JAPAN ECOLOGICAL FOOTPRINT REPORT 2009

ECOLOGICAL FOOTPRINT REPORT | JAPAN 2009

MAINTAINING WELL-BEING IN A RESOURCE CONSTRAINED WORLD

WWF

Global Footprint Network

Contents

WWF JAPAN

WWF is a global conservation organization acting locally in more than 100 countries aiming at building a future in which humans live in harmony with nature. To achieve this, WWF is working with its many partners to save biodiversity, and to reduce humanity's impact on natural habitats. WWF Japan, established in 1971 as the 16th office of WWF. Together with the WWF Network, we look for solutions to the key environmental issues like climate change and depletion of natural resources through field based projects, communications and policy initiatives with a foundation in science engaging with businesses, researchers, governments, international organizations, and local communities.

GLOBAL FOOTPRINT NETWORK

Global Footprint Network promotes a sustainable economy by advancing the Ecological Footprint, a tool that makes sustainability measureable by calculating how much nature can provide, how much we use, and who uses what. Together with its partners, Global Footprint Network coordinates research, develops methodological standards, and provides decision makers with robust resource accounts to help the human economy operate within the Earth's ecological limits.

Have you ever taken the time to stop and
think about the impact of our everyday life on the planet?

If everyone in the world lived the way
an average Japanese citizen lived,
we would need 2.3 planets.
How can we live within one planet?

The Ecological Footprint, a resource accounting tool,
tells us how much stress our lifestyles put on
the environment, and gives nations,
cities and corporations the data necessary to
manage their resources and achieve one-planet living.

What is the Ecological Footprint (EF)?

The Ecological Footprint is the amount of productive land and sea area required to produce the resources we consume and absorb our waste,including CO_2 emissions – and compares that with biocapacity, the ability of ecosystems to regenerate resources. The more resource-intensive one's lifestyle, the more land and sea area is required to support it. For example, the average per capita Ecological Footprint of the Japanese is 4.1 ghectares. For Americans, it is 9.0 ghectares.
Yet the average biologically productive area per person worldwide is only 1.8 ghectares, not taking into account areas needed for wild species.
It makes our excessive lifestyles very explicit.

The Ecological Footprint allows us to see our past and our present –and it gives the data we need to change the course for our future.

Foreword

Since the earliest stages of human civilization, people have satisfied their basic needs for water, food, daily-use commodities and medicines by obtaining these things from nature at little or no cost. Based upon their access to nature's unlimited gifts, civilizations arose all over the world, yet regardless of their level of development, all still remain dependent on natural resources for their survival.

The biosphere can be thought of as a huge symphony woven by countless living creatures and cultivated by nature over the course of billions of years. Today, however, the continuation of this system has reached a critical junction. Given the uninterrupted rise in human population and rapid economic development, we have tended to approach the classification of nature the biosphere from a very narrow viewpoint: how can it be used to profit the human race. In this way, we have excessively consumed, and in some cases even exhausted, the free gifts nature provides. The consequences of this policy are extremely serious. The idea behind the "Ecological Footprint" is to attempt to measure the sustainability of the demands that human activities place on the biosphere. From the results of such measurements, it has become clear that people are consuming natural resources at a rate exceeding what the earth can continue to produce by a wide margin.

Japan provides its citizens with an abundance of gifts courtesy of its natural ecosystems, including a wide diversity of foods obtained from both the land and the very rich surrounding sea. Japanese culture has also developed a unique view of the natural world and has adopted and followed a lifestyle in tune with the changing seasons for many centuries. In the years after World War II, Japan developed industrially through technological innovation and investment, and the nation became renowned as an economic power. Nowadays, however, from successive and rapidly propagated waves of globalization, Japan's economy would no longer be able to function if the country was cut off from the outside world, and the current way of life would be unable to continue. Today's Japanese lifestyle is heavily dependent on international natural resources. The purpose behind the publication of Japan's Ecological Footprint 2009 is to provide data showing the impact of Japan's activities on the Earth and to raise awareness of the risk of the entire world rapidly running out of resources and of the situation Japan would face in such a world. Further, in order to change the Japanese lifestyle while maintaining Japan's current standard of living, it will be vital to make a shift from a society that prioritizes economic growth to an economic society based on environmental preservation and cultural development. This document provides an objective and measurable starting point for politicians, businesses and individuals to act together to address the key challenges of sustainability.

If all of us were to keep the same lifestyle we have now, by mid-2030 the equivalent of two Earths would be required to support our standard of living. At the global level, this ecological "overshoot" cannot continue indefinitely without posing serious threats. Already, we can see symptoms of this imbalance through climate change, deforestation, soil degradation, fisheries collapse, river pollution, the disappearance of glaciers and ice fields, and through the endangering of many species of living things.In addition, with Japan's domestic biological productivity of 0.6 gha per capita, the nation is in ecological debt. To meet Japan's present standard of living, the nation relies on natural capital from outside its borders through trade. The Japanese people need to understand these facts deeply. Today, throughout the world, public awareness is on the rise that the environmental challenges we face demand collective and immediate action. In Japan, a variety of such measures have been implemented and progress is being made little by little toward reversing current trends. Regrettably, however, we are in a critical situation in which the earth is deteriorating more rapidly than such measures can address. Clearly our present efforts to tackle this issue are insufficient. What we need to do now is to take a more drastic approach. If we underestimate the urgency of the present situation by assuming that "conventional countermeasures against environmental problems will be sufficient," the situation will deteriorate progressively and at an increasing pace. Once nature has been degraded, it is considered virtually impossible to return it to its original condition. In order to prevent today's kindergarten and pre-school children from facing desperate environmental deterioration by the time they come to form the nucleus of adult society, we have reached the time when society as a whole must take concerted action.

The Environmental Basic Law, which has become the core pillar of Japan's environmental policy, states as one of its fundamental ideas that:

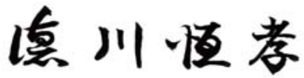
"With regard to environmental preservation, maintaining a healthy and richly blessed environment is indispensable to people's healthy and cultural living... There is a possibility that the finite environment that forms the basis for the continuation of human life may be damaged as a result of the environmental burden imposed by human activities... Our activities should be conducted appropriately in order that present and future generations may enjoy the benefits of a healthy and richly blessed environment that can be maintained into the future."

The fundamental idea behind this law is that the entire nation understands the law's purpose and that in order to improve the environmental situation all our activities must be undertaken appropriately. It is an obligation on all of us who drive society now to maintain our limited natural environment without further deterioration so that future generations will be able to enjoy the blessings of nature in the same way that we do.

In order to realize this goal, Japan will have to modify its economic activities so that they are firmly based upon world environmental preservation. It is essential that state and private financial systems take the needs of the environment into full account, that all corporations pay due consideration to the environment in the context of their guidelines' social responsibility activities, that national and local government legal systems and environmental policy contribute to the preservation of the global environment, and most importantly of all, that all citizens pay serious consideration to environmental issues, take a tough attitude against environmental degradation, and take action to purchase products that are environmentally conscious.

We Japanese have a history during which we created a comprehensive recycling society at the dawn of the modern age by cutting out waste and making maximum use of our limited natural resources without damaging them. This early modern society, which stood in awe of nature, protected its forests, refrained from polluting its rivers, and reaped limitless blessings from the seas, mountains, rivers and forests while at the same time creating a rich culture, was also a society that realized leading-edge solutions to environmental issues. It is my belief that Japan, which has achieved spectacular economic development over the past 50 years, can lead the world over the next 50 years in establishing a society in which people live together in harmony with nature by once again firmly uniting all our power.Towards this end, the keys to solving global environmental problems will be based on the power of citizens with an emphasis on ties between people beyond national boundaries. I believe that our role and responsibility in Japan is to change our lifestyle, and thereby hand down a sustainable society and a wholesome future to our children and to succeeding generations.

Tsunenari Tokugawa
Chairman, WWF Japan



Ecological Footprint and Biocapacity

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

Ecological Footprint of Consumption

EF_P does not give an accurate indication of the quantity of resources consumed nationally, which are directly related to domestic well-being. In order to assess domestic consumption of a population we use the Ecological Footprint of consumption (EF_C). EF_C accounts for both the export of national resources, and the import of resources used for domestic consumption. EF_C is most amenable to change by individuals through changes in their consumption behavior.

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

Ecological Footprint of Production

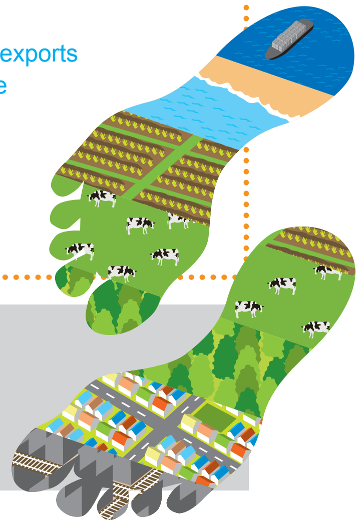
The sum of all human demand placed for the resources from cropland, grazing land, fishing grounds, forests, and built-up land, plus the carbon dioxide emitted, within a country's borders comprise the Ecological Footprint of production (EF_P). This measure mirrors the gross domestic product (GDP), which represents the sum of the values of all goods and services produced within a country's borders. The Ecological Footprint of production indicates the consumption of biocapacity resulting from domestic production processes.

The demands placed on the environment by a country through the emission of carbon dioxide are mostly dispersed throughout the globe. Therefore, if we wish to look specifically at impacts of direct resource harvest on the domestic environment, the carbon Footprint component should be excluded from the calculation (EF_P-carb). The Ecological Footprint of production excluding carbon measures a country's direct harvest of its own biocapacity.

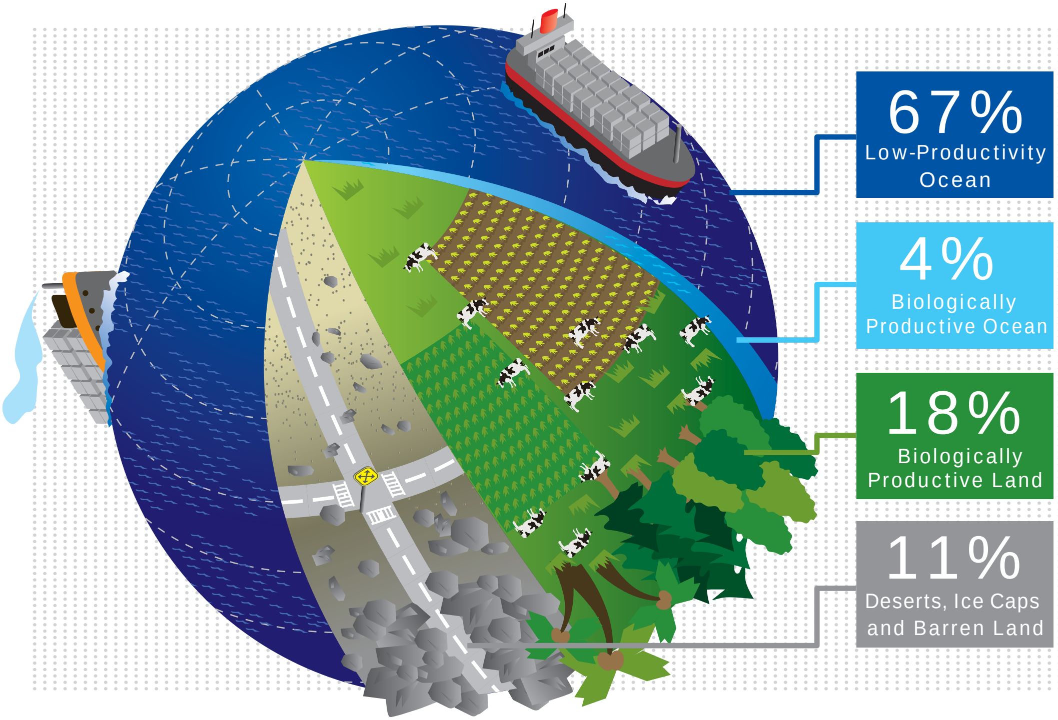
Net Ecological Footprint of Trade

Embodied 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 high, the resources used to support this trade have the potential to reduce the domestically available biocapacity. If the Ecological Footprint embodied in imports is high, then there is an indication that the country may be very susceptible to global resource constraints.

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



Box 1: Calculating the Footprint The Ecological Footprint represents appropriated biocapacity, and biocapacity represents the regeneration rate of resources on bioproductive land. For any land-use type, the Ecological Footprint (EF_P) of a country, in global hectares, is given by: $EF_P = P/Y_N * YF * EQF$; where P is the amount of a product harvested or waste emitted, Y_N is the national average yield for P, and YF and EQF are the yield factor and equivalence factor, respectively, for the land-use type in question. A country's biocapacity (BC) for any land use type is calculated as follows: BC = A*YF*EQF; where A is the area available for a given land-use type.



Biocapacity

The natural environment provides many resources for human use as well as a sink for their waste products.Different areas of land provide different volumes of resources: Highly fertile cropland with high rainfall can produce many more tonnes of food than arid grasslands.

To correctly account for the ability of an area of land (in hectares) to produce resources, the physical land area should be adjusted by the productivity of the land, both in comparison to other countries (the yield factor; see Box 1) and in comparison to other land-use types (the equivalence factor). These adjustments provide us with a measure of a country's biocapacity, in global hectares (gha).

Biocapacity indicates the regeneration of resources and the waste absorption that land can provide.

Ecological Overshoot

Ecological overshoot occurs when a population's Ecological Footprint exceeds the biocapacity of the country. Global overshoot occurs when humanity's demand on the biosphere exceeds the available biological capacity of the planet. By definition, overshoot must lead to a depletion of the planet's life supporting biological capital and/or an accumulation of waste products.

Humanity first entered overshoot around 1980, and since then has continued to increase the amount of overshoot. The cumulative overshoot is known as Ecological debt, and represents issues such as deforestation, fish population decrease, and the accumulation of carbon dioxide in the atmosphere.

Overshoot is the relative amount by which the Ecological Footprint exceeds biocapacity, and violates a basic criterion of sustainability.

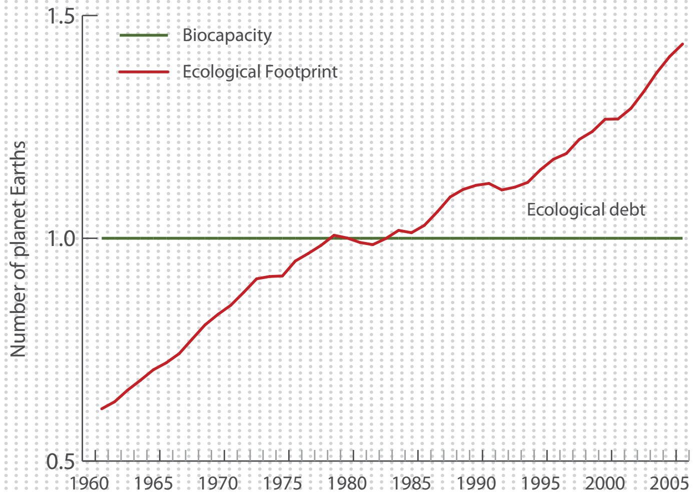
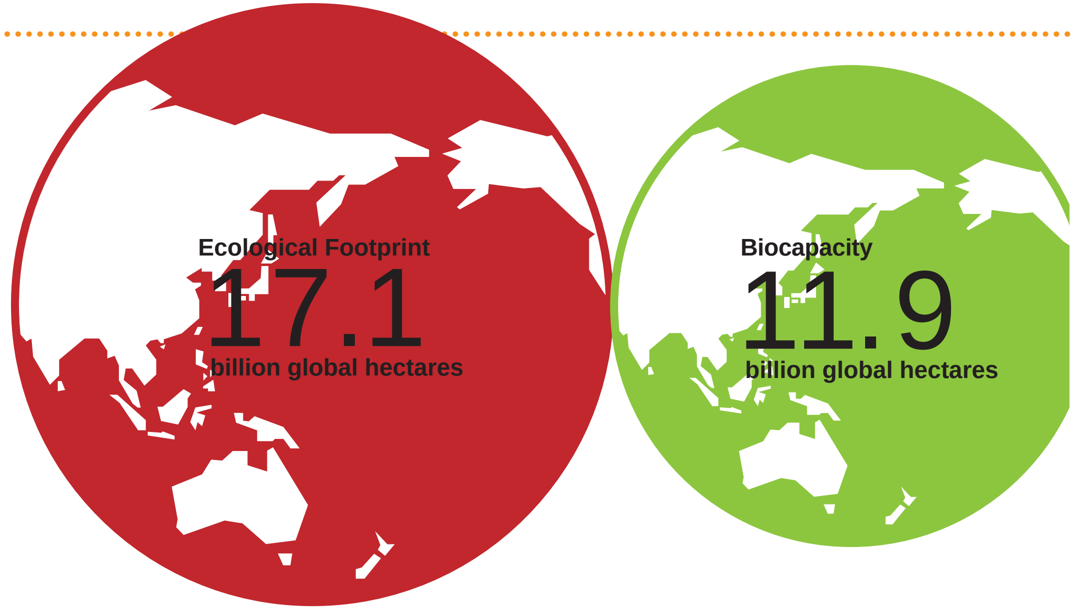


Figure 1. Humanity's Ecological Footprint, 1961-2006

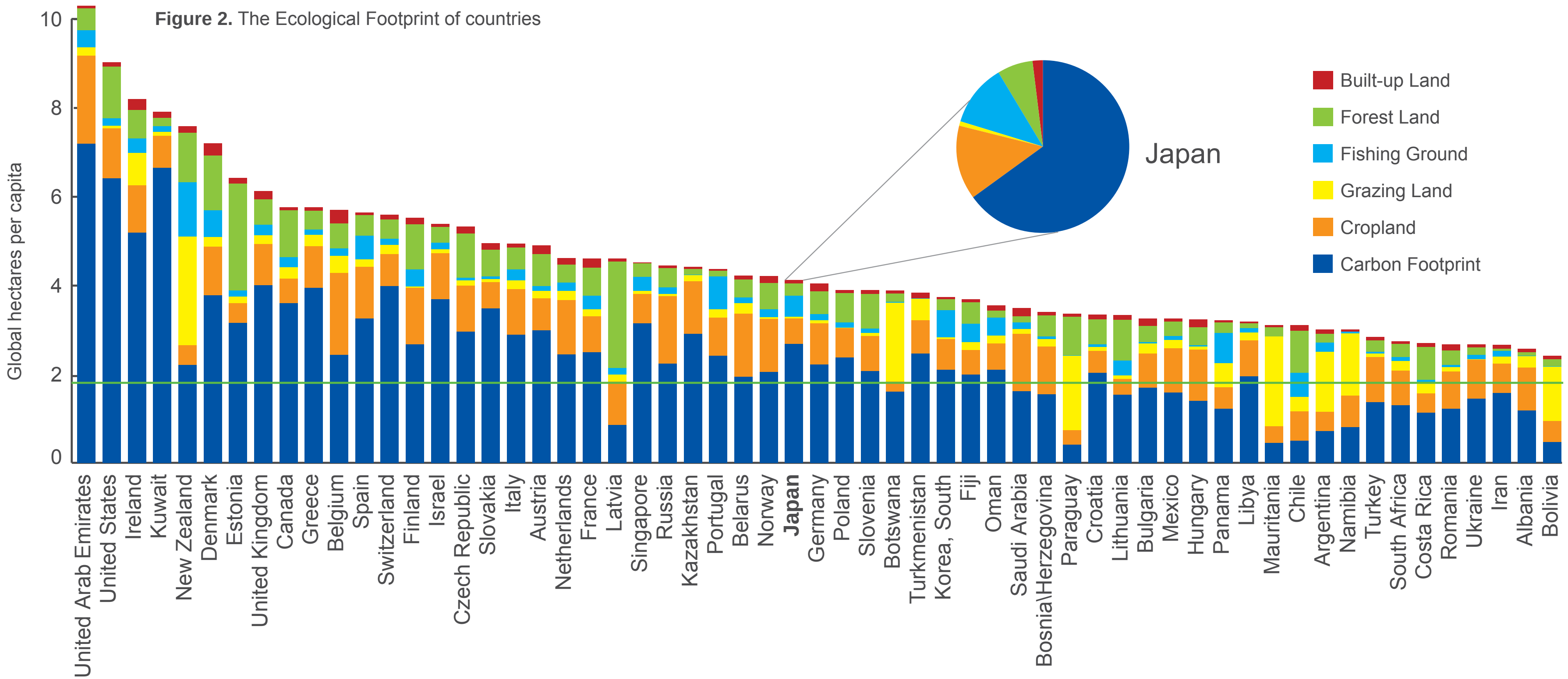
The Global Result

In 2006, humanity's total Ecological Footprint was 17.1 billion global hectares (gha), or 2.6 gha per capita. In that same year, the Earth had a total biocapacity of 11.9 billion gha (1.8 gha per capita).
Humanity's demand first exceeded the Earth's capacity to meet it around 1980. In 2006, the ecological overshoot was 44 percent, meaning that it took the Earth the equivalent of one year and 5 months to regenerate the resources used and assimilate the wastes produced.



Humanity's total Ecological Footprint is much larger than the available biocapacity

Figure 2. The Ecological Footprint of countries



Source: Global Footprint Network, The Ecological Footprint Atlas, 2008.

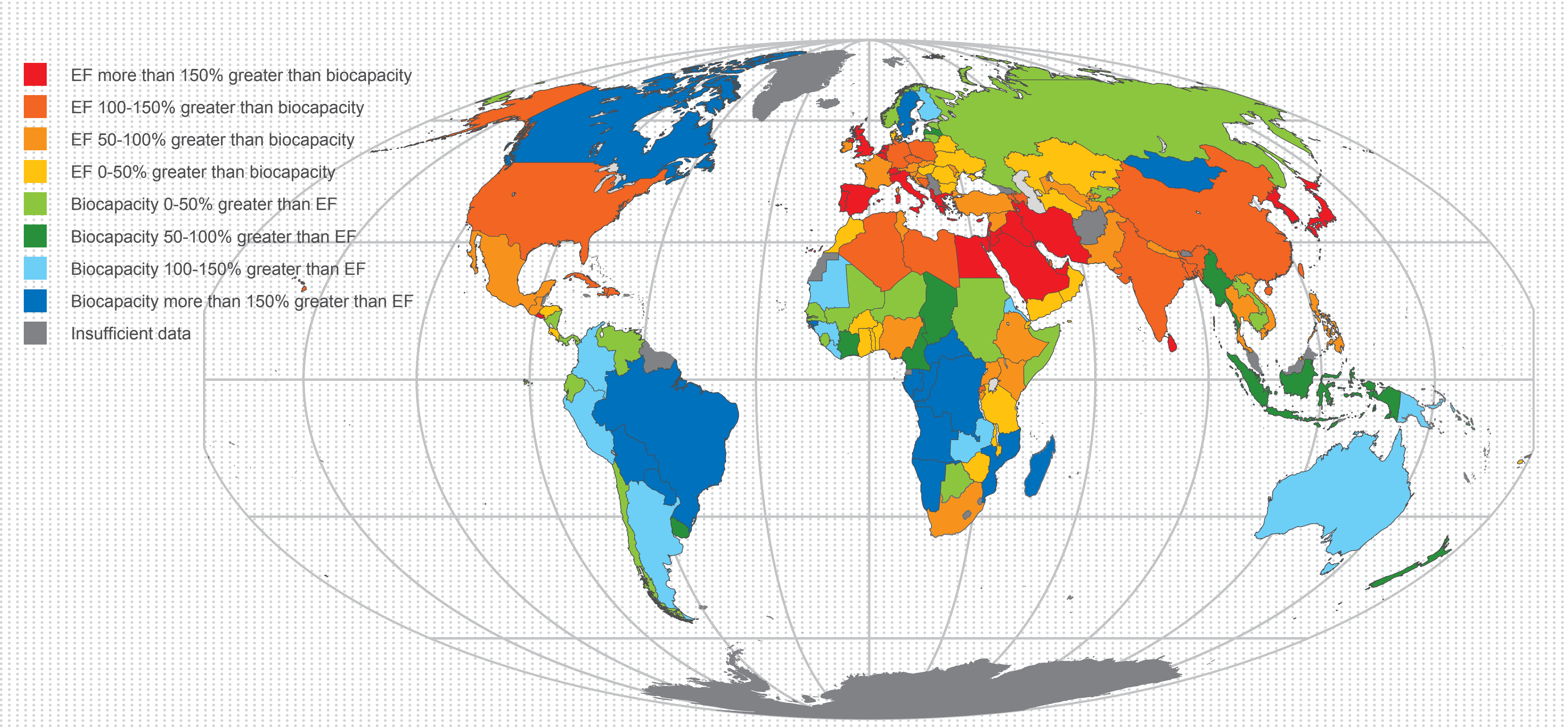
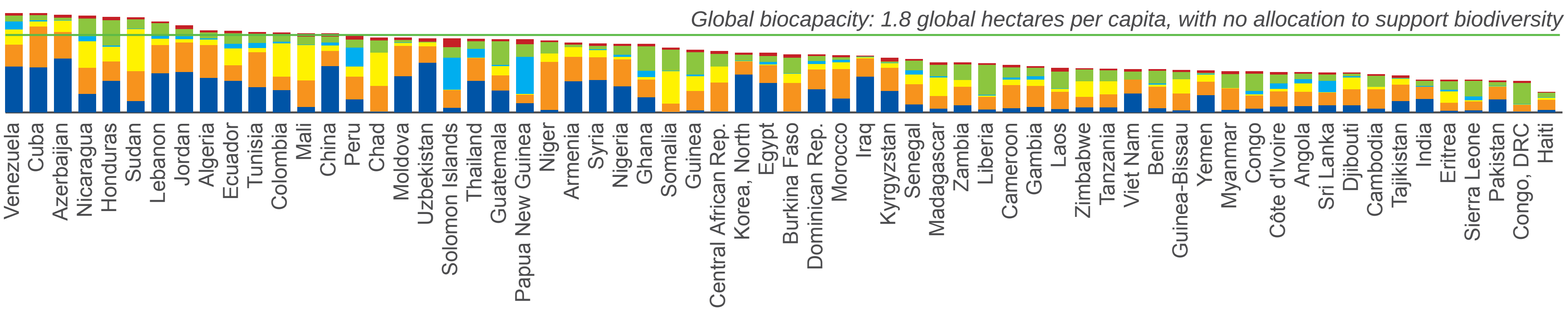


Figure 3. Ecological creditor-debtor status, indicating the Ecological Footprint to biocapacity ratio



The“present”through the EF lens

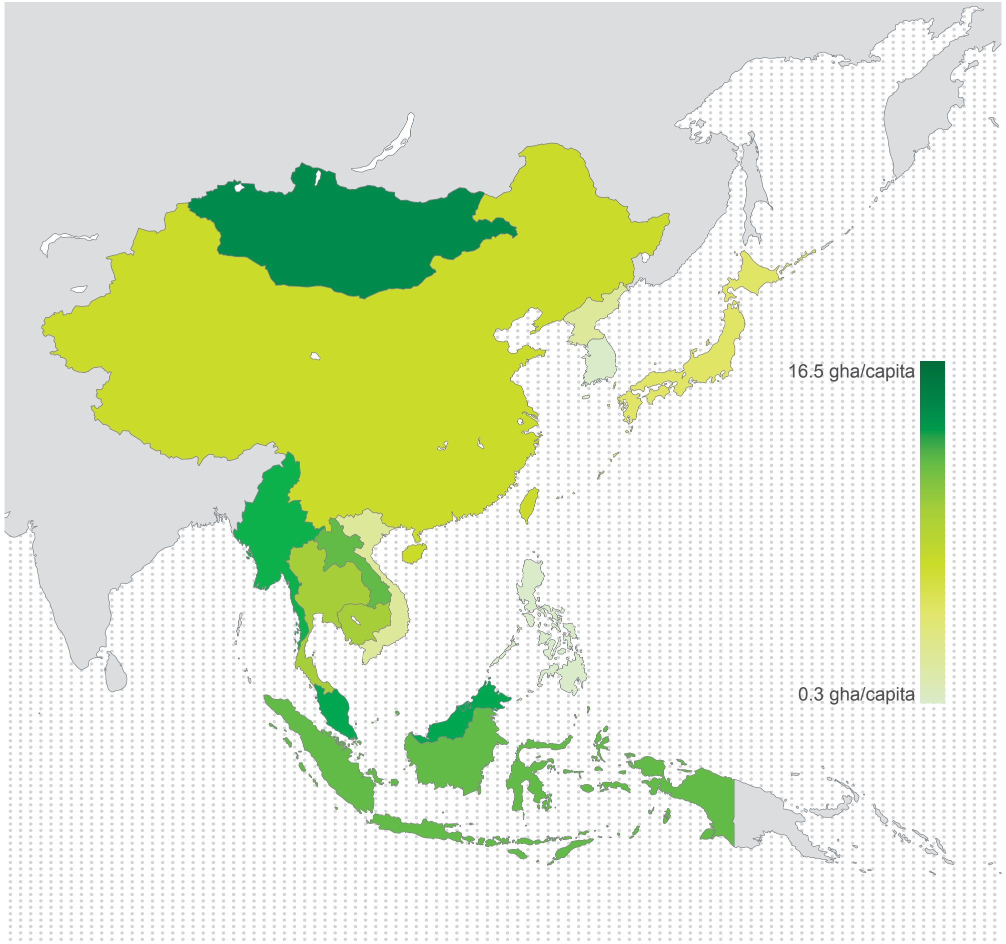
Our current Ecological Footprint exceeds the world average by 50 percent.
By looking at the details of our day-to-day activities, we start to see how different lifestyle choices lead to pressures on our environment.

Japan in the context of Asia

Compared to other regions of the world, the region comprising East and Southeast Asia has a low Footprint per capita of 1.9 gha per capita; below the world average. The regionally available biocapacity is also very low, at only 0.9 gha per capita. On a global scale, the East and South-East Asia region comprises 32 percent of the global population, and is responsible for 23 percent of the global Footprint.

Compared with the four countries closest geographically, Japan has the second highest Footprint per capita; only Russia slightly exceeds Japan's Footprint. Japan's Footprint is 10 percent higher than South Korea's and more than double that of China and North Korea. However,Japan is the only country in the group to have shown a significant decrease in the Footprint over the last decade, and if trends continue, 2010 may well see South Korea surpass Japan's Footprint.

The largest total Footprint in the region belongs to China, with its large population responsible for 14 percent of humanity's total demand while Japan is responsible for 3 percent. In a world that is becoming ever more resource constrained, China's demand will impact the ability of other countries, such as Japan, to meet their own growing demands. Regional policies and agreements will need to be formed in order to manage the flow of resources effectively, in addition to increasing the transfer of efficient technology.



Map 1. Biocapacity per capita in East and South-East Asia.

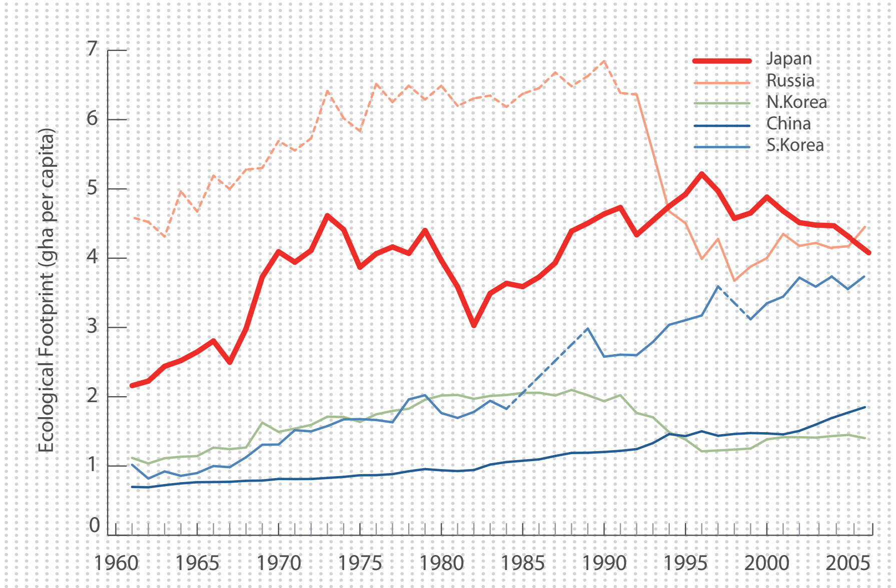
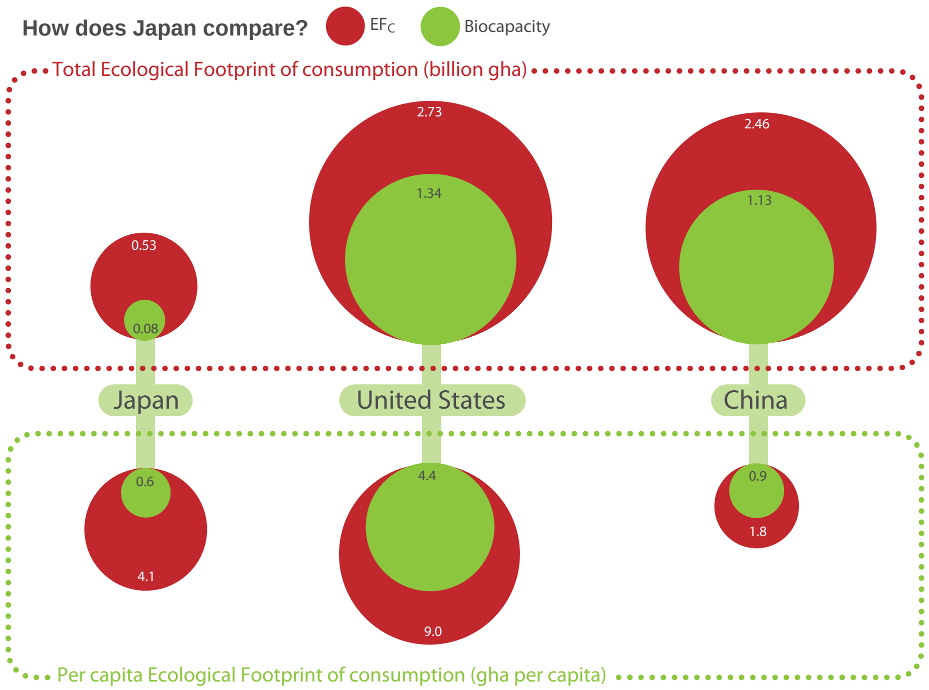


Figure 4. Trend in Ecological Footprint per capita for Japan and its four closest neighbors. Dotted lines represent interpolation for South Korea due to data inconsistencies and estimated historical Footprint values for Russia based on the USSR Footprint.

Japan's Ecological Footprint

Japan's Ecological Footprint of consumption (EF_C) in 2006 was 4.1 gha per capita, about one and a half times the global average. This places Japan within the highest 25 percent of countries using this measure. Meanwhile, Japan's Ecological Footprint of production (EF_P) was 3.2 gha per capita including carbon and 0.6 gha per capita without carbon (EF_P-carb). This is amongst the lowest in the world and similar to countries such as Viet Nam (0.6 gha per capita) and North Korea (0.5 gha per capita).

Japan's biocapacity was only 0.6 gha per capita in 2006, a third of the global average and placing it in the lowest 15 percent of countries using this measure. Japan's per capita biocapacity has been continuously decreasing. The ratio of EF_P-carb to biocapacity was 0.9; Japan was harvesting less biocapacity than was available, one of the most basic requirements for sustainability.



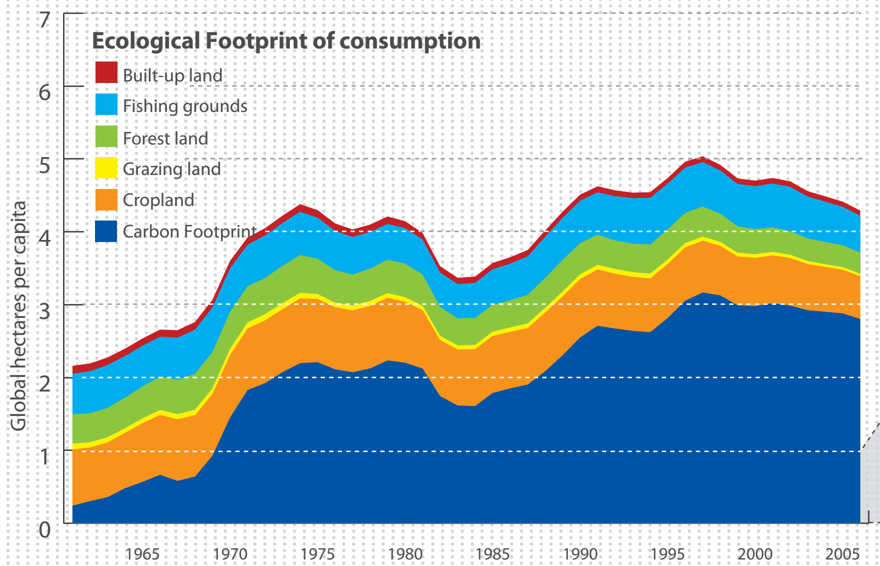


Figure 5. Japan's Ecological Footprint of consumption, 1961-2006

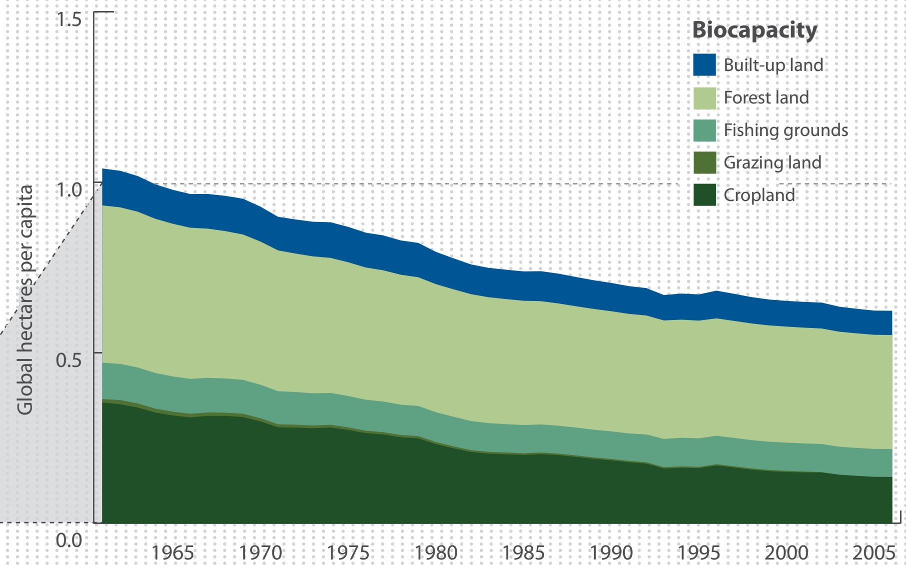


Figure 6. Japan's biocapacity, 1961-2006

Summary of land-use types

Carbon Footprint

Carbon dioxide emissions, primarily from burning fossil fuels, are the only waste product included in the National Footprint Accounts. On the demand side, the carbon Footprint is calculated as the amount of forest land required to absorb given carbon emissions. It is the largest portion of humanity's current Footprint and 65% of Japan's EF_C.

Cropland

Cropland is the most bioproductive of all the land-use types and consists of areas used to produce food and fiber for human consumption, feed for livestock, oil crops, and rubber. Cropland Footprint calculations do not take into account the extent to which farming techniques or unsustainable agricultural practices cause long-term degradation of soil.

Fishing grounds

The fishing grounds Footprint is calculated using estimates of the maximum sustainable catch for a variety of fish species. These sustainable catch estimates are converted into an equivalent mass of primary production based on the various species' trophic levels. This estimate of maximum harvestable primary production is then divided amongst the continental shelf areas of the world.

Forest land

The forest Footprint is calculated based on the amount of lumber, pulp, timber products, and fuelwood consumed by a country on a yearly basis.

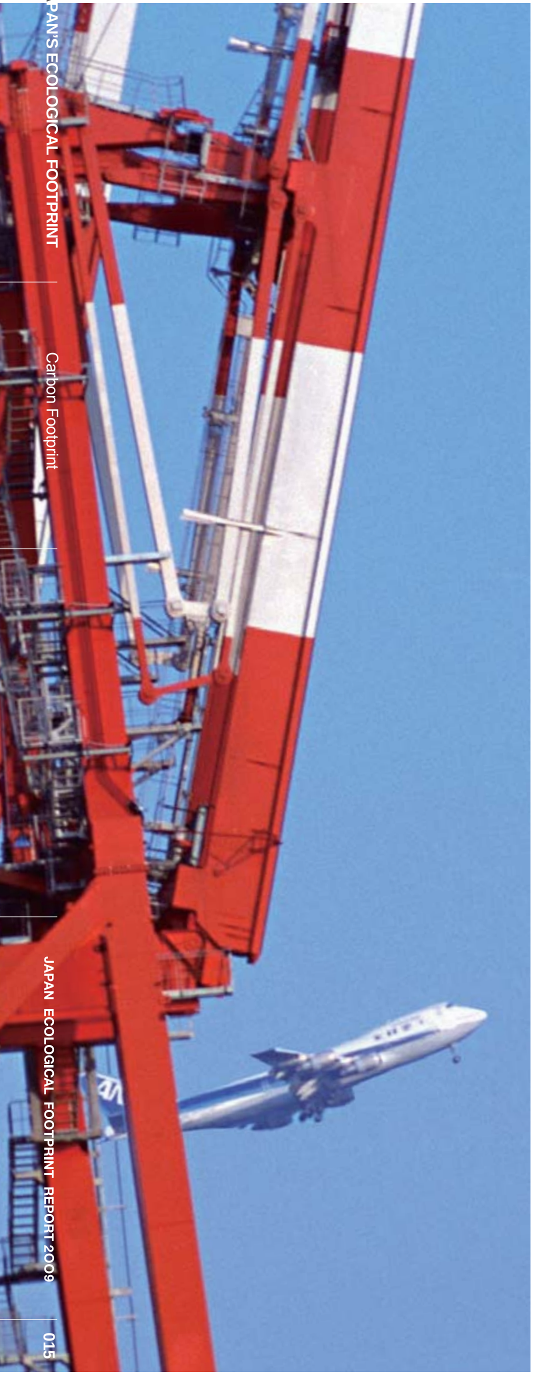
Built-up land

The built-up land Footprint is calculated based on the area of land covered by human infrastructure — transportation, housing, industrial structures, and reservoirs for hydropower. Built-up land presumably occupies what would previously have been cropland.

Grazing land

Grazing land is used to raise livestock for meat, dairy, hide, and wool products. The grazing land Footprint is calculated by comparing the amount of livestock feed available in a country with the amount of feed required for the livestock produced in that year, with the remainder of feed demand assumed to come from grazing land.

Carbon Footprint



The carbon Footprint represents the area of productive land that would be needed to sequester carbon dioxide released into the atmosphere. Globally, this is the largest component of the Ecological Footprint. The contribution of the carbon Footprint to Japan's total Ecological Footprint is even larger, corresponding to 65 percent and 82 percent of Japan's EF_C and EF_P respectively, and these fractions continue to increase.

There is no inherent biocapacity set aside specifically for the uptake of carbon dioxide. However, it is assumed that there are two sources of sequestration in the biosphere: oceans and forests. Therefore, if a country is not harvesting all of its potential biocapacity for wood products, the remainder is available for storing carbon dioxide.

Japan is in such a situation, where the forest EF_P is less than the forest biocapacity. Consequently, Japan's forests provide a net uptake of carbon dioxide from the atmosphere. However, the available forest biocapacity for sequestration is only able to offset less than 10 percent of Japan's carbon EF_C.

The remainder of Japan's carbon Footprint mixes in the atmosphere with that of all other countries. Some of this is sequestered by forests outside Japan, but the rest accumulates in the atmosphere. This accumulation contributes to anthropogenic climate change, which is likely to have adverse consequences for many countries around the world.

Box 2: Carbon Footprint vs. "Carbon footprint"

The carbon Footprint component of the Ecological Footprint describes the area of average bioproductive land required to sequester carbon dioxide emissions. Alternative uses of the term "carbon footprint" have been made by other organizations, though these describe the emissions of carbon dioxide and other greenhouse gases in mass quantities (usually tons).

Box 3: Nuclear Power Generation

"Nuclear power generation requires large fossil-fuel derived energy inputs during the processes of Uranium mining, purification, concentration, transportation, and reactor operation. In addition, numerous radioactive byproducts are formed which require careful isolation from the environment for periods up to a million years.

The current methodology behind the Ecological Footprint includes the carbon dioxide emitted during all stages of nuclear power generation, but does not include the long-term environmental impacts and economic cost of properly handling the waste products."

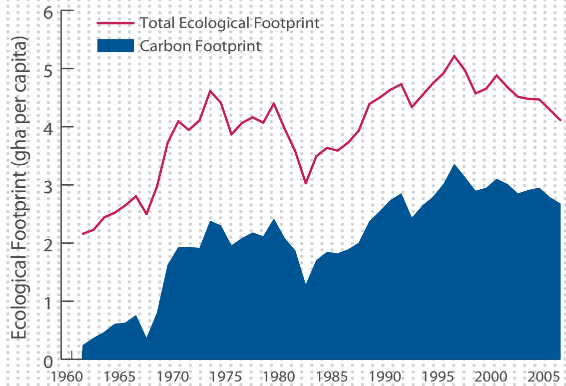


Figure 7. The contribution of the carbon Footprint to Japan's Ecological Footprint of consumption

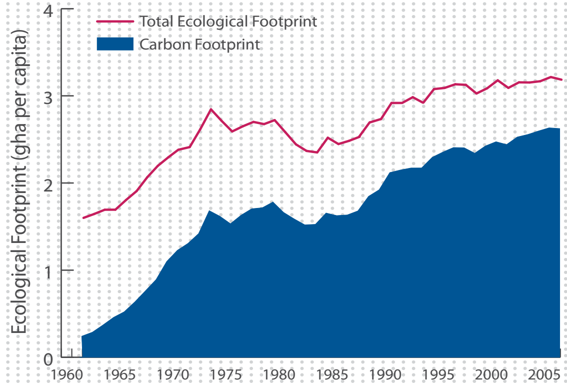


Figure 8. The contribution of the carbon Footprint to Japan's Ecological Footprint of production

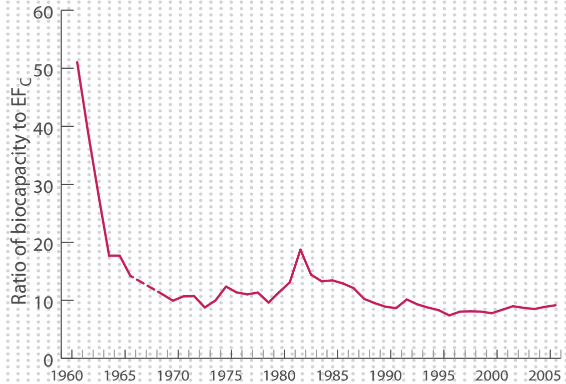


Figure 9. The ratio of Japan's carbon Footprint to unutilized forest biocapacity

Cropland

Japanese rice paddies are much more productive than world average cropland

The cropland Footprint represents the area of productive land required for the production of food crops, fiber, oil crops, and rubber. Globally, this is the second largest component of the Ecological Footprint. Similar to most high-income nations, the contribution of the cropland Footprint to Japan's total Ecological footprint is less, corresponding to 14 percent and 4 percent of Japan's EF_C and EF_P respectively.

Cropland occupies the most productive land worldwide – one hectare of cropland has the highest biocapacity of any land-use type. Japan has 4.7 million hectares of cropland, corresponding to a biocapacity of 0.13 gha per capita and giving Japan cropland availability in the bottom 10 percent of all countries.

As a consequence, Japan is highly reliant on other countries for imports to satisfy the majority of its cropland EF_C, and this trend has been increasing. Nevertheless, Japan's cropland EF_C of 0.58 gha per capita is similar to many developing countries. In comparison, the United States consumes twice as much per capita.

Japan's cropland EF_C is on a declining trend, but, given the universal need for food, there is a limit to how much this can continue to decrease. Climate change has the potential to change global output of crops in the long-term, and this may constrain Japan's ability to acquire even the small amounts it requires.

Box 4: Cropland Footprint policy implications

- Japan is highly reliant on imports for its food requirements. In a world of volatile food prices and potentially constrained supply, Japan may look to increasing domestic supply.
- What aspects of the Japanese diet contribute to a low cropland Footprint, and are these replicable in other countries?

Box 5: Areas for future study

What will be the effect of climate change on crop yields in Japan?

Box 6: Unharvested cropland

The percentage of unharvested cropland – land that is not utilized for growing crops – is gradually increasing in Japan. In 2007, 400 thousand ha of cropland in Japan (equivalent to 8% of all available cropland) was unharvested, indicating that there may be potential to increase domestic crop output.

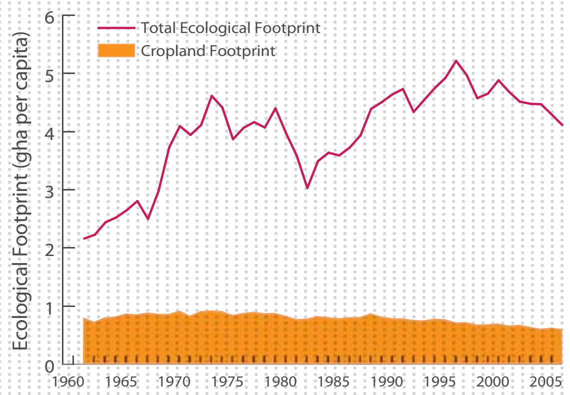


Figure 10. The contribution of the cropland to Japan's Ecological Footprint of consumption

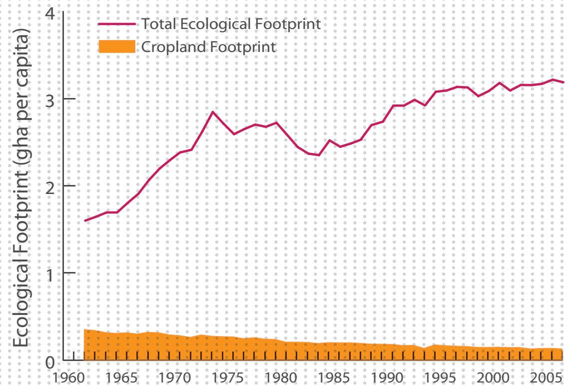


Figure11. The contribution of cropland to Japan's Ecological Footprint of production

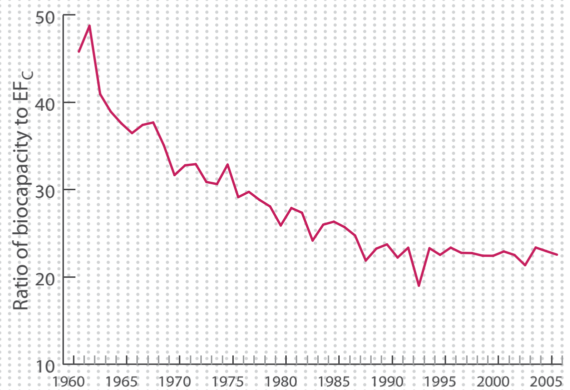


Figure 12. The ratio of Japan's cropland Ecological Footprint of consumption to biocapacity

Fishing Grounds


A collapse in Japanese fish stocks will put at risk the livelihoods of many multi-generational fishing communities.

The fishing grounds Footprint represents the minimum area of water required for the sustainable production of fish. Globally, this is the second smallest component of the Ecological Footprint. However, the contribution of fishing grounds to the Footprint varies regionally, and in Japan is 12 percent and 9 percent of EF_C and EF_P respectively. Papua New Guinea's EF_C is more than 50 percent comprised of fishing grounds, whereas in a landlocked country such as Central African Republic, less than 0.2 percent is made up of fishing grounds.

Japan's fishing grounds EF_C of 0.48 gha per capita is among the highest 10 percent of countries. Although Japan has the second highest fishing grounds Footprint of production in the world, at nearly 35 million gha (0.27 gha per capita), there is still a strong reliance on the production of other countries, such as the United States and China.

Japan's fishing grounds EF_P exceeds the available biocapacity from Japan's continental shelf by more than a factor of three. This strongly suggests that Japan may be at risk of collapsing its fisheries, and with effects that will be felt worldwide due to Japan's status as the largest importer of fishing grounds Footprint in the world. This may already be evident in Japan's declining fishing grounds EF_P.

Japan's fishing grounds EF_C has remained relatively constant over the last 45 years. With a declining domestic production, Japan's reliance on other countries to supply its demands will continue to increase. With many global fisheries currently at risk, there is the potential for disruptions to this global supply.

Box 7: Fishing grounds policy implications

Japan's status as one of the leaders in the Fishing industry may be jeopardized by potential collapses in its fisheries.

Box 8: Areas for future study

- How can greater geographical resolution for catch data be obtained, in order to estimate the impacts on individual populations?
- How can better estimates of maximum sustainable yields over time be made?
- What would more suitable equivalence factors for fishing grounds be?

Note that Japan's fishing grounds biocapacity only includes the area of continental shelf that belongs to Japan. Japan also accesses fish from international waters, which do not show up in national biocapacity.

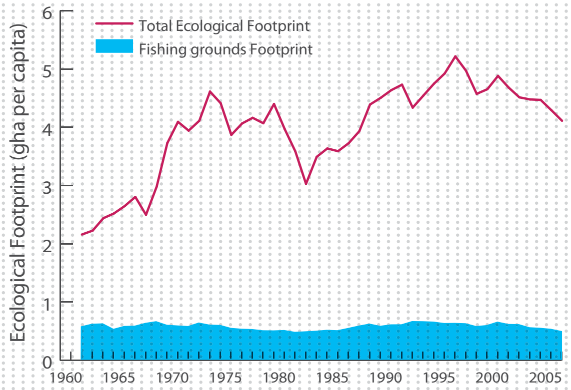


Figure 13. The contribution of fishing grounds to Japan's Ecological Footprint of consumption

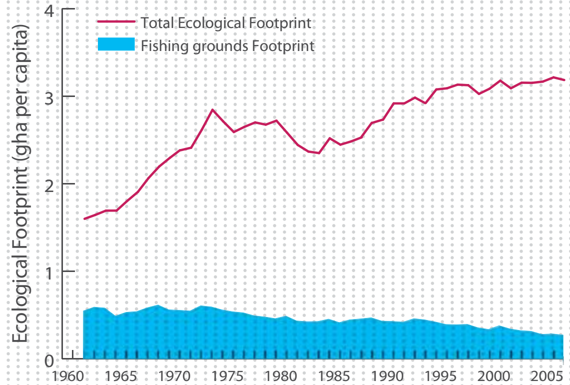


Figure 14. The contribution of fishing grounds to Japan's Ecological Footprint of production

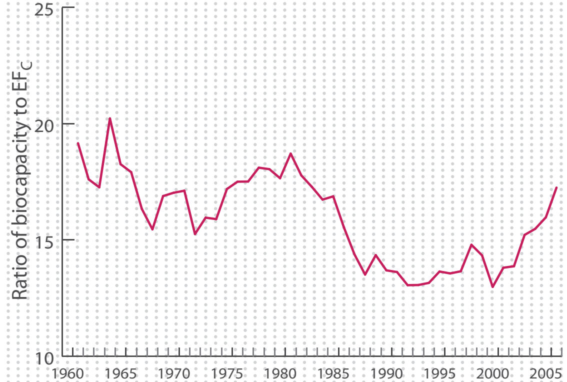


Figure 15. The ratio of Japan's fishing grounds Ecological Footprint of consumption to biocapacity

Forest Land

Japan is among the most highly forested of high-income countries

The forest land Footprint represents the area of land required for the production of lumber, pulp, timber products, and fuelwood. Globally, this is the third largest component of the Ecological Footprint at 11 percent. The contribution of forest land to Japan's Footprint is lower than this at 7 percent and 3 percent of EF_C and EF_P respectively.

Japan's forest land EF_C of 0.47 gha per capita is close to the world average, and lower than many developed nations. However, Japan's EF_P, at 0.27 gha per capita, is in the lowest 25 percent of countries.

Despite a relatively small land area, Japan is highly forested. When combined with forests that are 39 percent more productive than the world average, this forest cover gives Japan 42.8 million gha of forest biocapacity – placing it in the top 15 percent of countries worldwide. Japan would be able to theoretically meet its entire domestic demand for forest products from local biocapacity.

Japan's forest land EF_P has been decreasing on a per capita basis over the last 40 years, while forest land EF_C has only been slightly decreasing. Consequently, a large amount of Japan's forests is available for sequestration of carbon dioxide, and Japan has a large buffer against international constrictions in the supply of forest products.

Box 9: Forest land policy implications

- Japan may be able to increase its production of forest products without negatively impacting the area of forest
- Japan places a high demand for wood products on countries that are experiencing deforestation, such as Indonesia. Replacing imports with domestic supply would have positive international impacts.

Box 10: Areas for future study

- Are Japan's forest policies replicable in other countries?
- How could a forest harvest strategy be developed to allow Japan to meet domestic forest product demand without deforestation?

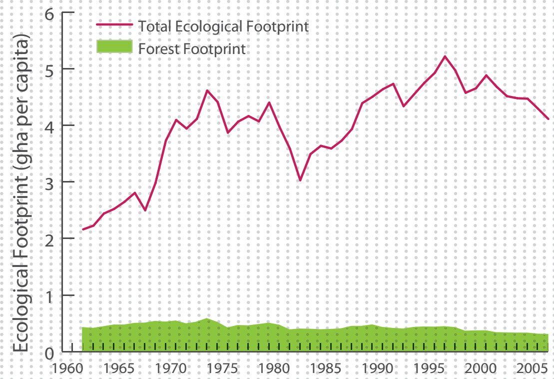


Figure 16. The contribution of forest land to Japan's Ecological Footprint of consumption

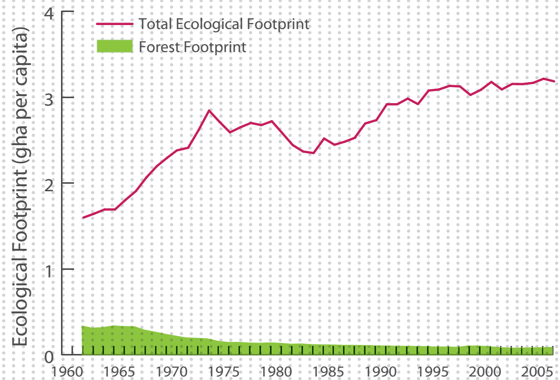


Figure 17. The contribution of forest land to Japan's Ecological Footprint of production

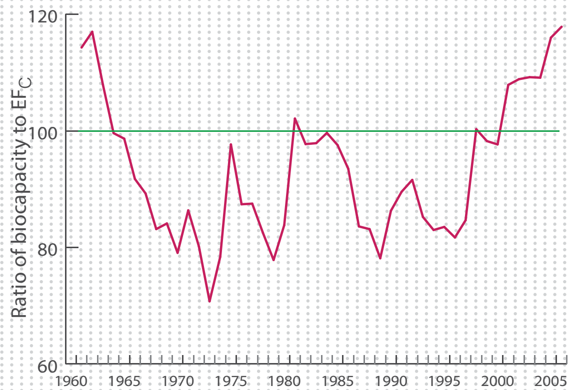


Figure 18. The ratio of Japan's forest Ecological Footprint of consumption to biocapacity
Points below the green line indicate Ecological debt.

Built-up land

Japan's densely populated cities reduce the built-up land Footprint below that of other developed nations

The built-up land Footprint represents the area of land covered by human infrastructure for transportation, housing, industrial structures, and reservoirs for hydropower. Globally, this is the smallest component of the Ecological Footprint at 2 percent. The contribution of built-up land to Japan's Footprint is also 2 percent.

Built-up land is not a tradable product, so the built-up land EFc and EFp are equal. Additionally, because all built-up land is being used for human purposes, the biocapacity is also equal to the Footprint.

Japan's built-up land per capita of 0.07 gha is close to the median value for all countries in the world, and below that of most other high-income nations. This low value prevents the need to expand cities to the detriment of other land uses.

Japan's built-up land per capita has been continually decreasing over the last 45 years and is now nearly 40 percent below that in 1961. With Japan's relatively stable population, this also means that the overall built-up land is decreasing. The question remains that whether, as Japan's population numbers peak and start to reduce, there is a continued increase in population density in urban areas.

Box 11: Built-up land policy implications

- If Japan's overall built area decreases, projects to restore the freed-up land may strongly influence Japan's biocapacity.

Box 12: Areas for future research

- How can we increase the accuracy in determining the area of Japan covered by infrastructure?

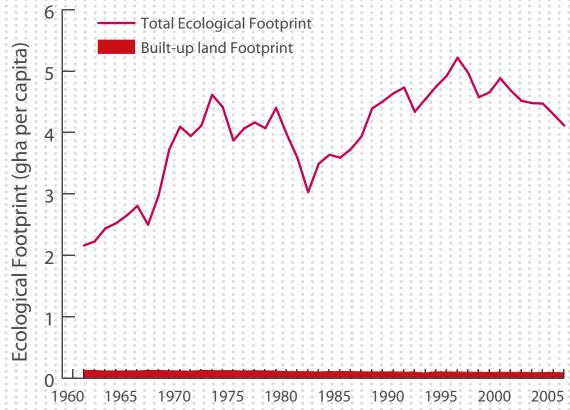


Figure 19. The contribution of built-up land to Japan's Ecological Footprint of consumption

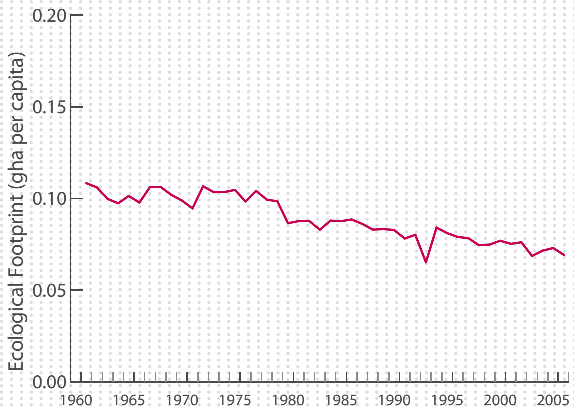


Figure 20. Japan's built-up land Ecological Footprint of consumption

Grazing land

Japan has no land set aside for the grazing of animals and must import livestock products or raise them on cropped feed

The grazing land Footprint represents the area of land used to graze livestock for meat, dairy, hide, and wool products. Globally, this is the third largest component of the Ecological Footprint at 11 percent. The contribution of grazing land to Japan's EF_C is much smaller at less than 1 percent. Since 2001 Japan has had no EF_P for grazing land, though even at the maximum in 1961, it was only 0.01 gha per capita.

Japan has no land set aside for grazing and must, therefore, import all livestock products raised on grazing land. In 2006, this amounted to 0.03 gha per capita. Japan does produce livestock products using crop based feed, though this method may cause air and water pollution that must be managed.

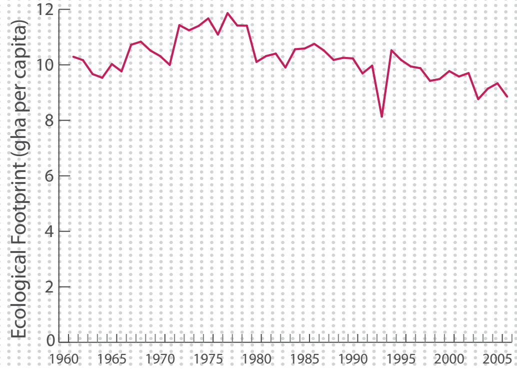


Figure 21. Japan's grazing land Ecological Footprint of consumption

Japan's Footprint and Trade

(c)Michel GUNTHER/WWF-Canon

The Ecological Footprint of consumption (EF_C) is derived from the Footprint of all resources consumed and emissions generated within a nation (EF_P), plus the embodied Footprint of goods imported (EF_I), minus the embodied Footprint of goods exported (EF_E).

Figure 23 illustrates this flow: the left side of the figure represents the use of biocapacity from domestic production and imports from other countries into the Japanese economy; the right side of the figure shows that the final goods and services produced by these inputs from the biosphere are consumed domestically or exported to other counties.

In 2006, the total inputs into the Japanese economy were 6.37 gha per person. Japan imported 3.19 gha per person from other countries (EF_I): half of total input. Japan also utilized 3.19 gha per person of domestic biocapacity (EF_P), which is more than five times the total available biocapacity in Japan (0.62 gha per person). Japan consumed approximately 4.11 gha per person (EF_C), representing 65 percent of the total output, and exported 2.26 gha per person to other countries (EF_E).

The carbon Footprint dominates the total Ecological Footprint flow, accounting for 76 percent of the total. Cropland is the second largest component (9 percent), followed by fishing grounds (8 percent), and forest land (5 percent). Japan is heavily dependent on imports for the biomass-based Footprint: 78 percent, 48 percent, and 72 percent of the economic input of cropland, fishing grounds, and forest land respectively were imported. Japan is the 2nd largest importer of fishing grounds biocapacity in the world, after China.

The structure of Japan's trade is clearly reflected by the Ecological Footprint, in which Japan imports natural resources and exports manufactured products. The carbon Footprint represented 96 percent of EF_E (as compared to 70 percent of EF_I) while each biomass-based Footprint contributed less than 2 percent.

The Ecological Footprint in trade can be examined on a country-specific basis. Maps 2 and 3 show Japan's top trading partners for imported Footprint. In 2006, the largest contributor for total Ecological Footprint imports into Japan was China (0.48 gha per person), followed by the United States (0.40 gha per person), Indonesia (0.35 gha per person), and Australia (0.25 gha per person). Together, these countries supplied 47 percent of the total imported Ecological Footprint of Japan.

Looking into each component separately, it can be seen that Japan heavily relied on crop land from the United States, Canada, and Australia; forest land from Canada, Russian Federation, and Malaysia; fishing grounds from the United States, China, and Chile; fossil fuels from China, Indonesia, and Australia.Japan's main trade partner for exported Ecological Footprint was China (0.47 gha per person), followed by United States (0.28 gha per person), and Panama (0.26 gha per person), which together comprised 45 percent of the overall Footprint of exports.

Japan relies heavily on other countries for its food, fiber, and timber. Additionally, Japan's carbon dioxide sequestration potential is limited, so Japan places pressure on other countries both for their sequestration potential and the likely impacts of climate change. Understanding this high level of dependency on ecosystem services is vital not only for economic security but also for sustainability in Japan and the rest of the world.

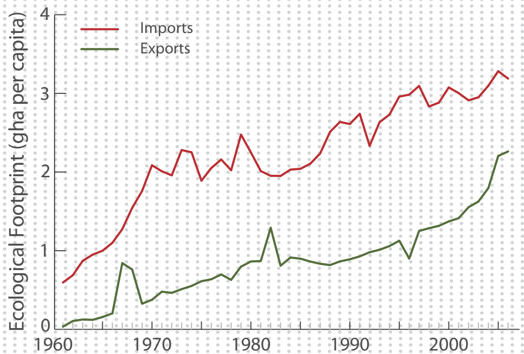


Figure 22. The historical trend in imported and exported Footprint

Map 2.
Sources of Ecological Footprint imports into Japan.
The size of the lines represents the size of EF_I from that country.

Map 3.
Destinations of Ecological Footprint exports from Japan.
The size of the lines represents the size of EF_E to that country.

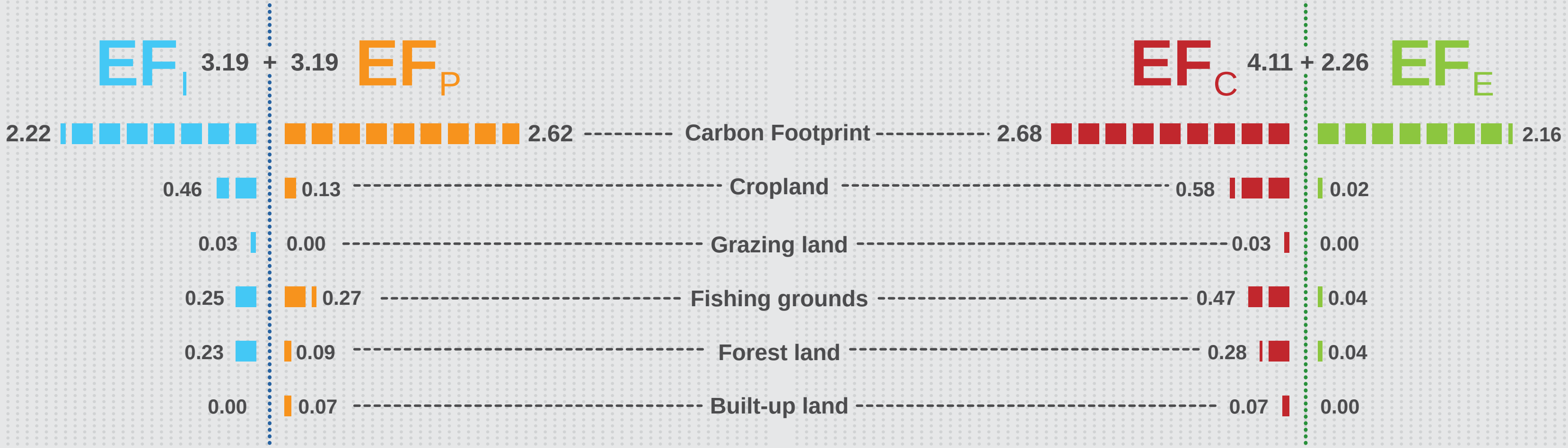


Figure 23. The flow of the Ecological Footprint through the Japanese economy.
Total inputs are represented on the left side by imports plus production (EF_I+ EF_P). Total outputs are represented on the right side by consumption plus exports (EF_C + EF_E)

Japan's Ecological Footprint: Household demand

The average Ecological Footprint of consumption in Japan is 4.1 gha per person. This Footprint can be broken into both personal and societal components. The personal Footprint is associated with food, transportation, goods, and services based on each individual's lifestyle choices. However, an individual's Footprint also includes societal factors, such as public infrastructure and national security. For Japan's residents to achieve sustainability, they need to focus on their individual lifestyles while simultaneously encouraging governments to become more resource efficient.

Disaggregating the Ecological Footprint by final demand category is one of the best ways to understand the contribution of the different sectors of society. This result can provide insightful information to determine a ratio of personal and societal components of an individual's Footprint. The Ecological Footprint by household consumption can be further broken down according to household consumption categories (food, housing, transportation, goods, and services).

Surprisingly, 67 percent of the Ecological Footprint of Japan comes from household consumption, followed by gross fixed capital (25 percent), and government consumption (6 percent), as shown in Figure 24. Gross fixed capital formation is the second largest component, which accounts for 25 percent of the total Ecological Footprint in Japan. Gross fixed capital consists of investment activities by the government (social infrastructure), firms (new factory), and households (new houses). Focusing on gross fixed capital is an urgent priority to ensure our future well-being, since these investments often have lengthy lifespan - a concept referred to as "slow things first." The government provides services such as law enforcement, defense, and wealth redistribution. These activities also place a demand on regenerative capacity and consequently have an associated Ecological Footprint. In order to influence the government portion of the Ecological Footprint, including gross fixed capital formation by the government, voting action and the dissemination of information and publications are a key.

Food represents the largest contribution (36 percent) to the Footprint of household consumption. Second, is services (19 percent), followed by mobility (17 percent), housing (15 percent), and goods (13 percent). Compared to other household consumption category, the Ecological Footprint for food has the largest portion of cropland, fishing grounds, and forest land and relatively small carbon Footprint. The housing and mobility are, for instance, dominated by carbon uptake land which is produced by a generation of electricity, transportation, and heating water process.

Box 13. Food waste in Japan

In 2005, it was found that residents of Japan throw away large quantities of food: totaling 13.8 million tons annually. Eliminating food waste could, potentially, reduce the Japanese Ecological Footprint by 26 million global hectares without any change in consumption patterns.

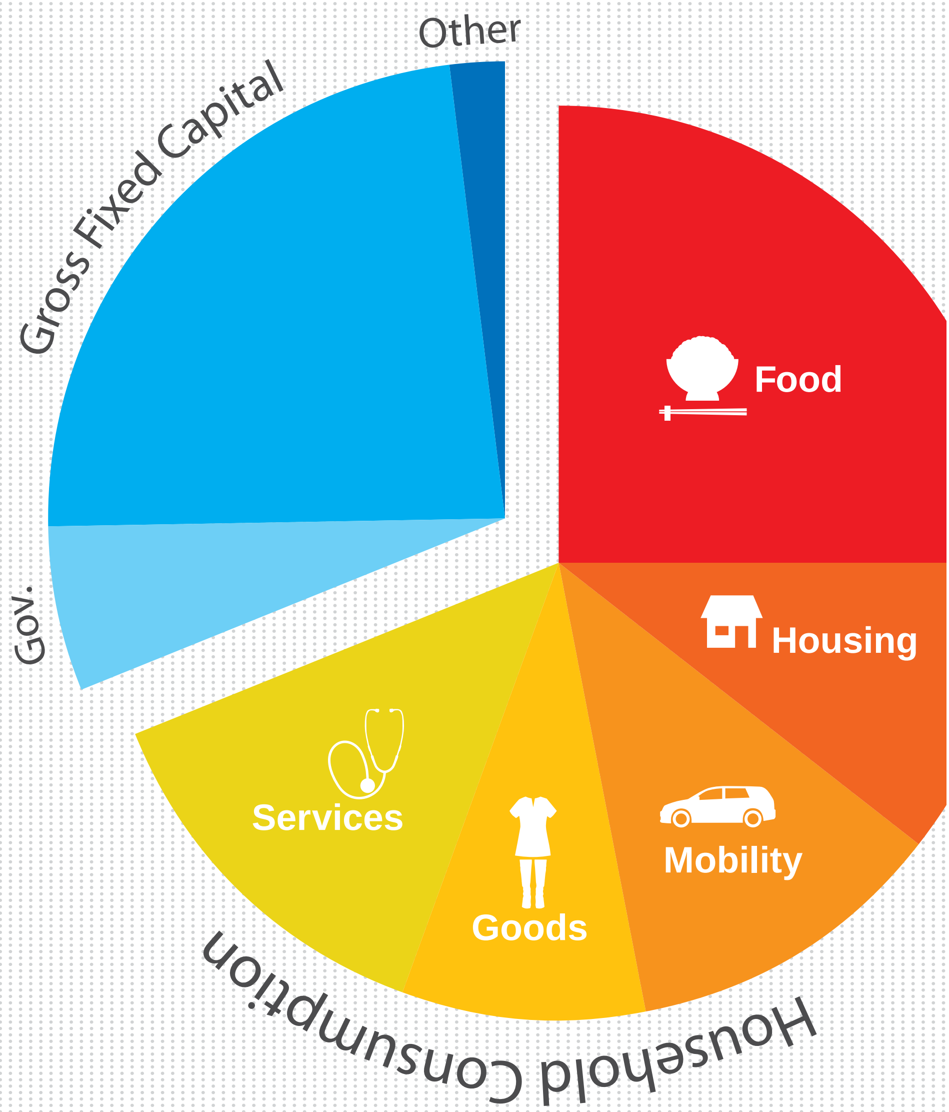


Figure 24. The contribution of each sector of final demand to the total Japanese Ecological Footprint of consumption

Ecological Footprints of household consumption category vary widely depending on economic efficiency and life style. For example, 61.1 percent of India's Ecological Footprint is from food demand. Poland and the United States have higher housing Footprints (22.1 percent, and 21.9 percent, respectively).

In short, the main contributor for Japan's Ecological Footprint is daily Footprint of household; this means that lifestyle choices actually have great potential to moderate Japan's Ecological Footprint. Indeed, household decisions can catalyze large scale shifts in production process in business sectors, driving them towards high production efficiency and environmentally sound products.

Box 14. The Personal Footprint Calculator

The Personal Footprint Calculator allows individuals to determine the area of land required to support their demands, and to highlight areas where they could reduce their Footprint. Developed with the aid of in-country experts and national statistical data, each calculator is unique for the country. Japan is a recent addition to the suite of calculators1, which have attracted over one million visitors so far.

http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/

36%

Food

The food category of final demand includes all food and beverages purchased for consumption at home. With additional information, food can be broken down into plant-based, which only places demand on cropland, and animal-based, which places demand on both cropland and grazing land.

15%

Shelter

The shelter category includes both the rental and ownership of land and structures for housing. This category also includes maintenance of the dwelling, water and sanitation services, and electricity, gas, and other fuels used in the home.

17%

Transport

The transport category includes the purchase of private transport vehicles (motor cars, motorcycles, bicycles), maintenance and repair of these vehicles, and the fuels used to operate them. This category also includes the fares for public transportation, such as trains, buses, and aircraft.

13%

Goods

The goods category covers a broad range of purchased physical items not covered in the other categories. These include clothing and footwear, home furnishings and appliances, communications and entertainment equipment, and tobacco.

19%

Services

The services category covers purchased services not included in the other categories, such as medical services, education, catering services, insurance, and personal care.

More detail on the categories used to disaggregate household consumption can be found through the United Nations Classification of Individual Consumption According to Purpose (COICOP) notes2.

Japan, Water, and the Ecological Footprint

The availability of freshwater is a critical factor in determining both economic success and human development opportunities in a region. Pressure on freshwater resources is further intensified in densely populated archipelagos such as Japan. With five main islands and thousands of uninhabited, subsidiary islands, Japan occupies only 376,520 km² of land, 70 percent of which is mountainous (World Bank 2006). Japan's annual average precipitation is 1,178 millimeters per year, ranging from 800 mm in the north of Hokkaido Island to 3,600 mm in the south of the country, with over 70 percent of this rain falling between the months of June and September.

Due to its small surface area, monsoon winds and mountainous terrain, Japan loses an average of 200 cubic kilometers of naturally renewable surface water each year to evaporation and runoff (FAO 2003). This leaves the nation with only 430 cubic kilometers of naturally renewable freshwater for consumption each year, a volume that is much higher than many of the world's water-scarce nations, but low considering that with 337 inhabitants per square kilometer, Japan is one of the most densely populated countries in the world (DESA 2008).

Figure 25 compares the amount of renewable water resources (both surface and groundwater) available per person for a range of countries. It is estimated that 1,000 cubic meters of water per inhabitant is the minimum amount to meet basic needs and ensure agricultural production in countries that require irrigation such as Japan (Rijsberman 2006). Japan's residents have access to 3,378 cubic meters of naturally renewable water resources per year - less than half of world average availability1 (FAO 2003b).

Of Japan's total available freshwater, 64 percent is consumed by the agricultural sector, 19 percent by industry and 17 percent by households (see figure 26). According to the Water Resource Division within the Japanese Ministry of Land, Infrastructure, Transport and Tourism, per person consumption of water in Japanese households doubled between the years of 1965 and 2004. This increase is largely attributed to changes in lifestyle, such as the rapid spread of flush toilets and potable water in rural areas.

When combined with increases in population and economic growth over the same period, the total domestic water consumption in Japan between 1965 and 2004 increased tri-fold. Japan's industrial sector experienced a similar rise in water consumption since 1965, however due to advances in water recycling (the reuse of water for industrial activities such as heating, cooling, cleansing and product processing) and the introduction of incentive-based pricing mechanisms, Japan has experienced a 12 percent decrease in the volume of freshwater withdrawal used to meet industry needs since 1974 (Japanese Ministry of Land, Infrastructure, Transport and Tourism, The Current State of Water Resources).

Water-stressed countries such as Japan can meet some of their needs by importing goods that require high water volumes to produce. Japan's limited freshwater supply and competitive land use, causes the country to import a significant portion of its agricultural, industrial and timber products. In 2005, Japan was the world's biggest grain importer (Comprehensive Assessment of Water Management in Agriculture 2007, 17).

Japan produces only nine percent of the wheat, and five percent of the legumes that the country consumes, shifting the cost of 3.3 billion cubic meters of freshwater consumption off-shore. Japan also imports more than 60 percent of its demand for textile products, and as one of the world's largest timber importers, Japan purchases 25 percent of the world's available timber (Japanese Ministry of Land, Infrastructure, Transport and Tourism, Responding to International Water Resource Problems). In order to grow all of the agricultural, industrial and timber products that Japan imports, it is estimated the country would need an additional 40 billion cubic meters of freshwater consumption (World Bank 2005).

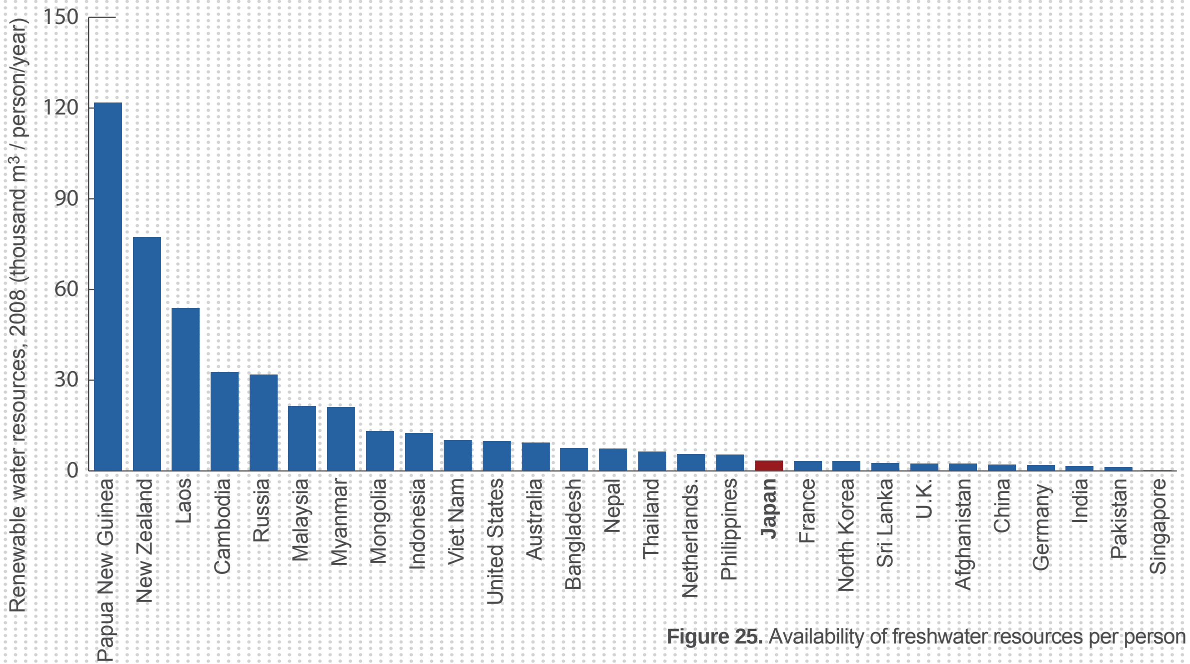


Figure 25. Availability of freshwater resources per person

Japan's high level of agriculture imports are reflected in its Ecological Footprint. In 2006, Japan had a net Ecological Footprint of imports of 118.5 million global hectares, and over 50 percent of this Ecological Footprint came from cropland and carbon Footprint imports (Global Footprint Network 2009). While the consumption of embodied water, sometimes referred to as "virtual water", can help alleviate local demand on scarce water resources, it may also increase the carbon portion of the Ecological Footprint, as water intensive products are transported from afar.

Biological productivity is a product of the quantity of land area, regional climate, soil fertility, water availability and the efficiency of production. Japan's cropland yields are slightly lower than the world average cropland yields, while the nation's forest land yields are higher than the world average yields for these same land types. Japan's lower-than-average cropland biocapacity could be caused by a multitude of these factors; however, the availability of freshwater is likely to be a key determinant.

Japan uses 96 percent of its total available cultivable area (4,776 hectares), with 63 percent of this cultivated land fully irrigated, helping the country compensate for its limited land area and scarce freshwater supply (FAO 2003b). Although Japan's comprehensive and intense cultivation processes can alleviate the need to import food, this high intensity land use is not without consequences. The large demand of freshwater for irrigation and industrial development in Japan has caused a two-centimeter reduction in ground level per year during the 1960s and 1970s. Since then, regulations to restrict groundwater pumping have been put in place, mitigating the amount of ground subsidence in Japan (World Bank, 2006).

The strong link between bioproductivity and freshwater availability in Japan was illustrated during one of the country's most serious droughts in 1992 (Japanese Ministry of Land, Infrastructure, Transport and Tourism, Issues on Water Resources). From 1961 to 1992, Japan exhibited a steady increase in its Ecological Footprint of production for cropland, a sign that the country's agricultural production was flourishing.

In 1993, Japan's cropland Footprint decreased by 4.1 million global hectares, or 19 percent of the total Footprint in 1992. Once rainfall patterns resumed to their near-average rate in 1994, the Ecological Footprint of production for cropland increased by 21 percent, or 4.8 million global hectares (Global Footprint Network, 2009). This country-wide drought restricted water access for more than 16 million Japanese residents, and caused an estimated loss of 140 billion yen (Japanese Ministry of Land, Infrastructure, Transport and Tourism, Issues on Water Resources).

Box 15: Why is water not included in the Ecological Footprint?

The Ecological Footprint includes only those aspects of resource consumption and waste production for which the Earth has regenerative capacity, and where data exist that allow this demand to be expressed in terms of productive area. Therefore, the consumption of freshwater is not considered as a component of the Ecological Footprint.

However, the carbon emissions produced when pumping and treating water is included as part of the carbon Footprint. Freshwater is a natural resource cycled through the biosphere, and although related to many of the biosphere's critical goods and services, freshwater is not itself a material produced or absorbed by a biologically productive area (Global Footprint Network 2008).

In 2002, A.Y. Hoekstra proposed that the Water Footprint be created as a sustainable water-use indicator measuring the total volume of freshwater directly or indirectly used by a population. It is a metric that tracks the embodied water through the global trade of products, sometimes referred to as "virtual water". The Ecological Footprint measures the biological capacity a population uses and the Water Footprint measures the freshwater a population uses (Hoekstra and Chapagain 2008). They each provide a different piece of information in the sustainability puzzle.

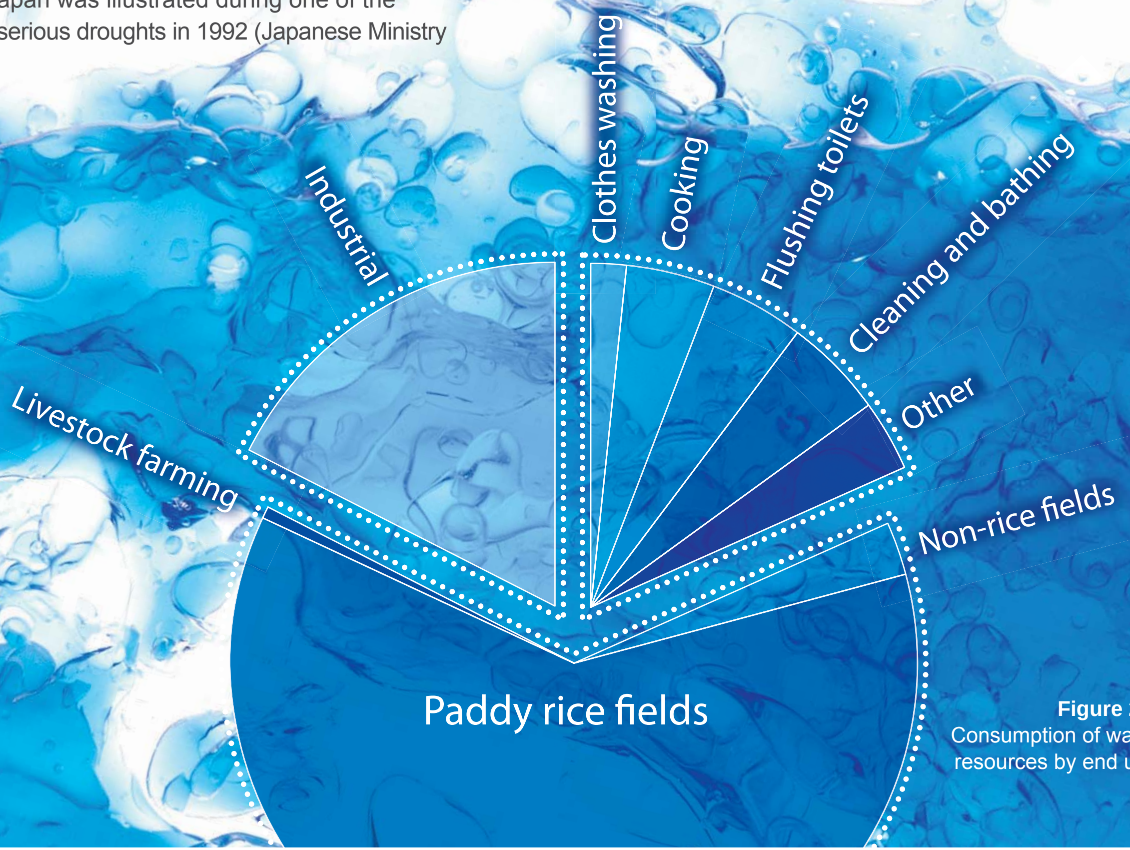


Figure 26. Consumption of water resources by end use

What will our future look like?

The Ecological Footprint makes clear

that there is much we can do to improve how we live.

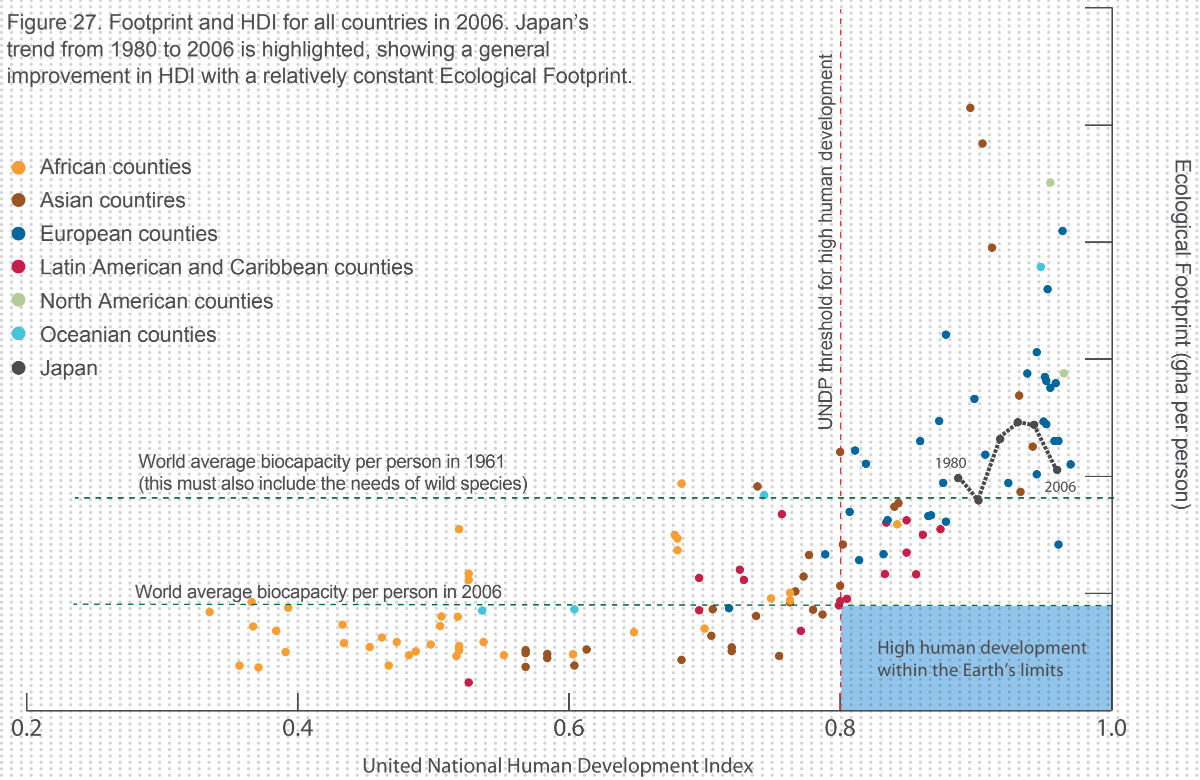
Our decisions today will change how our future will look.

Human Development and the Ecological Footprint

The well-being of human society is intricately linked to the biological capital on which it depends. Amartya Sen, one of the most influential voices in the United Nations Development Programme (UNDP), defines development as the societal structure that allows individuals to pursue their own goals (Sen, 1999). Historically, this structure has been defined as a long and healthy life, with access to knowledge and a decent standard of living. However, it is increasingly clear that the health and sustainability of ecological resources are key factors in assessing the well-being of a society. Similar to Sen's explanation of development, biocapacity can be thought of as the physical resource flows that allow individuals to provide for their needs.

Development requires necessary exploitation of natural resources to provide for development, without depleting the stock of natural resources and removing the ability of future generations to provide for their own development. Figure 27 depicts the challenge of reaching a high level of human well-being while ensuring long-term resource availability. This underlying message has been noticed by the United Nations Development Programme. In 2010, it was announced that their key publication, the Human Development Report, and the HDI would be undergoing a comprehensive overhaul, with the inclusion of environmental sustainability measures.

Figure 27. Footprint and HDI for all countries in 2006. Japan's trend from 1980 to 2006 is highlighted, showing a general improvement in HDI with a relatively constant Ecological Footprint.



Box 16: The Human Development Index (HDI)

In 1991, the UNDP proposed a measure of development that went beyond just looking at monetary wealth. The key concept did not change from then until 2009, when the Human Development Index (HDI) was defined as the unweighted average of three components expressed as an index from 0 to

1. Life expectancy at birth
2. Adult literacy rate and primary and secondary school enrollment
3. GDP per capita

In 2006, Japan was ranked 10th in the world for the HDI, between that of France and Switzerland. Japan had the highest score in the world for the life expectancy index, 24th in the world for the GDP index, and 33rd in the world for the education index. These values are highly influenced by policies: Many ex-Soviet states rank higher than Japan in the education index due to their emphasis on universal education and literacy over many years.

Box 17: Potential future trends in Japan's HDI

As Japan's population ages, more resources are likely to be funneled into providing the elderly with better care and medicine, likely increasing Japan's life expectancy index. The reduced size of the school-age population will make achievement of universal school enrollment easier, but overall literacy is unlikely to change rapidly, keeping the education index relatively constant. Japan's GDP per capita is likely to increase slower than that of many other highly developed nations, possibly decreasing Japan's GDP index. On balance, Japan is likely to remain around its current position in the HDI ranks.

Scenarios for Japan's Future

Japan faces unique challenges in its future. By 2030 its population is predicted to decrease by more than 0.5 percent per year (UND P), and GDP growth is expected to diminish to 0.5 percent per year.

While these trajectories will influence the well-being of Japanese residents, there are also significant impacts that will be seen on Japan's Ecological Footprint and biocapacity. Reductions in population and slowed growth in production will lead to lower resource throughput; however, an aging population often experiences slower technological innovation.

The following scenarios explore how various stories of Japan's future may affect Japan's Ecological Footprint and biocapacity.

Scenario 1 Business as Usual

In the business-as-usual scenario, Japan's native population continues to age and shrink, decreasing by 10 million between 2006 and 2030. The rate of immigration continues to be low by the standards of OECD countries and is insufficient to slow the decline; Japan's population contracts to just over 100 million by 2050.Due to the decline in population and an aging workforce, GDP growth is also slow: 1.3 percent per year between 2007 and 2015, and 0.5 percent per year from 2015 to 2050. GDP per capita grows to $52,600 by 2050.Improvements in the efficiency of converting the Ecological Footprint of production into GDP are also slow, as technological innovation decreases due to the elderly population: improving at only 0.2 percent per year (compared to 2 percent per year as seen currently).

Consequently, Japan's Ecological Footprint of production continues to increase. The increased demands this places on Japan's environment decreases the stock of natural resources and consequently decreases the available biocapacity.

A continuation of the decrease of the influence of public and private consumption on the Ecological Footprint seen in the historical trend, combined with a falling population, suggest that Japan will continue to decrease its total Ecological Footprint of consumption.

Under the business-as-usual scenario, Japan's Ecological overshoot decreases from 600 percent overshoot to just under 300 percent. However, assuming that the carbon dioxide component of Japan's production Footprint remains constant, Japan will once again start to over-harvest its domestic biocapacity in the next few years.

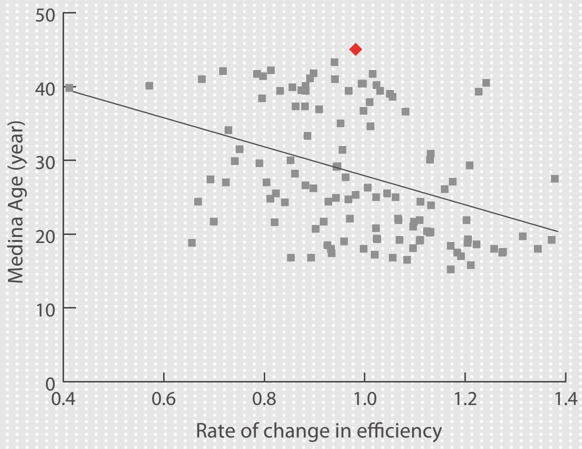


Figure 28. The correlation between the median age of a population in 2000 and the rate of change in efficiency from 1995-2005. (Japan is highlighted in red)

Box 18: Measuring efficiency in production

The Ecological Footprint of production measures the ecological demands of production processes. GDP measures the total value of these processes. Therefore, efficiency can be defined as the Ecological Footprint per unit of GDP.

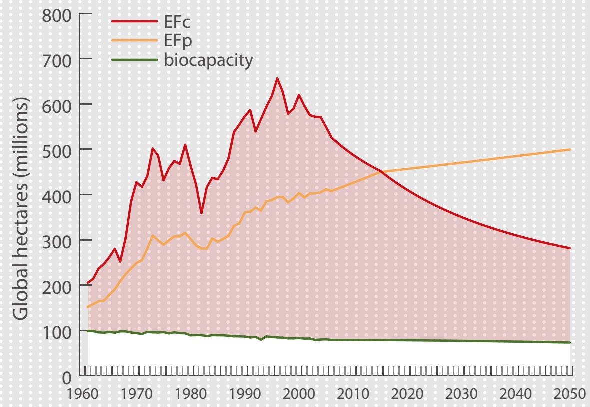


Figure 29. The trend in EF_C, EF_P, and biocapacity under the business-as-usual scenario

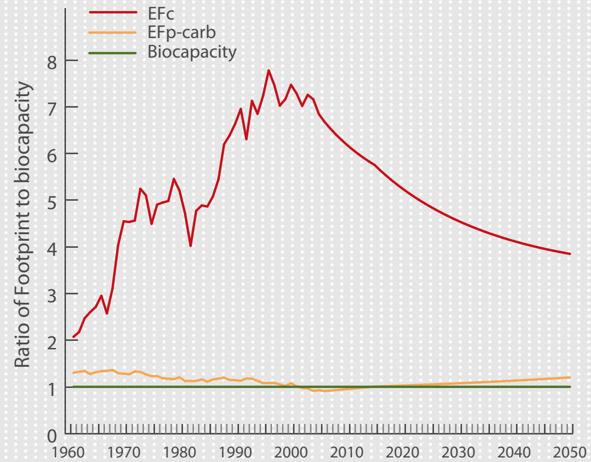


Figure 30. EF_C and EF_P-carb as a multiple of available biocapacity under the business-as-usual scenario.

Scenario 2 — Growth and Immigration

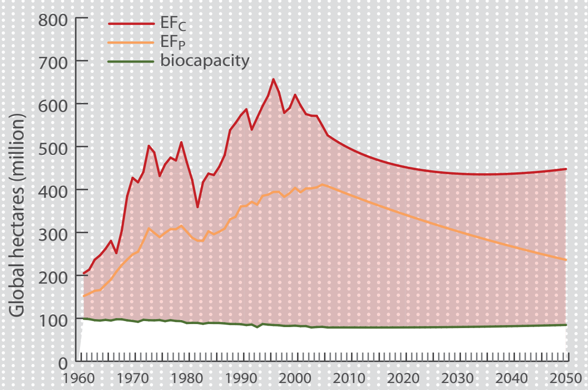


Figure 31. The trend in EF_C, EF_P, and biocapacity under the growth and immigration scenario

In order to counteract Japan's aging native population, immigration policies are revised and population increases at 0.35 percent per year, reaching nearly 150 million by 2050. GDP growth is maintained at the 1.73 percent per year seen in recent years; GDP per capita reaches $57,000 by 2050.

The younger population resulting from immigration, and the higher fertility rate that immigrants usually have, spurs technological innovation: improving at 3 percent per year. As a result, despite increasing production, the input of domestic ecological resources into the economy decreases by nearly 50 percent by 2050, to about 240 million gha. This decline in the use of domestic resources reduces the pressure on domestic biocapacity, allowing it to increase after 2015.However, increasing population and wealth prevent the Footprint of consumption from declining much: a minimum of 435 million gha is reached in 2035 and the Footprint increases thereafter.

Despite the increasing consumption, overshoot is maintained at around 420 percent due to increasing biocapacity.

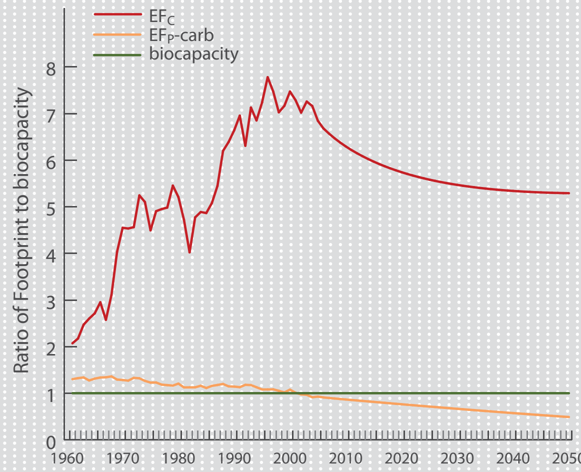


Figure 32. EF_C and EF_P-carb as a multiple of available biocapacity under the growth and immigration scenario.

Scenario 3 — Redefined Priorities

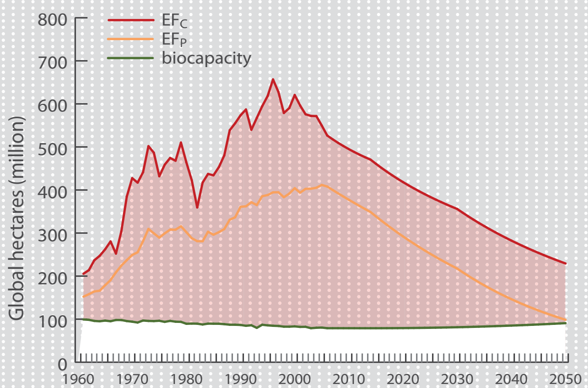


Figure 33. The trend in EF_C, EF_P, and biocapacity under the redefined priorities scenario

Japan maintains its current immigration policies and population declines. However, focus shifts away from GDP as a national priority:GDP increases by 0.5 percent per year until 2015, stays static until2030, and then declines by 1 percent per year thereafter.

Technological innovation is maintained at a higher rate of 3 percent through a reduction in public and private consumption and re-directing the wealth into investment in efficient technologies.The Ecological Footprints of both production and consumption decline, to 98 million and 229 million gha respectively. Biocapacity increases, as the reduced production demands result in a regeneration of stocks.Overshoot is still present, therefore Japan is still reliant on the natural resources of other countries. A large decline in overshoot isseen, to about 150 percent, a level which hasn't been seen since 1963.

The preceding scenarios all assume that the availability of land is the only limiting factor in the fulfillment of human demand. However, other, critical resources will also constrain Japan's future paths: key amongst these is the availability of freshwater, as discussed previously.

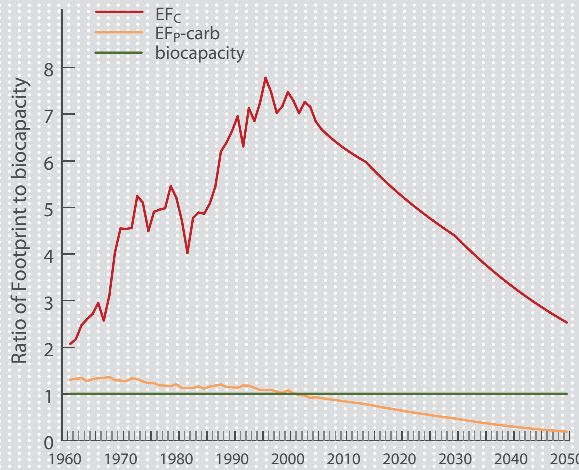


Figure 34. EF_C and EF_P-carb as a multiple of available biocapacity under the redefined priorities scenario.

Policy Recommendation

The history of economic development in Japan and other Asian countries

In 1968, Japan became the second richest country in the world, a position that has been maintained until the present. Japan's success in economic development was due in part to hard work by people, but also to global politics after World War II, especially those of the Korean War and the subsequent Cold War. The strategic importance of Japan at the border between the capitalist democratic world and communist world led to a large amount of investment by the United States.

Japan followed a typical 20th century Asian roadmap of development: importing raw materials, processing them with high technical level, and exporting cheap but high-quality products. Abundant labor from a large population and good ports for transportation were key factors in this process. As a result, Japan, a small and resource-poor country, became heavily industrialized and a majority of the population migrated to urban centers along the coast of Pacific Ocean. This development model was emulated in many other countries around the world.

At the same time, other Asian development models were also expanding. For example, in the late 1980s, the Malaysian, Indonesian, and Thai economies were developing as fast as Japan's. This was partly due to investment from Japanese enterprises, which moved their domestic factories to those countries, where they could cut processing costs drastically by using much cheaper land and labor.

This development model did not result in improving the quality of life along with the economic growth, but in the Asian Financial Crisis in the late 1990s. Why was Japan able to successfully develop while the development in these other countries was unsustainable?

What can we learn from the historical trend in the Ecological Footprint?

The growth of the global Ecological Footprint reveals economic development in the world, and highlights some events such as the oil shock in the early '70s or the bubble economy in late '80s. In particular, Japan's Ecological Footprint has been strongly influenced by global events, largely because of its heavy dependence on international trade and foreign resources.

In 1961, the first year of Footprint calculation, Japan was one of only a few countries that had already exceeded its biocapacity by more than 150 percent. At the time, Japan had just recovered from the damage of World War II and started enjoying development in increasing incomes and subsequent improvement of life among members of its population. The population also expanded throughout the period, which enabled the rapid industrialization. Consequently, Japan's Footprint grew as fast as GDP growth through the '60s and '70s.

On the basis of this societal shift, there was strong political will to rebuild Japan in a manner that enabled rapid economic growth. This will was embodied in the policies of the Prime Minister, Mr. Kakuei Tanaka, who pursued the radical "Japan Archipelago Restructuring Strategy" in 1972. This strategy envisioned Japan as the most highly developed country in the world. Economic growth at the time was symbolized with international events such as the Tokyo Olympics (1964) and the Osaka World Exhibition (1970). However, social development does not necessarily depend solely on economic growth, and the country faced some criticism for its model, i.e., "Japan as Economic Animal".This strategy and following industrial development is currently being replicated 40 years later in China: an improving quality of life along with increasing incomes; and a desire to demonstrate economic success through hosting world events such as the Olympics and the World Exhibition. China's Ecological Footprint is also showing rapid growth accordingly.

The trend of Japan's Footprint shows a second phase of rapid increase starting in the late 1980s, especially in the Footprint associated with carbon and fishing grounds. Although a majority ("over 90% middle class population" by the United Nations' Human Development Index) of Japan's society had achieved a sufficient quality of life by the beginning of the 1980s, the Footprint did not remain steady. Commodity consumption started increasing again after less than a decade, and by the mid '90s had increased by 10 to 20 percent. In principle, once the basic demands for life are met in a society, its Ecological Footprint should become stable over time to maintain sustainability, which was not the case in Japan.During this period, expanding choice in consumer products resulted in demanding a large amount of unnecessary items, and instead of investing in improving efficiency of industries to better manage biocapacity, Japan invested in endless exploitation of cheaper materials and natural resources from abroad. This economic trend created a "bubble economy", which destroyed the real value of natural resources or stocks on the ground. This was contradictory to the traditional Japanese lifestyle, which was based on the appreciation of a small number of high-quality, durable products. This concept came to be known as mottainai, a term disseminated by Wangari Maathai, the Nobel prize-winning former Kenyan Vice-Minister of Environment. The alternative lifestyle along with indifferences to the value of natural resources, however, rapidly spread across Japan and was followed by the production of large quantities of waste.

China, Indonesia and other Asian countries became increasingly important as trade partners for Japan in the late 1980s, following their industrial restructuring. Large Japanese enterprises moved their production base to China and South East Asia, while the Japanese government began to pursue the idea of integrating into an Asian/Pan Pacific Economic Grouping, along the lines of the European Union. Unfortunately, resource constraints did not allow the region to develop in an "old-fashioned" Japanese economic model. At the time of Japan's development in '60s, Asia still had sufficient biocapacity. The global Footprint exceeded one planet in late '80s, and Asian economic development became further resource-constrained.

Japan's second phase of growth in the Ecological Footprint did not result in the direct improvement in quality of life, as seen in the first phase, but rather in large volumes of waste production and unbalanced demands on natural resources. For example, fast food restaurants and "convenience" stores became popular in Japan during the "bubble economy", during which time people were seeking cooked but fresh food that should not be kept more than a few hours. In order to fulfill the population's huge food demands, not only in quantity but also variety, the suppliers needed to provide much more (approximately 30% more) food than consumers actually purchased. As a result, waste control became an increasingly serious issue. Another example is the Sushi boom, especially that of Bluefin Tuna during the "bubble economy". The demand for this fish resulted in a rapid increase of Bluefin Tuna farming and a subsequent import increase of up to 4 times more within less than 20 years. Resource constraints, as well as intense international debates over consumption of fishery products, resulted accordingly.
Not only do we continue to waste food (as the end products), but biocapacity itself – the area of abandoned cropland is slowly increasing annually, reaching up to 400,000 ha. Globalization through trade liberalization, which WTO is prompting, has forced Japan to be more and more dependent on foreign biocapacity, instead of improving the management of domestic biocpacity.

The whole structure of Japan's society had shifted to an unsustainable consumption model. This was not only a resource-constraints issue, but a human welfare issue. Japanese society in the last 20 years has continued to be "worse off" rather than "better off" due to an uneven distribution of wealth and access to the resources.

What is a real Asian model of successful development in the 21st Century?

Through the lens of the Ecological Footprint, the lack of sustainability in Japan is mainly caused by two key factors: an increase in the land needed for the sequestration of carbon dioxide, and unbalanced commodity uses. The carbon Footprint was nearly 13 times higher at its peak in the late 1990s than in 1961. While Japan's domestic forest biocapacity is more than sufficient to meet paper pulp and timber consumption needs, Japan is importing more than 80 percent of these commodities. Fish stocks and fisheries are drawing global attention to Japanese consumption as a primary example of unsustainability. Contributing to this, the waste of food or food materials in Japan has reached 30 percent of entire production, or 13.8 million ton/year, which is 1.7 times more than the food aid provision delete of the entire world.

The good news for Japan is that the Ecological Footprint peaked in 1997 and has kept on a downward trend for a decade. Although more detailed data collection and analysis are required, this suggests a great opportunity for Japan to lead a win-win solution for sustainable development in Asia, if immediate action is taken.

Japan's Ecological Footprint by category of household consumption suggests that both decision-makers and consumers should be involved in this action. For example, although Japan is one of the developed countries in the Kyoto Protocol Annex I, the government did not introduce any strong policy or regulation on carbon dioxide uptake, which resulted in a large increase of carbon emissions. In other words, there is a huge potential to reduce net carbon emissions through appropriate implementation of domestic emissions trading schemes or carbon taxes. (However, it is not wise to depend on Nuclear Power Generation, before some of the complementary "footprints" in relation to Nuclear [Wada. 2010] are carefully examined), Controls of supply chains and waste production have the ability to decrease the Footprint associated with food by 20 to 30 percent.

Japan's actions will have a big impact in the region. Strong relationships with other East Asian countries through trade, especially with China, will play a key role in realizing a sustainable Asia. Japan needs to demonstrate the creation of a sustainable society and lifestyle in balance with global biocapacity, which would provide good practices and solutions to the region.

The lessons we can learn from the past do not seem complicated; the "bubble economy" during the late 1980s and early 1990s created a mechanism of production and consumption, which concealed the actual resource supply chain and the poor condition of natural stocks. Unless Japan builds an economic system that places value on natural stocks or biocapacity, the "worse off" trend will not be reversed. The fast developing countries such as China or India are now facing the same need for a paradigm shift in industrialization, and whether they can adapt to a different model than what Japan pursued is critical not only for their future but for our planet.

In 1961, 3 billion people lived on half the biocapacity of the planet. In 2006, 6 billion people on 144 percent of the biocapacity of the planet. If everybody lived at the same level as 1961, the doubled population should still be within the planet's capacity now. Time is running out, and the developed countries, including Japan, that are responsible for this excess 40 percent should take a strong leadership to reverse this trend. Japan once had a relatively small Footprint, with a majority of its population enjoying a high quality of life. Moving back towards this pattern is a necessary first step towards global sustainability.

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