hectare of, for example, grazing land is half as productive as a world average biologically productive hectare, it is worth half a gha.



The Ecological Footprint of consumption shows the demand on ecological services by an individual or population. It includes local demand and what is imported.

The Laguna Lake region is home to 14.5 million people. In 2009, their total Ecological Footprint for Laguna Lake region was 24,200,000 gha. This is the area needed to renew everything they consume, absorb the CO_2 they emit, and to provide space for urban infrastructure. But the local ecosystems contain far less biocapacity: 813,000 gha. This means that it currently requires the biocapacity of 30 Laguna Lake regions to meet the demand of its population. Resource demands from Metro Manila alone make up more than half – 65 percent – of Laguna Lake region's total Ecological Footprint. The largest component of the Footprint was cropland (35 percent); followed by fishing grounds (24 percent); carbon (23 percent); forest land (7 percent); grazing land (6 percent); and built-up land (5 percent).

Per capita, the average resident of Laguna Lake region had an Ecological Footprint of nearly 1.7 gha. This is higher than the national average of 1.2 gha per person, but just within the world average available biocapacity of 1.8 gha. This means that if everyone on the planet lived like the average person in Laguna Lake region, there would just about be sufficient biocapacity globally to support this total demand (to give wild species a chance to survive, a good portion of the world's biocapacity would need to be left aside for those species). As explained above, these 1.7 gha per person were met by only 0.05 gha biocapacity per person in the region.

FIGURE 10.
TOTAL ECOLOGICAL FOOTPRINT FOR LAGUNA LAKE REGION (GHA)

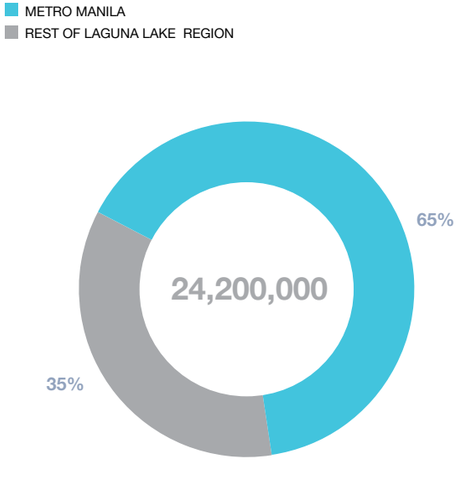
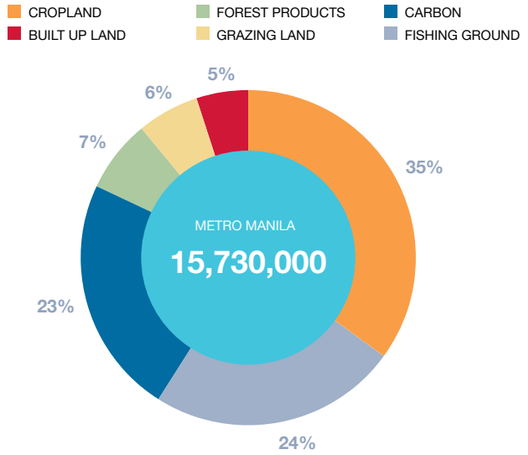


FIGURE 11.
LAGUNA LAKE REGION'S TOTAL ECOLOGICAL FOOTPRINT OF CONSUMPTION BY LAND TYPE

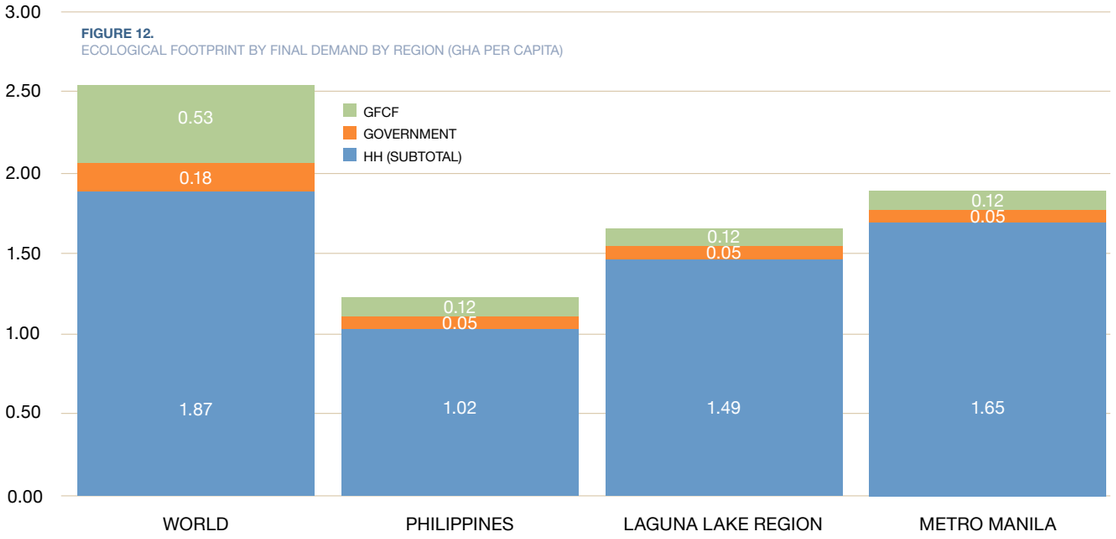


This biocapacity deficit of 1.65 gha per resident was met through the use of global commons, such as emitting CO_2 from fossil-fuel burning beyond local sequestration capacity, consuming imported resources such as food, fiber, forest products and embodied energy from outside the region, and overuse of one's own ecosystems.

This widening gap between demand and supply is particularly significant, given Laguna Lake region's unique role in the country (particularly that of Metro Manila). Laguna Lake region makes up more than 60 percent of the Philippines' GDP. But the function of Laguna Lake region's economy is highly dependent on both the availability of ecological assets outside its borders and its ability to pay for access to the resources and services they produce. Financial assessments may underestimate the importance of biocapacity because agricultural products continue to be undervalued by the market. This blinds us from the reality that lack of resources seriously stifles economies' ability to operate. In other words, Laguna Lake region's biocapacity deficit poses economic risks that can have a ripple effect across the nation.

The Consumption Land Use Matrix (CLUM) Which part is used for what?

FIGURE 12.
ECOLOGICAL FOOTPRINT BY FINAL DEMAND BY REGION (GHA PER CAPITA)



By making ecological limits central to decision-making, local governments within the region have the opportunity to develop strategies and policies that address the challenging twin trajectories of shrinking resource supply, and the growing demands on them.

Attributing the overall demand on nature to particular human activities requires an additional analytical step beyond basic Ecological Footprint accounting. Since statistical offices track how households, government and industry spend their money, we can use these estimates to translate land-based Ecological Footprint results into activity-based Ecological Footprint results. This is called the Consumption Land-Use Matrix, or "CLUM". These final demand categories include: 1) consumables paid for by households (HH); 2) consumables paid for by government (GOV), such as school supplies in public schools, police equipment, paper for public administration; and 3) lasting goods and assets, or "gross fixed capital formation" (GFCF), such as construction of buildings, roads, factories and its equipment.

The direct consumption by households accounts for 90 percent of Laguna Lake region's consumption Footprint. This indicates that residents' daily decisions significantly impact regional (and, subsequently, national) Footprint trends.

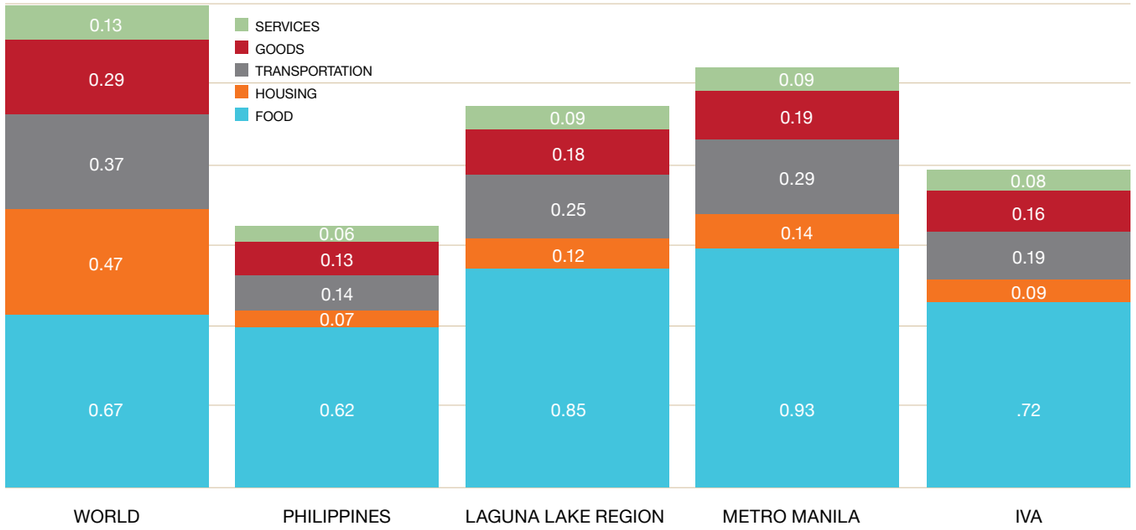
While the direct consumption by government is only 3 percent of Laguna Lake region's consumption Footprint, decisions made by the government have a large impact on how we build cities and infrastructure, which strongly influences household consumption patterns.

FIGURE 13.
LAGUNA LAKE REGION CLUM (CONSUMPTION LAND USED MATRIX)

(gha person^{-1})	CROPLAND	GRAZING LAND	FOREST LAND	FISHING GROUNDS	BUILT-UP LAND	CARBON	TOTAL
FOOD	0.41	0.05	0.01	0.34	0.02	0.03	0.85
HOUSING	0.00	0.00	0.01	0.00	0.01	0.10	0.12
TRANSPORTATION	0.05	0.02	0.02	0.03	0.02	0.11	0.25
GOODS	0.08	0.02	0.02	0.01	0.01	0.04	0.18
SERVICES	0.01	0.00	0.01	0.01	0.01	0.03	0.09
HH (SUBTOTAL)	0.55	0.09	0.08	0.39	0.07	0.31	1.49
GOVERNMENT	0.01	0.00	0.01	0.00	0.01	0.02	0.05
GFCF	0.02	0.01	0.03	0.00	0.01	0.05	0.12
TOTAL	0.58	0.11	0.11	0.39	0.09	0.38	1.55

Ecological Footprint by household consumption is broken down further into five major domains: food, housing, transport, and goods and services. The figure above shows that food Footprint is by far the largest component of Laguna Lake Region's household-driven Footprint (57 percent of the total), followed by its transportation Footprint (17 percent). The consumption of food by household is primarily linked to two land types: cropland (48 percent), and fishing (40 percent).

FIGURE 14.
ECOLOGICAL FOOTPRINT BY CONSUMPTION (GHA PER CAPITA)



The figure above shows that the food Footprint for the Philippines is equivalent to the world average of 0.61 gha, and that both the Laguna Lake region and Metro Manila have higher food Footprints than the national average and the world average. This is likely due to the fact that these populations have relatively higher incomes than the national average. However, as resources become scarcer, food supply could pose a national security issue (as was witnessed in the 2008 rice crisis throughout Asia). Residents of Laguna Lake region, and the country as a whole, are growing more dependent on imported biocapacity for food, and thus access is directly linked to world food prices.

Ecological Footprint for Producing Things

FIGURE 15.

RESOURCE INTENSITY (GLOBAL HECTARES/MILLION PESO)	PHILIPPINES	MANILA + CALABARZON	METRO MANILA	CALABARZON
I. AGRI, HUNTING, FORESTRY & FISHING	58.0	65.6	45.7	67.3
II. INDUSTRY SECTOR	5.6	4.3	5.6	3.5
III. SERVICE SECTOR	1.5	1.3	1.2	1.8
TOTAL	9.8	3.8	2.1	7.2

This table shows how much biocapacity in global hectares is needed to generate 1,000 Philippine pesos. It shows that agriculture requires the most biocapacity per pesos, which could also indicate that agriculture gets undervalued by markets. We assume that resource intensity for Metro Manila is the same as the National Capital Region (NCR), and the one for LLDA is the same as one for NCR plus Calabarzon due to data limitations.

As the Ecological Footprint can track the resource demand for consumption, it can also be used to analyze the economy from the production end. While the consumption Footprint indicates how much it takes to support a resident's consumption, the production Footprint measures how much biocapacity is needed as input to produce all the value added of an economy. It is also possible to calculate the production Footprint minus its demands on the global commons (for example, CO_2 emissions to the atmosphere, since the demands placed on the environment by a country through the emission of carbon dioxide are mostly dispersed throughout the globe). This gives us the direct demand of a country on its own ecosystems. In other words, the production Footprint measures a country's direct harvest of its own biocapacity.

Assessing the Footprint from all these perspectives offers useful and complementary insights. There are also various methods of calculating each. One approach that is increasing in use is based on Input-Output analysis. Global Footprint Network performed a preliminary assessment of the production Footprint of some areas within the Laguna Lake region. Due to its early research phase, the results will be made available in a research paper.

Among the key findings of the production Footprint for the Laguna Lake region is that resource intensity in the agricultural sector is the highest per peso, both in the Philippines as a whole, as well as in the LLDA region.

One could conclude that the service industry is the most efficient way to produce value. But this may be a dangerous interpretation because it may suggest that agriculture is not important. Another interpretation is that agriculture, even though it is fundamental necessity, gets a very small portion of the value added of an economy. As a result we underinvest into the capital that is most significant, and is disappearing the fastest. Natural capital can exist without human capital, but human capital (including social capital, intangible assets, built-up capital) cannot exist without natural capital. Therefore, low resource prices should not be interpreted as lack of importance, but rather as a distortion of value, where agricultural production is poorly compensated, and food security can become a serious and potentially surprising risk.

If agricultural production is grossly undervalued, it can lead easily to its liquidation. This distortion poses major risks, as, ultimately, natural capital cannot be substituted and is at the bottom of every value chain and one of the key factors for maintaining food security.

Next Steps

Resource Limits in Policy

A climate-resilient country with healthy, safe, prosperous and self-reliant communities, and thriving and productive ecosystems: this is the people's vision for the Philippines. In keeping its eyes on the goal, the country endeavors to put its best foot forward and in doing so has embraced the Ecological Footprint as a primary means to understand the key elements that would prove fundamental in pursuing this ideal in the face of the complex web of crises that we confront as a nation, and as a planet.

Looking at the larger context within which we situate ourselves in, the international community's current efforts to address climate change indicate that we may be likely in for a 4 degrees Celsius warmer world, a catastrophic scenario no less, with profound impacts on food, water, natural ecosystems, human security, and spawning irreversible changes. There is no doubt that climate change would deepen poverty and widen the chasm between rich and poor, thereby posing a tremendous challenge to social and human development. And the headlines that we see in the news every day are by no means reassuring. Just in the first half of 2013, CO_2 levels in the atmosphere has breached the dangerous 400ppm threshold.

We likewise confront the sobering fact that every living system in the world today is in decline, compounded with resource scarcity, energy deficits, steep biodiversity decline, and heightened risk to climate change and disasters.

The Climate Change Commission, which led in the formulation of the national vision in the face of the climate change challenge and in embarking on this critical national exercise of ecological accounting, takes pleasure in seeing the Ecological Footprint being embraced by institutions at the sub-national level, in particular by the Laguna Lake Development Authority and the Metro Manila Development Authority in their respective jurisdictions. The importance of the Footprint approach for local government units cannot be overemphasized as their decisions can have a major impact on resource consumption and on building resilience to climate impacts. Such impacts can have far-reaching implications not just for the local communities but for the country as a whole and this is especially true for the Laguna Lake region, which encompasses the main economic nucleus of the Philippines that is characterized by both vast potentials and serious sustainability problems.

The Commission is acutely cognizant of the need for all government agencies and instrumentalities, from national to the grassroots, to work together closely in order to internalize the issue of resource limits into the governance culture and in decision-making processes.

In the first phase of this endeavor, the country produced "A Measure for Resilience: 2012 Report on the Ecological Footprint of the Philippines," which brought to the fore an abundance of key issues that needed to be confronted in the context of the country's quest for resilience. Providing the Philippines with a new framework to measure resilience, the report was endorsed by President Benigno S. Aquino III and formally adopted by the Cabinet Cluster on Climate Change Adaptation and Mitigation, which works to ensure the integrity of the environment by promoting sustainable natural resource utilization and climate change adaptation and mitigation strategies and measures as part of the key result areas of the President's social contract with the Filipino people.

Resource accounting is an idea whose time has come and has immense value at the sub-national level – regions, provinces, cities, and municipalities – where land-use decisions can have a ripple effect on the economy and society. The Ecological Footprint is not a tool that is meant to curtail development and growth, but rather, it is intended to help governments in making development decisions that promote sustainable economies and ensure well-being of the people.

The implementation of the Footprint in the Laguna Lake region in this second phase also marked the capacity-building stage where participating government institutions acquired the necessary know-how regarding the accounting methodology of the Ecological Footprint. This heralds a new era in the country's capacity to take control of its future as from here on out, we have effectively built the local expertise to track and manage our resources, and to use the data and information in our policy-making duties.

With the national vision firmly fixed in our sights, we aim to bring the success of the Ecological Footprint approach to a higher level with its Phase 3, which is intended to marshal the most in-depth Footprint analysis that we will embark on with Global Footprint Network. Together, we will map the flow of the Ecological Footprint between industry sectors and link this flow to consumer final demand. This analysis will help direct more targeted outreach about resource use and waste generation to households and consumers, while also helping the national government understand the ecological impacts of industrial sectors. Guided with the resultant findings, this next phase will also include a scenario analysis and a plan for action.

Our work has been cut out for us. The commitment towards sustainable development is an everlasting ideal. In other words, the work is really just beginning. The objective is to continue to incorporate Footprint accounting and resource limits into public discourse and policy-making in perpetuity -- for a truly sustainable, resilient Philippines.

Naderev M. Saño
Commissioner
Climate Change Commission

Appendix A.i
Calculating the Ecological Footprint, Consumption, Production and Biocapacity

The National Footprint Accounts track countries' use of ecological services and resources, as well as the biocapacity available in each country. As with any resource accounts, they are static, quantitative descriptions of outcomes, for any given year in the past for which data exist. The detailed calculation methodology of the most updated Accounts—the National Footprint Accounts 2012 Edition—is described in Borucke et al. (2013). The National Footprint Accounts 2012 Edition calculates the Ecological Footprint and biocapacity for over 200 countries and regions, from 1961 to 2009.

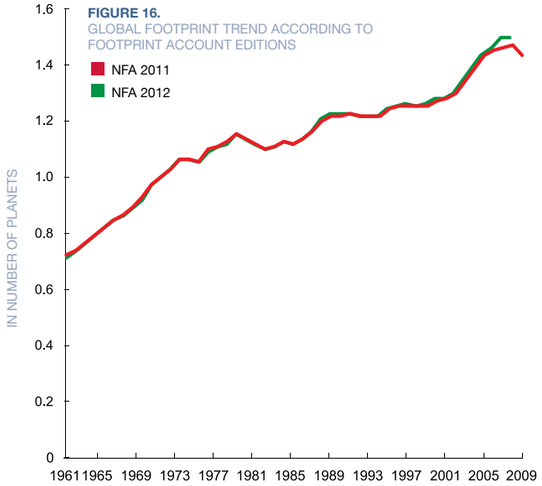
For each annual Edition of the National Footprint Accounts, the most current data for the entire time series is downloaded, forming the basis of all the updated calculations. Some factors and values taken from scientific literature are also updated where possible. New data can cause changes in results between NFA Editions for the same years. Furthermore, in the NFA 2011 Edition, an Intertemporal Yield Factor (IYF) was introduced to allow better comparability between the results for each year within an NFA Edition. Further detail is available in Boruke et al. (2013). By definition, the IYF changes base years in each NFA Edition, which causes a change in the way the results appear between NFA Editions. In some NFA Editions, methodological changes to incorporate the latest research and available data may also affect the results, but no significant methodological changes were made in the NFA 2012 Edition.

DIFFERENCES IN THE ECOLOGICAL FOOTPRINT

The National Footprint Accounts 2012 Edition track human demand for resources and ecological services in terms of six major land-use types (cropland, grazing land, forest land, carbon, fishing grounds, and built-up land). The Ecological Footprint of each major land-use type is calculated by summing the contributions of a variety of specific products. Built-up land reflects the bioproductivity compromised by infrastructure and hydropower. Forest land can either provide forest products, or it can serve for carbon dioxide uptake. In the latter case, it represents the carbon absorptive capacity of a world average hectare of forest needed to absorb anthropogenic CO_2 emissions, after having considered the ocean sequestration capacity (also called the carbon Footprint). The Ecological Footprint calculates the combined demand for ecological resources and services wherever they are located and presents them as the global average area needed to support a specific human activity. This quantity is expressed in units of global hectares, defined as hectares of bioproductive area with world average bioproductivity. By expressing all results in a common unit, biocapacity and Footprints can be directly compared across land use types and countries. Demand for resource production and waste assimilation are translated into global hectares by dividing the total amount of a resource consumed by the yield per hectare, or dividing the waste emitted by the absorptive capacity per hectare. Yields are calculated based on various international statistics, primarily those from the United Nations Food and Agriculture Organization (FAO ResourceSTAT statistical databases). Yields are mutually exclusive: If two crops are grown at the same time on the same hectare, one portion of the hectare is assigned to one crop, and the remainder to the other. This avoids double counting. This follows the same logic as measuring the size of a farm: Each hectare is only counted once, even though it might provide multiple services. The Ecological Footprint, in its most basic form, is calculated by the following equation:

EF = D/Y

where D is the annual demand of a product and Y is the annual yield of the same product (Monfreda et al., 2004; Galli et al., 2007). Yield is expressed in global



hectares. In practice, global hectares are estimated with the help of two factors: The yield factors (that compare national average yield per hectare to world average yield within the same land category) and the equivalence factors (which capture the relative productivity across the various land and sea area types). Therefore, the formula of the Ecological Footprint becomes:

EF = (P/YN)*YF*EQF

where P is the amount of a product harvested or waste emitted (equal to D above), YN is the national average yield for P, and YF and EQF are the yield factor and equivalence factor, respectively, for the country and land use type in question. The yield factor is the ratio of national-to-world-average yields. It is calculated as the annual availability of usable products and varies by country and year. Equivalence factors translate the area supplied or demanded of a specific land use type (e.g., world average cropland, grazing land, etc.) into units of world average biologically productive area (global hectares) and vary by land-use type and year. Annual demand for manufactured or derivative products (e.g., flour or wood pulp), is converted into primary product equivalents (e.g., wheat or roundwood) through the use of extraction rates. These quantities of primary product equivalents are then translated into an Ecological Footprint. The Ecological Footprint also embodies the energy required for the manufacturing process.

Appendix A.ii
Multi-Regional Input-Output Analysis for the Ecological Footprint

WHY EE-MRIO APPROACH IS NECESSARY

The Ecological Footprint has become an influential measure of global demand for biological capital. However, the current National Footprint Accounts (NFA) provide disaggregation only according to land-use types, limiting their utility to government and private sector decision-makers. The information provided by the NFAs is extended by utilizing Environmentally Extended Multi-Regional Input Output analysis (EE-MRIO) through the Global Trade Analysis Project (GTAP) published by Purdue University. The EE-MRIO approach provides Ecological Footprint results for 57 industrial sectors, three types of final demand, and a Consumption Land Used Matrix (CLUM) for 129 world regions, as well as trade data.

Calculation methodology for EE-MRIO at National Level:

Monetary input-output tables were first proposed by Wassily Leontief in the early 20th century. The use of input-output analysis to support physical flow accounting gained early acceptance for energy and pollution analysis in the 1970s. Environmentally Extended Input-Output (EEIO) models have been utilized for material and energy flow accounting and land-use accounting to forecast trends and measure eco-efficiency. Environmentally extended input-output analysis for the Ecological Footprint requires three key calculations: (1) Leontief inverse, (2) direct Footprint intensity, and (3) total Footprint intensity

LEONTIEF INVERSE

The Leontief inverse calculation provides the direct and indirect requirements of any industry supplied by other industries to deliver one unit of output for final demand. For generation of the Leontief inverse, Global Footprint Network utilizes the Global Trade Analysis Project (GTAP) 8 database (https://www.gtap.agecon.purdue.edu/default.asp).

GTAP8 provides coverage of 129 regions (countries). Since GTAP does not cover all the countries in the NFA, concordance matrices are used to aggregate/disaggregate some GTAP regions (e.g. “Sub-Saharan Africa”) into the constituent countries in NFA.

Economic structure for 2004 and 2007. If one assumes the economic structure does not change annually, it is possible to use the EF-MRIO to calculate results for any other year covered in the NFA.

Distinction of 57 products / sectors in each country.

DIRECT FOOTPRINT INTENSITY

To build the EF-MRIO Global Footprint Network requires an Environmental Satellite Account, which is the Ecological Footprint of Production (EFp) as taken directly from the NFA, restructured into the GTAP 57 sector format. In MRIO lingo, the work of restructuring the EFp data from the NFA into the above format is called Initial Allocation (see sample table below).

The direct Footprint intensity is calculated by dividing the Ecological Footprint production of each land type by the total output for final demand, including imports. This represents the direct required Footprint per unit of currency spent.

TOTAL FOOTPRINT INTENSITY

The total Footprint intensity provides the direct and indirect Footprints of industrial sectors to provide one unit of production to final demand—including the entire supply chain. This total Footprint intensity is calculated by multiplying the direct Footprint intensity by the Leontief inverse.

The Results in the EF-MRIO Model:
Ecological Footprint by Final Demand
The Ecological Footprint of consumption is redistributed into three final demand categories by multiplying total Footprint intensity by domestic final demand, which is expressed as household consumption, government consumption, and gross fixed capital formation.

Household Consumption (HH): Short-lived consumption by households (food, housing maintenance, goods and services paid for and consumed within a fiscal year); Government Consumption (GOV): Short-lived consumption by governments (public services, schools, policing, defense, etc.); Gross Fixed Capital Formation (GFCF): Long-lived assets, purchased by households (e.g. new houses, white goods), firms (e.g. machinery), and governments (e.g. transport infrastructure).

Short-lived consumption by business is not a final demand category input-output analysis; it is intermediate demand. To accurately calculate the total EFc for a business, the first step is to prepare a final demand vector itemizing that business’s purchases, then use that final demand vector in a Leontief demand-pull model to calculate the total

environmental inputs required to satisfy that final demand bundle. The final demand bundle used in the EF-MRIO is that of “final” demand, i.e. purchases of goods for the ultimate use before disposal.

CONSUMPTION LAND USE MATRIX (CLUM)

The household component is then redistributed to household consumption categories using a sector-COICOP matrix. This matrix was created by linking data from the Environmental Impacts of Products (EIPRO) project and Classification of Individual Consumption According to Purpose (COICOP). As shown above, a Consumption Land Use Matrix (CLUM) can be created by combining the Ecological Footprint of household consumption, government consumption, and gross fixed capital by land-use type.

CLASSIFICATION OF INDIVIDUAL CONSUMPTION ACCORDING TO PURPOSE (COCICOP)

A CLUM can be used to inform policymaking and consumer choices. For example, households can directly influence their Footprint by changing their consumption pattern. They can also use their influence and voice to change their “societal footprint” i.e. the portions of final demand over which they do not have direct control, such as government buying and government / business capital expenditure.

Calculation methodology for Sub-Regional CLUM: Sub-national CLUMs are developed through scaling procedures that take household expenditures (HHE) for the nation and each region and adjust them by consumer price index (CPI) and energy efficiency data (the percentage of carbon dioxide emissions per unit of energy produced).

National CLUM “Scaling Procedure” Sub-national CLUM Ecological Footprint by government consumption and gross fixed capital formation in each region are allocated the same as the national average due to data limitations and vague definitions of some national government spending and investment allocated to each prefecture.

Appendix A.iii
Methods for Calculating Biocapacity of LLDA Region

Biocapacity is defined as the capacity of ecosystems to produce useful biological materials (to humans) and to absorb waste materials generated by humans, using current management schemes and extraction technologies. Global Footprint Network calculates biocapacity for every country in the world for every year from 1961 to 2009 (the latest year for which data is available); it is calculated as the area assigned to a particular human use, multiplied by yield and equivalence factors. The equation for biocapacity is:

BCi = Ai * YFi * EQFi

where A is the area of a country dedicated to land-type (i),YF is the yield factor (ratio of national yield to world yield) for land-type (i) and EQF is the equivalence factor for landtype (i), which relates the productivity of the six land types track by the Global Footprint Network to a common unit—the global hectare. The total biocapacity is the sum of the biocapacity of all land types.

To calculate the biocapacity of a sub-national region such as LLDA, our methodology consisted of making use of land-use maps of the LLDA region (provided by the LLDA authority itself), and satellite images of values known as net primary productivity (NPP). NPP values are a measure of the biological material produced by photosynthesis, which plants themselves do not use for respiration.
The equation used for biocapacity for sub-regional LLDA is the national biocapacity modified by an NPP factor (ratio of NPP sub-national to NPP national), which scales the national biocapacity to the sub-national level.

We were provided with a higher resolution map for the LLDA region and a lower resolution map for the Philippines. We compared the lower resolution Country map (2002) to the area data reported by FAOSTAT (2009) to determine accuracy with the map. We determined that the higher resolution land use map was more accurate than the lower resolution map for the LLDA region, so this map was used for the area values. However the lower resolution map was used to calculate the NPP factor for each land type in each province since the higher resolution map coverage did not include the entire Philippines.

CAVEATS TO CALCULATION

The area for the Low Resolution Land Use map was not the same as the High Resolution Land Use map. We used land use area values from the low resolution map- the only map for with coverage for the entire Philippines. However, these area values do not match the values from the FAOSTAT database.

Acknowledgements

AusAID
Special thanks to the Australian Government for supporting the Ecological Footprint collaboration for the Laguna Lake region, which includes publication of this report, a technical training to build in-country capacity, and a policy workshop to ensure resource accounting in policymaking.

Global Footprint Network
Pati Poblete
Mathis Wackernagel, Ph.D.
Michael Borucke
Katsunori Iha
Haley Smith Kingsland
Elias Lazarus
Dharashree Panda

Laguna Lake Development Authority
J.R. Nereus O. Acosta, Ph.D.
Dolora N. Nepomuceno
Adelina C. Santos-Borja
Jocelyn G. Sta. Ana
Rowena J. Pagdingalan
Maristel C. Espiritu
Charisse V. Lopez
Leonor A. Poserio
Maureen S. Tolentino
Eduardo L. Torres/John Andrew de Guzman
Alvin A. Faraon
Adelio D. Rico
Irish I. Hormachuelos
Maria Carolane P. Gonzales
Marigold M. Del Prado
Beniaflor Ada
Ireneo G. Bongco

Climate Change Commission
Commissioner Lucille Sering
Commissioner Naderev Saño
Desiree Llanos Dee

Metro Manila Development Authority
Chairman Francis N. Tolentino
Aristidy Correa
Maria Luwalhati C. Dorotan
Reynaldo Estipona
Jo Faulan
Marvelous S. Libril
Emma Quiambao
Joaquin Antonio M. Santos
Alex Umagat

Office of the Presidential Adviser for Environmental Protection
Phillip Fullon
Jenica Dizon
Melissa Lavente

Data Sources (External)
National Statistical Coordination Board
National Statistics Office
National Economic and Development Authority
Department of Energy
Mario Marasigan
Jess Tamang

Photographs
Pictures were contributed by the following LLDA offices/units:
Public Information Unit - Office of the General Manger
Office of the Assistant General Manager
Project Development, Monitoring & Evaluation Division
Jeffrey Delfin/UNWFP

Design
Tink Tank Studio

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www.ausaid.gov.au

Global Footprint Network
In 2003, Global Footprint Network, a 501(c)(3) nonprofit organization, was established to enable a sustainable future where all people have the opportunity to live satisfying lives within the means of one planet. That is why our work aims to accelerate the use of the Ecological Footprint – a resource accounting tool that measures how much nature we have, how much we use, and who uses what.

The Ecological Footprint is a data-driven metric that tells us how close we are to the goal of sustainable living. Footprint accounts work like bank statements, documenting whether we are living within our ecological budget or consuming nature's resources faster than the planet can renew them.
www.footprintnetwork.org

Laguna Lake Development Authority
The LLDA was organized by virtue of Republic Act No. 4850 as a quasi-government agency with regulatory and proprietary functions. Through Presidential Decree 813 in 1975, and Executive Order 927 in 1983, its powers and functions were further strengthened to include environmental protection and jurisdiction over the lake basin's surface water.

The Laguna Lake Development Authority envisions a Laguna Lake Region with a balanced ecology, maintained through a science-based approach in monitoring, management and maintenance of the ecosystem. It aims to make the Laguna Lake Region a model of environmental governance in Asia and the focal area of sustainable development for the region and the whole country.
www.llda.gov.ph

Metropolitan Manila Development Authority
The role of the Metropolitan Manila Development Authority is to assist the 17 political units within Metro Manila in crafting and implementing an integrated development plan characterized by unity of purpose, innovation, resiliency, sustainability, adaptability and creativity in meeting the challenges of transport decongestion, climate change, waste management, and disaster prevention among others, in order to achieve a decent quality of life for Metro Manilians.
www.mmda.gov.ph