

THE ECOSYSTEM PROMISE

The Ecosystem Promise explains a new trend of assigning financial value to nature and payment for the services that nature offers. This is an opportunity for companies to invest in nature conservation and nature restoration. It shows that making use of the services of nature in a responsible way is often much cheaper than building installations and maintaining these.

The Ecosystem Promise takes the reader on a journey to projects all over the world, while scientists, conservationists, entrepreneurs, local villagers and young people of all continents share their views about the values and benefits of nature. It is an inspiring array of fundamental ideas and concepts about starting points in business and a green economy.

The Ecosystem Promise explains how nature conservation and restoration contribute to water supply, food security, poverty alleviation and new jobs. It shows that investing in nature restoration pays off and that consumers and companies can become allies on the pathway to sustainability. It shows that restoring nature is possible in many places and that involving local people in nature restoration is of key importance to themselves and to the rest of the world. It is a book of hope for human welfare, health and well-being.



ABOUT THE EDITOR

Meindert Brouwer (1951) is an independent conservationist and writer from the Netherlands. He specializes in developing and implementing innovative communication and marketing concepts for nature conservation, sustainable development and development cooperation. His previous book *Amazon Your Business - Opportunities and solutions in the rainforest* has received excellent reviews and has been distributed to 88 countries.



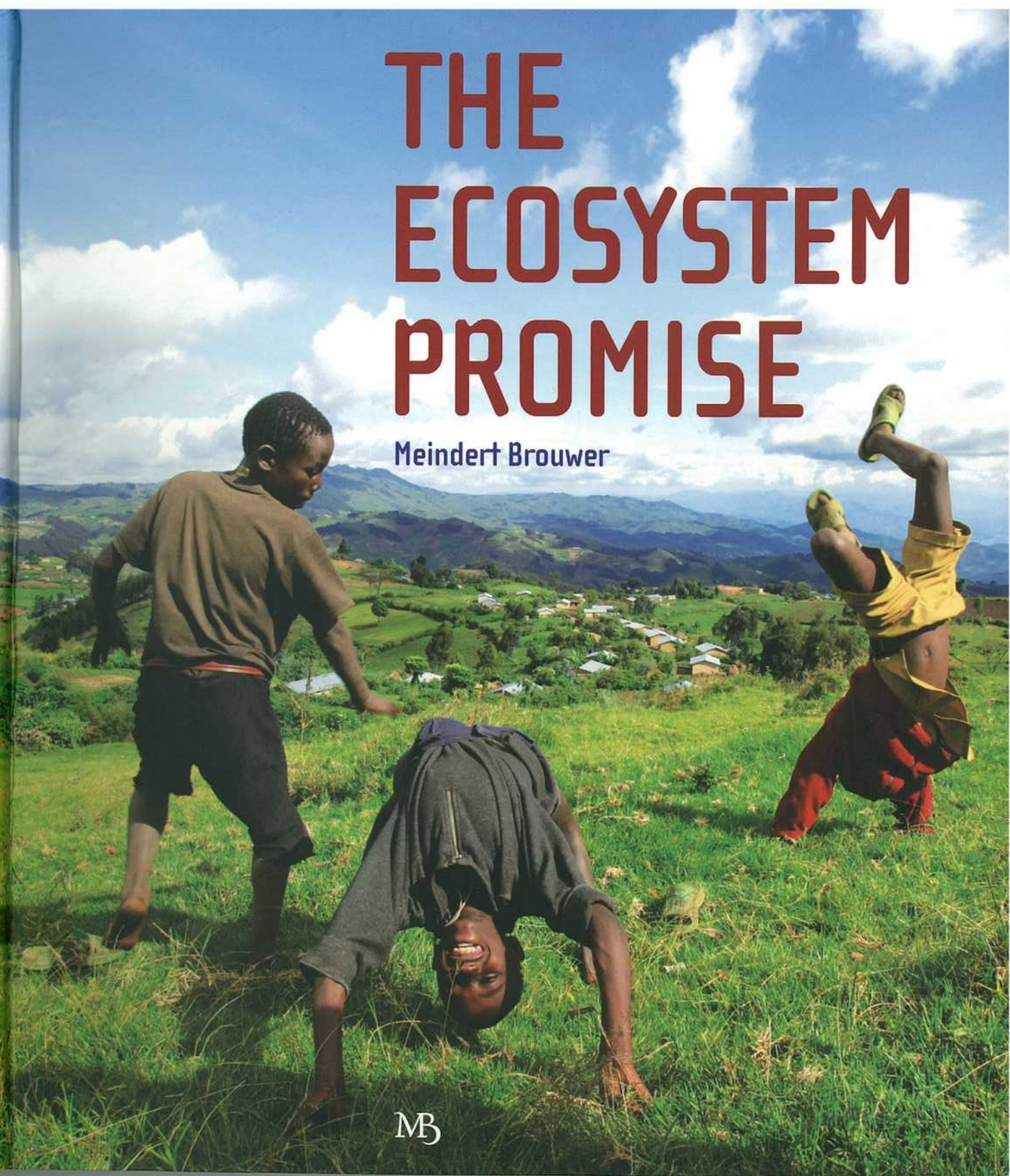
THE ECOSYSTEM PROMISE

Meindert Brouwer

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COLOPHON
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Keeping the ecosystems intact,
secures a continuous provision
of important ecosystem services
well into the future.

*Heleana Zambanino,
Socio Bosque Project, Ecuador*

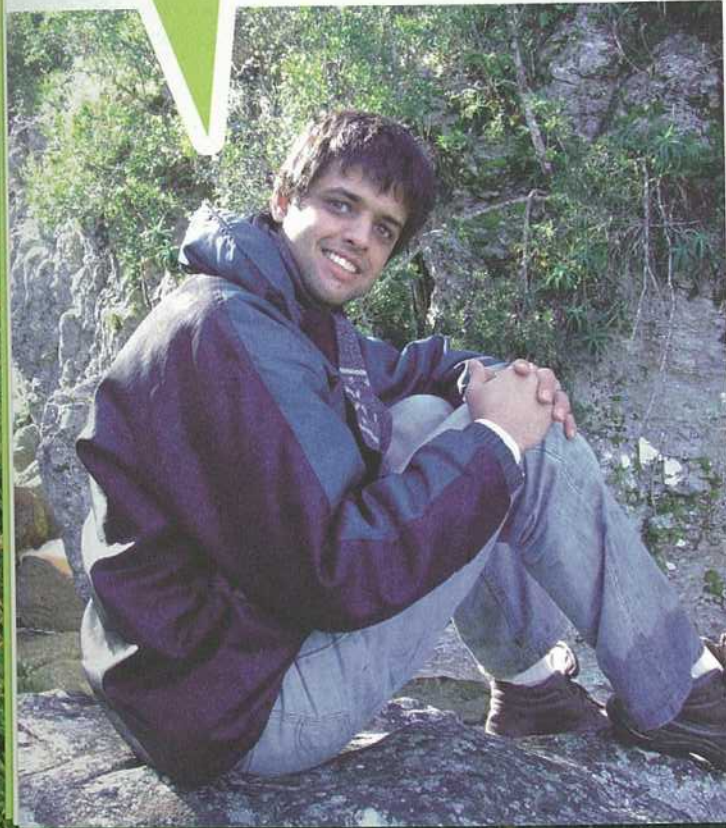
THE ECOSYSTEM PROMISE

The voice of the young

WILLEM MATTHEE

Age: 22
Nationality: South-African
Occupation: Student

I have often imagined a world before human intervention – before overgrazing, deforestation, the introduction of invasive species and the stripping of the landscape to uncover the minerals belowground. In short, a perfectly-functioning world full of opportunity and value to mankind. Only through the active restoration and rehabilitation of our degraded landscapes will we be able to experience everything our world has to offer: clean water, fresh air, abundant grazing for our livestock and other ecosystem services the Earth provides free of charge. Only then will we be able to experience this Utopia.



RISHABH KHANNA

Age: 26
Nationality: Indian
Occupation: strategic connector, co-founder of the Indian Youth Climate Network

It's exciting to see that sustainability is a concept at work redefining our parameters of success. The global economy is not a machine any more, but a living and breathing organism. New communities are being created which speak a new language of 'strategic collaboration' uniting people from different spheres. New tools have been designed to apply nature's way of creating in the human society (social biomimicry). We live in a world which is surpassing the traditional structures of hierarchy, information flows and interactions in the human society become more complex and fluid (we already observe this with the coming of social media). Systems of dialogue and interaction like Meshworking lead to a more inclusive society as complex multi-stakeholder dialogues become possible.



JULIA PODEDWORNY

Age: 22
Nationality: American
Occupation: Urban Planner and Researcher

The value of nature for local economies can best be seen in areas of extreme vulnerability to climate change; one of which is the Florida Keys. The Keys' largest industry, tourism, is highly dependent on nature's bounty and is therefore in danger of irrepressible decline. Unless businesses in the tourism industry start taking action to adapt to the inevitable environmental change, their properties (the basis of their livelihoods) will be at danger of severe land loss due to water inundation.

GERALDINE OVANDO DE LA QUINTANA

Age: 29
Occupation: Film maker
Nationality: Bolivian

In my country we think of nature as a mother, that's why we call it Pachamama, mother earth. That's why we can't think of destroying it or abusing it. As a mother, she gives without restriction and protects without condition, but at the same time she is waiting for us to be grateful and careful with her. With this promise in our hearts we search for the world and for all of us to live well. This means living in balance with each other and with our Mother Earth. Not having plenty, but having enough. To live with joy, not with emptiness. To share, not to set aside, and live as a family in harmony with the universe.





PAOLA MOSCOSO ROSERO

Age: 26
Nationality: Ecuadorian,
Occupation: biologist

If we wonder what nature is, we should examine ourselves first because we are part of it. Hence, the value we can assign to nature is exactly the same value we assign to our own existence and to that of all other creatures on Earth. Ecuador attempted to acknowledge this approach in its Constitution as the Rights of Nature. It is necessary that, apart from valuing nature for its material value for human beings, its economic significance, we should also understand its inherent values in order to fully understand it and to contribute to genuine conservation action.

LUDWIG SCHRAMM

Age: 22
Nationality: German,
Occupation: Film maker

While thinking about my vision on the value of nature I sat down on a meadow, pushed aside the grass, and observed life on the ground underneath. I was so surprised and awed at what I saw. The earth is alive everywhere. I do not know how many hundred or thousand little creatures inhabit a single square yard: bugs, ants, worms, snails, spiders, lice, all the way to the micro-organisms. If we add it all up, we know something about richness!



MEGAN NEEDS

Age: 25
Nationality: Canadian
Occupation: Student

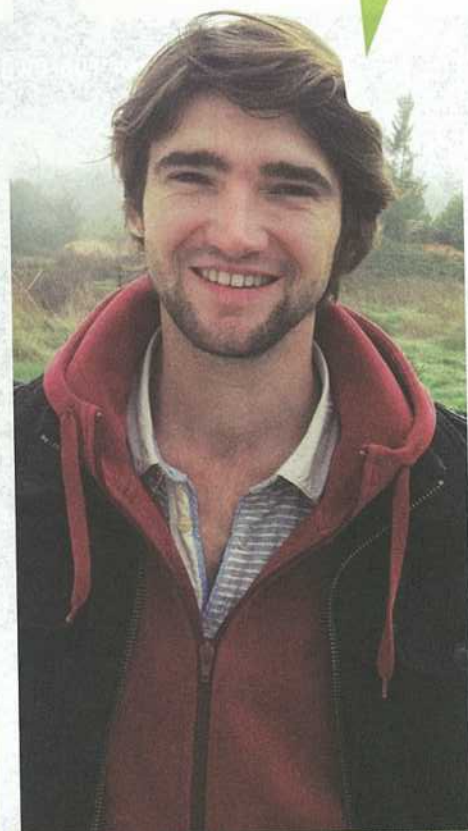
Nature has always fascinated me; the way it grows and adapts, and is breathtakingly beautiful while at the same time provides us with everything we need. I don't understand why so many in the 'Modern World' choose to ignore Nature; they have no idea where their food comes from, and rely on chemical-based medicines when natural remedies grow right outside their back door. We are tenants in a world where anything is possible; everything we need is right here. Nature is the landlord of Utopia, it's time we open our eyes and say 'Thank You!'.



LEON CHEN

Age: 24
Occupation: entrepreneur and philanthropist
(founder of www.suchenglobal.org)
Nationality: British (Chinese born)
Country of residence: China.

I believe a flourishing natural environment, that is to say great ecosystem functionality, all comes down to the harmonious interdependencies of a myriad of different interlinking elements from trees and animals to climate and habitats. Humans must fit into this in picture and in order to maintain the diversity and life of the ecosystem we must contribute just as much as we take. In order for us to progress I believe we need a consciousness shift that will require a great deal of lot of hard work and a revolution in our education systems to provide for far more creative, resourceful and sustainable thinking and doing.



DAVID SILVA

Age: 21
Nationality: Portuguese
Occupation: Student

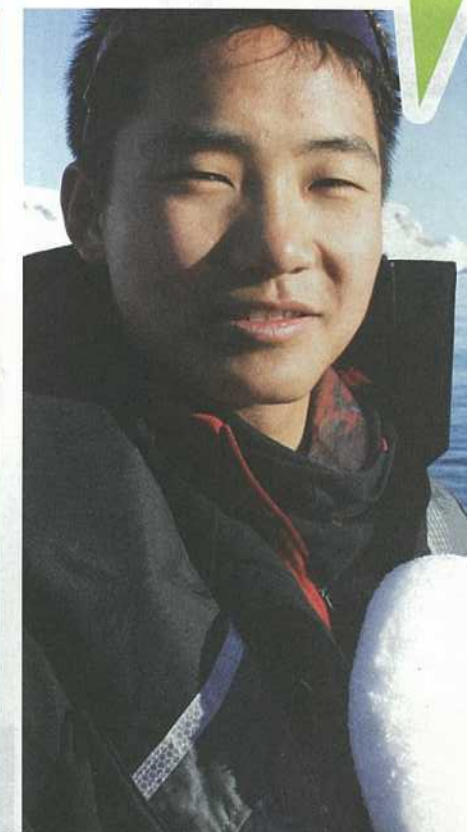
Preserving Nature is not preserving the environment. Preserving Nature is preserving ourselves. No wastewater treatment plant can filter and treat water as the rivers or ecosystems can. No air filter can purify polluted air as a green forest can. We are not a substitute. So, I think of Nature not as my garden or playground, but as my home: we may be wealthy, powerful or vain, but what would we be without a home? And yet, we are burning it down. We can change. We can do better. And this book makes me believe that we will!



FATOUMATA DIALLO

Age: 21
Nationality: Burkinabe
Occupation: student

For this book, I have written a story. The story is called 'This is a cry from an orphan': God gave me a mother and a father, then, unfortunately he snatched them away and I was left behind alone. But, being the protector of the orphan, God entrusted me to two trees in the savannah. These trees are: the shea and nere trees. From their fruits I get my daily bread. From their nuts I get butter from the first and the second helps me to have a delicious soup. At the time of harvest the little money I receive by gathering the nuts allows me to attend school. Woodcutters, I beg you spare and save the orphan food giver.





ROSANNA GEARY

Age: 26
Nationality: British
Occupation: Policy Administrator

Nature has an intrinsic value which is both immeasurable and un-quantifiable. Its value is infinitely greater than the sum of its parts. However, nature needs to be protected, and a quantifiable method of valuation must be formulated if legislation and frameworks to facilitate protection are to be effective. An effective valuation tool will also assist in securing support for environmental priorities, conveyed in terms of increased human well-being, societal and economic outcomes.



MIHAELA MAGHIAR LACRAMIDARA

Age: 19
Nationality: Romanian
Occupation: Student

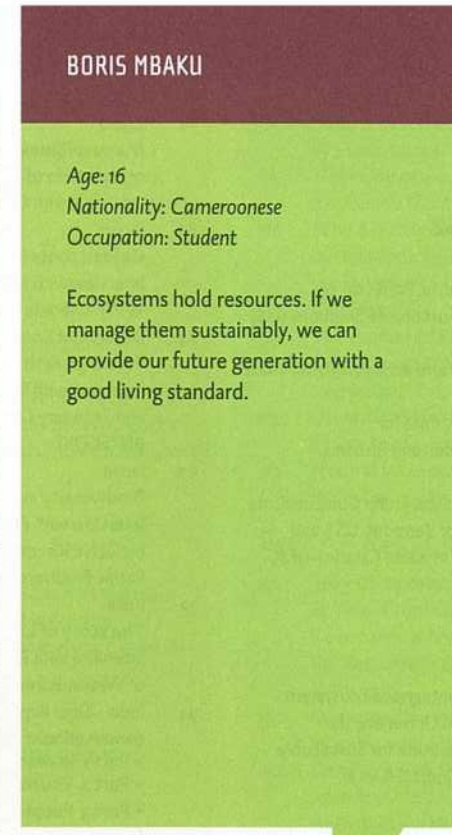
I've always found my true self in Nature, in one form or another: as a torrential river, as a travelling cloud... And Nature has always manifested itself in me, at one moment or another: when I was careful not to step on the snail on the path or when I planted little trees. I cannot find words to express the value of the close bond between me and Nature. But I try to do it through my everyday innocent, natural gestures, attitude, behaviour. I know Nature is fragile and in permanent conflict with Man and I'm asking myself: where is that Man-Nature balance, a sustainable and harmonious balance?



SAJID IQBAL

Age: 21
Nationality: Bangladeshi
Occupation: Student

Whenever the word nature is used, a heavenly image appears in my mind. But, humans are now lost in the world of industrialization and urbanization which is destroying the diversified beauty of nature. Humans have forgotten that the world is not only for them, the world is there for other species, too. A small insect may not have any value to man but is an indispensable part of nature. Extinction of this micro-species means a huge loss for nature. If we care for nature, nature will also care for us.



BORIS MBAKU

Age: 16
Nationality: Camerooneese
Occupation: Student

Ecosystems hold resources. If we manage them sustainably, we can provide our future generation with a good living standard.



LEIGH FERGUSON

Age: 22
Nationality: Australian
Occupation: Student

I'm walking through the tropical rainforest of Byron Bay, Australia, feeling the nourishing vapour on my skin, and squinting up at the canopy's serene dappled light. Stepping slowly along the damp rainforest bed, I feel the presence of the vast insect ecosystem in the soil below, and try not to disturb a translucent worm as it buries itself into the undergrowth. The sound of distant waves and the gentle rainforest create a symphony of nature that calms my breath. Gradually, the forest opens onto the majestic blue surf of the Pacific Ocean, and I smile at the playful dolphins out on their pristine waters. They smile back, and I am so alive!

BRAM HALLO

Age: 21
Nationality: Dutch,
Occupation: Student

For me it is important that I will be able to go hiking or sailing in an area that is not polluted. Not only now but also in fifty years' time. In my opinion people, but especially companies, get away with living and producing in an unsustainable manner too easily. When people start living in a sustainable way and within that context only consume products from companies that share this way of producing, society will automatically change as well. It is usually more expensive to live this way at first but I hope people will make this investment. If they do not, I fear that the consequences of for instance climate change will exceed the initial investment needed by far.

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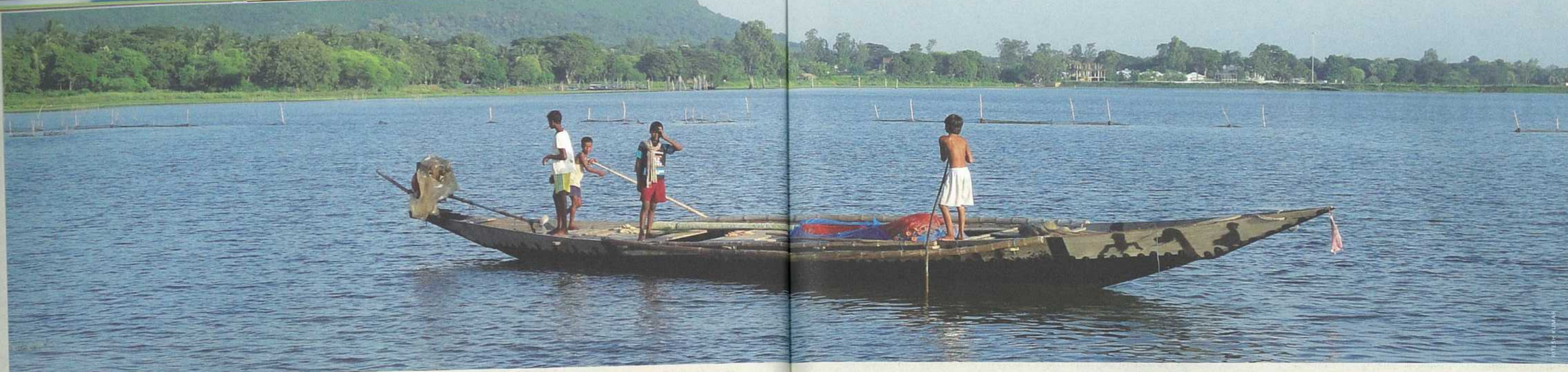
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Hope

This book is a book of hope, a book of opportunities and solutions. It shows that restoration of degraded areas all around the world is possible. It is the report of a journey with visits to scientists, conservationists, entrepreneurs and local people in many countries. It presents great ideas, replicable practices from around the world and testimonies how to move forward to restore nature, on which we all depend and which we are part of.

It explains the ecosystem services that Nature has in store, such as food, water, medicinal plants, climate regulation, water purification, flood protection, pollination of crops and plant-disease control by insects. And its beauty which inspires and calms us when we are anxious.

It shows the way to a green economy. It shows how nature conservation and restoration contribute to water supply, food security, poverty alleviation and new jobs. It shows that making use of the services of nature in a responsible way is often much cheaper than building installations and maintaining these. This applies to water purification and to flood protection, to mention only two examples.

One of the causes of the massive destruction of Nature is the absence of a price-tag on nature and most of the services it provides. If there is no price, it doesn't count in the economy. Assigning financial value to Nature and paying for ecosystem services (PES) are of key importance to the conservation and restoration of Nature. It's a new trend.

This is an opportunity for companies to invest in nature conservation and nature restoration. It's in their own interest, as they depend on what Nature has to offer. It's also their obligation. The public domain will hold any party increasingly accountable for ecosystem degradation and loss of biodiversity, while hundreds of millions of people and many parties are highly dependent on so far unaccounted ecosystem services.

The time has come that the view on conservation of nature changes. Many believe that nature conservation only costs money. This view is out of date. Investing in nature conservation and restoration, means investing in ecosystem services on which we all depend. The return on investment can be measured and is priceless at the same time. Organizations and people who manage natural areas should be paid for their management and should be facilitated by the stakeholders, including the government.

Some object to monetarizing something as beautiful as Nature. They speak of its intrinsic value and don't want to have anything to do with it. This is understandable but focusing on the intrinsic value only will not save Nature in a world where money counts. Nature has to become part of the economy, otherwise it will keep being treated as a free good, which in fact is a license to unsustainable conduct and depletion of natural resources.

Some are afraid that monetarizing ecosystem services means that the rich will buy and that the poor, especially in developing countries, will be left behind with less or without access to these services. Their fear is justified. Companies who use ecosystem services for business purposes should pay for the use. They should also commit themselves to clean behavior so local people who depend on the same ecosystem services for their livelihood can continue to use them.

Many hundreds of millions of people depend on Nature to survive. Poor people living in nature and in the rural areas of developing

countries are poor precisely because they don't have jobs, don't produce goods and do not take part in democracy. An important solution is that they get paid for the conservation and restoration of nature from which all stakeholders can benefit. Local people are the guardians of ecosystems and ecosystem services. Without their cooperation losses of nature areas are inevitable.

In each country 15% to 20% of nature should be strictly protected without any modern economic activity being carried out there. We need these areas for our well-being. They will also serve as a safe haven for other species beside us on this planet and to which we owe respect. Strictly protected areas also serve as treasure chambers of species that will play an indispensable role to restore degraded areas. This book shows how natural assets can be part of the balance sheet. They should be, otherwise we are more likely to lose them.

In spite of the troublesome times for nature conservation, there are two things which are very inspiring and motivating. One is the ability of nature to recover. Thanks to ocean reserves, fish populations grow. It is only one example. The other is the creativity and courage of so many people who work on the conservation and restoration of our planet every day. With results, as this book shows.

Meindert Brouwer

Bunnik, the Netherlands, June 2012

Glossary

This chapter explains what ecosystems, ecosystem services and related terms mean.

BIOMES, BIODIVERSITY AND ECOSYSTEMS Nature can be divided in large units which are called natural biomes, such as rainforest, oakforest, woodland and shrubland, desert, tundra, grassland and rangeland, mountains, polar ice regions, inland freshwater wetlands, coastal systems, marine areas and open oceans. Biomes contain many different ecosystems. An ecosystem is a dynamic community of interdependent plants, animals and micro-organisms in a specific non-living environment. Elements of a non-living environment are the amount and composition of soil, rocks, nutrients, water, air, changes in quantity and quality of these elements, circumstances such as light, temperature, the wind, pressure in deep waters, erupting volcanoes and more. The elements of a non-living environment influence and are influenced by the way the living parts of the system function. Biodiversity (biological diversity in full) is the variability among living organisms. Biodiversity includes diversity between species – such as plants, trees, mammals, birds, fish, reptiles, insects, and micro-organisms –, diversity within species (genetic diversity) and diversity between ecosystems.

In addition to largely 'natural' biomes we can distinguish two biomes that are dominated by humans: cultivated areas and urban areas. Cultivated areas contain human-dominated ecosystems such as croplands, plantations, orchards and aquaculture. Urban areas of towns and cities also contain ecosystems such as parks and gardens.

In human-dominated ecosystems the quantity of biodiversity is less compared to intact natural ecosystems, in most cases.

PRIMARY PRODUCTION Primary production makes life on earth possible. Primary production is the production of organic compounds by green plants, and some species of bacteria, including algae. They produce these organic compounds using carbon dioxide, water, various elements like nitrogen, phosphorus, sulfur, calcium, iron, manganese etc., and a source of energy. That source of energy is usually sunlight, or in greenhouses an artificial source of light. Instead of sunlight, certain bacteria use the energy that is liberated

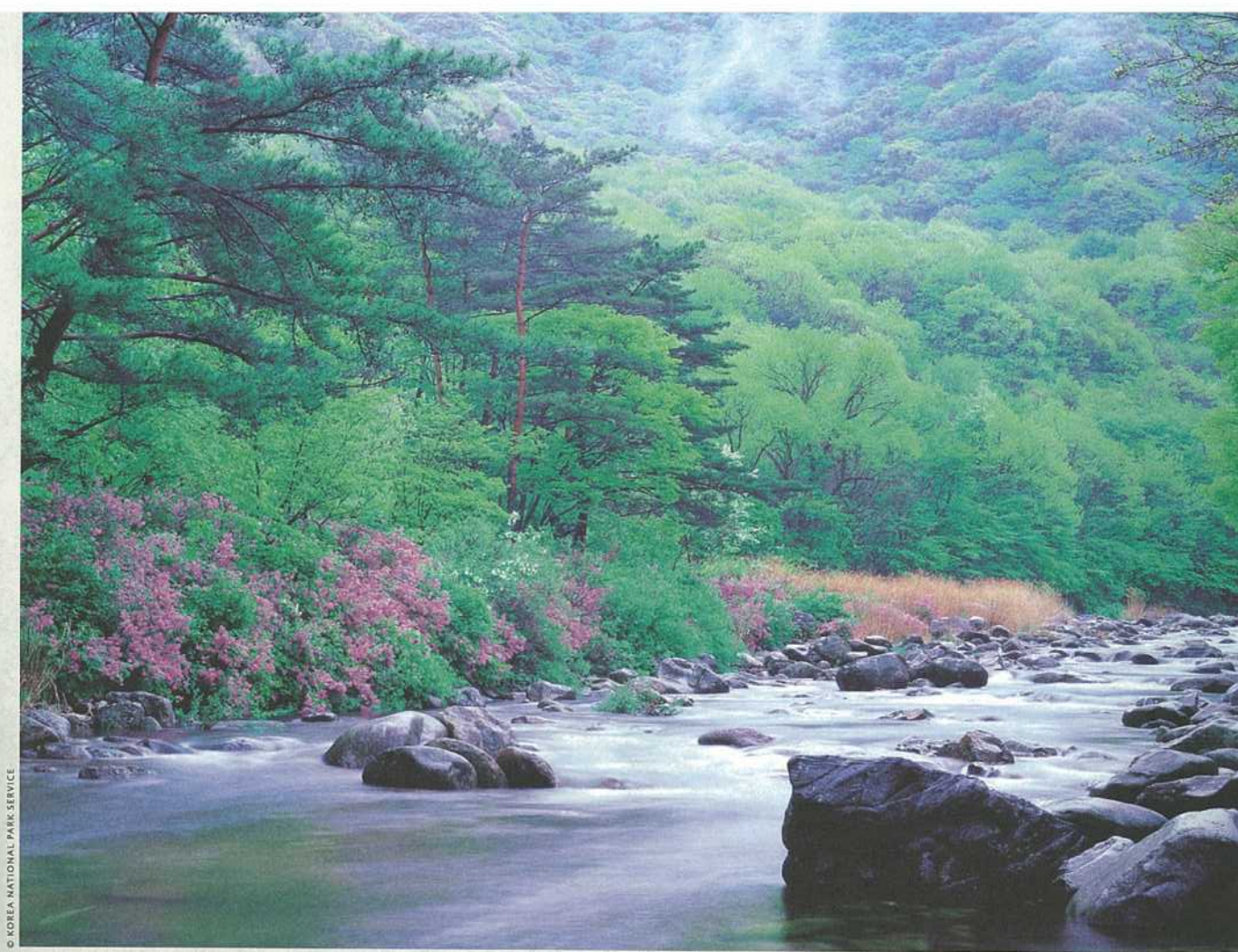
when they convert the inorganic compounds they feed on. Photosynthesis is the first step in primary production for green plants and green algae. In addition, during photosynthesis oxygen atoms from the carbon dioxide and water are recycled to the atmosphere as live-sustaining oxygen molecules. Primary production is what makes life on earth possible. All animals depend on it, directly (plant eaters) or indirectly (meat eaters). Which is why what animals produce (meat, milk, hides, etc.) is called secondary production.

PROCESSES AND FUNCTIONS The biophysical structure of ecosystems and processes such as primary production, nutrient cycling and water cycling are of key importance for ecosystems to function. Vital ecosystem functions such as water regulation, water purification and the production of biomass are essential for human welfare and well-being.

ECOSYSTEM SERVICES Ecosystems are our natural capital assets. Ecosystems deliver all kinds of services to humans. Ecosystem services are defined as the benefits human derive from ecosystem functions and processes. Scientists use different classifications of ecosystem services. Here the classification is based on and at some points adapted from the classification of Pushpam Kumar et al (TEEB, 2010), who refer to Costanza, R. et al (1997), De Groot R.S. et al (2002), Millennium Ecosystem Assessment (2005a) and Daily et al (2009). The following classification proposes to distinguish 23 ecosystem services in five categories.

PROVISIONING SERVICES

- Food (such as fish, game, crops, fruits, nuts).
- Water (for drinking, irrigation, cooling and more).
- Raw materials (such as timber, fibers, fodder, fertilizer).
- Vegetable ingredients of many products (such as cosmetic and bodycare products, energy drinks and food supplements).
- Genetic resources (for crop improvement and more).
- Medicinal plants.
- Ornamental resources (for artisan work and more).



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REGULATING SERVICES

- Air quality regulation (such as capturing (fine) dust and chemicals).
- Climate regulation (such as carbon sequestration, influence of vegetation on rainfall).
- Moderation of extreme events (storm protection, flood prevention and more).
- Regulation of waterflows (natural drainage, irrigation, drought prevention and more).
- Erosion prevention.
- Waste treatment (water purification, detoxification and decomposition of waste, and more).
- Soil formation, nutrient cycling and maintenance of soil fertility.
- Pollination by insects (pollination of crops, fruit trees and flowers).
- Biological control (such as seed dispersal by birds and other animals, plant disease control by insects and properties of plants).

Spring stream in Jirisan National Park, Republic of Korea.

SUPPORTING SERVICE

Photosynthesis (see primary production).

HABITAT SERVICES

- Maintenance of life cycles of migratory species (nursery services for fish and birds).
- Maintenance of biodiversity and genetic diversity (especially in biodiversity hotspots and in protected areas).

CULTURAL AND AMENITY SERVICES

- Opportunities for recreation and tourism.
- Inspiration for culture, art and design.
- Spiritual experience.
- Education.

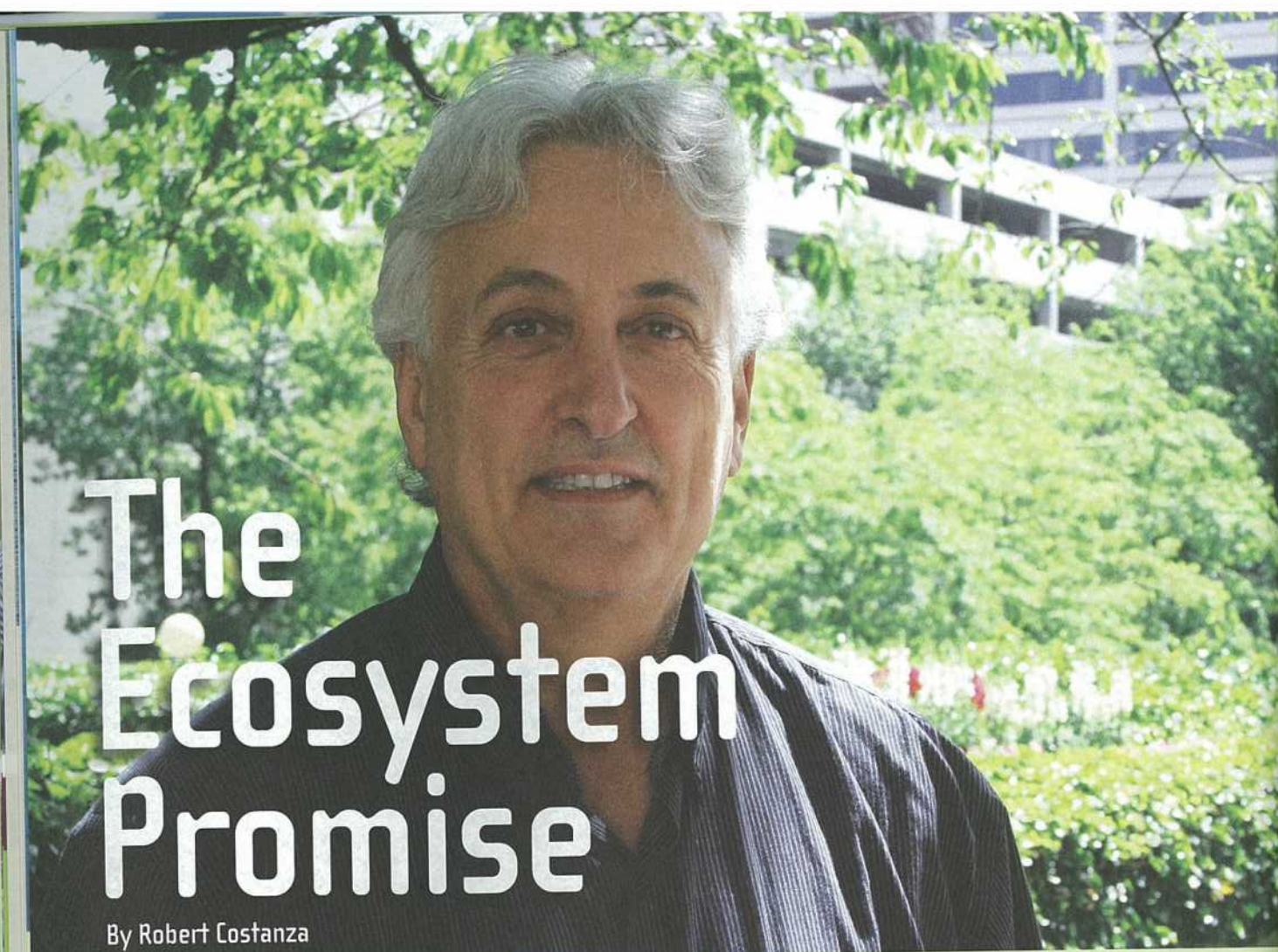
Part 1

The Ecosystem Promise

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Fishermen with cast net fishing on the Dzanga River, Central African Republic.

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The Ecosystem Promise

By Robert Costanza

The world has changed dramatically. We no longer live in a world relatively empty of humans and their artifacts. We now live in what some are even calling a new geologic era – the ‘anthropocene’ (Crutzen 2002) – a full world where humans are dramatically altering our ecological life support system (Daly 2005).

Our traditional concepts and models of the economy were developed in the empty world. The conventional view of the ‘economy’ is based on a number of assumptions about the way the world works, what the economy is, and what the economy is for (Table 1). In this ‘empty world’ context, built capital – the houses, cars, roads, and factories of the market economy – was the limiting factor. Natural capital – our ecological life support system – and social capital – our myriad relationships with each other – were abundant. It made sense, in that context, not to worry too much about environmental and social ‘externalities’ – effects that occurred outside the market – since they could be assumed to be relatively small and ultimately solvable. It made sense to focus on the growth of the market economy, as measured by Gross Domestic Product (GDP), as a primary means to improve human welfare. It made sense, in that context, to think of the economy as only

marketed goods and services and to think of the goal as increasing the amount of these goods and services produced and consumed.

But in the new full world context, we have to think differently about what the economy is and what it is for if we are to create sustainable prosperity. If we seek ‘improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities’ as the UN has recently proclaimed as the primary global goal (UNEP 2011), we are going to need a new vision of the economy and its relationship to the rest of the world that is better adapted to the new conditions we face.

We have to first remember that the goal of the economy is to sustainably improve human well-being and quality of life. We have to remember that material consumption and GDP are merely means to that end, not ends in themselves. We have to recognize, as both ancient wisdom and new psychological research tell us, that material consumption beyond real need can actually reduce our well-being. We have to better understand what really does contribute to sustainable human well-being (SHW), and recognize the substantial contributions of natural and social capital, which are now the limiting factors to improving SHW in many countries. We have to be able to distinguish between real poverty in terms of low SHW and merely low monetary income. Ultimately we have to create a new vision of what the economy is and what it is for, and a new model of development that acknowledges this new full world context and vision.

PLANETARY BOUNDARIES Our planet’s ability to provide an accommodating environment for humanity is being challenged by our own activities. The environment – our life-support system – is changing rapidly from the stable Holocene state of the last 12,000 years, during which we developed agriculture, villages, cities, and contemporary civilizations, to an unknown future state of significantly different conditions.

One way to address this challenge is to determine ‘safe planetary boundaries’ based on fundamental characteristics of our planet and to operate within them. ‘Boundaries’ here mean specific points related to a global-scale environmental process beyond which humanity should not go. Identifying our planet’s intrinsic, non-negotiable limits is not easy, but recently a team of scientists have specified nine areas that are most in need of well-defined planetary boundaries (Rockstrom et al. 2009). The nine areas they identified that are most in need of planetary boundaries are climate change,

DR. ROBERT COSTANZA

Dr. Robert Costanza is one of the world’s foremost ecological economists. He is Distinguished University Professor of Sustainability at Portland State University, Oregon, USA, holding the position of Director of the Institute for Sustainable Solutions. Costanza is co-founder and past-president of the International Society for Ecological Economics, and was chief editor of the society’s journal, *Ecological Economics* from its inception in 1989 until 2002. Costanza is editor-in-chief and co-founder (along with Paul Hawken, David Orr and John Todd) of the journal *Solutions* (www.thesolutionsjournal.org), a new hybrid academic/popular journal.

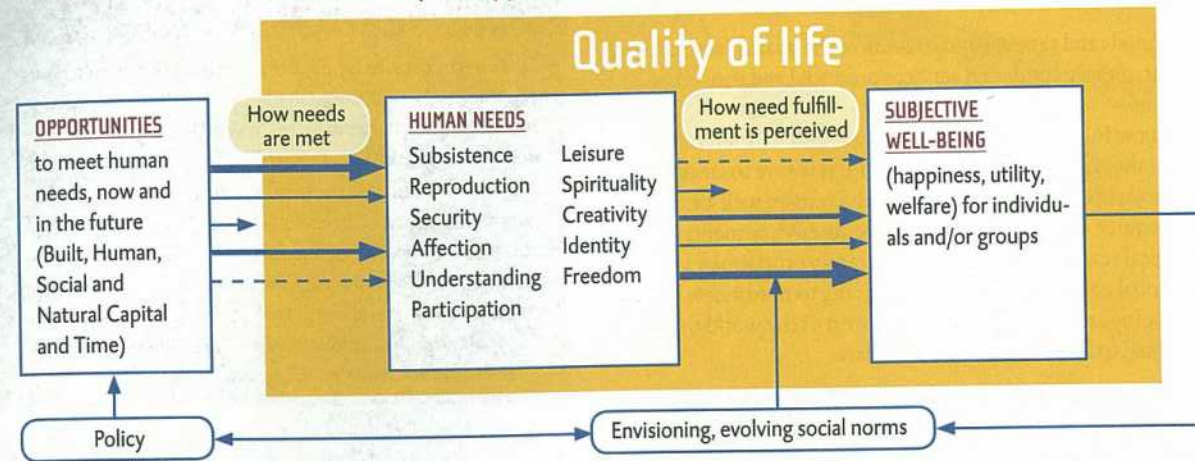
biodiversity loss, excessive nitrogen and phosphorus production, stratospheric ozone depletion, ocean acidification, global consumption of freshwater, change in land use for agriculture, air pollution, and chemical pollution. They estimate that humanity has already transgressed three of these boundaries: climate change, biodiversity loss, and nitrogen production, with several others rapidly approaching the safe boundary.

Clearly, remedial policy responses to date have been local, partial, and inadequate. Early policy discussions and the resulting responses tended to focus on symptoms of environmental damage rather than basic causes and policy instruments tended to be ad hoc rather than carefully designed for efficiency, fairness, and sustainability. For example, in the 1970’s emphasis centered on end-of-pipe pollution control which, while a serious problem, was actually a symptom of expanding populations and inefficient technologies that fueled exponential growth of material and energy throughput while threatening the recuperative powers of the planet’s life-support systems.

These problems are all evidence that the material scale of human activity is rapidly approaching, or already exceeds, the safe operating space for humanity on the earth. We are degrading our life-support systems – the ecosystem services provided by our natural capital assets.

ECOSYSTEM SERVICES Ecosystem services are defined as ‘the benefits people obtain from ecosystems’ (Costanza et al. 1997, Millennium Ecosystem Assessment, 2005). These include provisioning services such as food, water and medicinal plants; regulating services such as air quality regulation, water purification, regulation of floods,

Quality of Life (QOL) as the interaction of human needs and the subjective perception of their fulfillment, as mediated by the opportunities available to meet the needs.



From: Costanza, R., B. Fisher, S. Ali, C. Beer, L. Bond, R. Boumans, N. L. Danigelis, J. Dickinson, C. Elliott, J. Farley, D. E. Gayer, L. MacDonald Glenn, T. Hudspeth, D. Mahoney, L. McCahill, B. McIntosh, B. Reed, S. A. T. Rizvi, D. M. Rizzo, T. Simpatico, and R. Snapp. 2006. Quality of Life: An Approach Integrating Opportunities, Human Needs, and Subjective Well-Being. *Ecological Economics* 61: 267-276.

drought, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, scientific and spiritual benefits (Costanza et al. 1997, Daily 1997, de Groot et al. 2002).

This is an appropriately broad and an appropriately vague definition. It includes both the benefits people perceive, and those they do not. The conventional economic approach to 'benefits' is far too narrow in this regard, and tends to limit benefits only to those that people both perceive and are 'willing to pay' for in some real or contingent sense. But the general population's information about the world, especially when it comes to ecosystem services, is extremely limited. We can expect many ecosystem services to go almost unnoticed by the vast majority of people, especially when they are public, non-excludable services that never enter the private, excludable market. Think of the storm regulation value of wetlands (Costanza et al. 2008). How can we expect the average citizen to understand the complex linkages between landscape patterns, precipitation patterns, wetlands and flood attenuation, when even the best landscape scientists find this an extremely challenging task? We need to remember the definition of ecosystem services (the benefits provided by ecosystems), and acknowledge that the degree to which the public perceives and understands them is a separate (and very important) question.

Conventional economic valuation presumes that people have well-formed preferences and enough information about trade-offs that

they can adequately judge their 'willingness-to-pay.' Since these assumptions do not hold for many ecosystem services (Norton et al. 1998) we must either:

1. inform people's preferences by showing the underlying dynamics of the ecosystems in question and their connection to human well-being;
2. allow groups to discuss the issues and 'construct' their preferences within a framework that conveys information about the connections; or
3. use other techniques that do not rely directly on preferences to estimate the contribution to human well-being of ecosystem services for example through the use of scientific studies and computer models that can trace the complex linkages between ecosystem functioning and human well-being.

In addition, the benefits one receives from functioning ecosystems do not necessarily depend on one's ability to pay for them in monetary units. For example, indigenous populations with no money economy at all derive most of the essentials for life from ecosystem services but have zero ability to pay for them in monetary terms. To understand the value of these ecosystem services we need to understand the trade-offs involved, and these may be best expressed in units of time, energy, land or other units, not necessarily money, remembering that the local population may or may not understand or be able to quantify these tradeoffs. Finally, if one can express the tradeoffs (value) in one set of units, then one can convert the trade-offs into the other units that

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may better communicate with certain audiences. For example, if we can express trade-offs in units of time (i.e. how many hours of labor it takes to complete a task) and can estimate the time/money trade-off, (i.e. the wage rate of labor) we can express the trade-offs in those units. But this does not imply that monetary units are the only or the best way to express the trade-offs. One must also not confuse expressing values in monetary units with treating ecosystem services as tradable private commodities. Most ecosystem services are public goods that should not be privatized or traded. This does not mean they should not be valued.

A second issue is that ecosystem services are, by definition, not ends or goals, but means to the end or goal of sustainable human well-being. This does not imply that ecosystems are not also valuable for other reasons, but that ecosystem services are defined as the instrumental values of ecosystems as means to the end of human well-being.

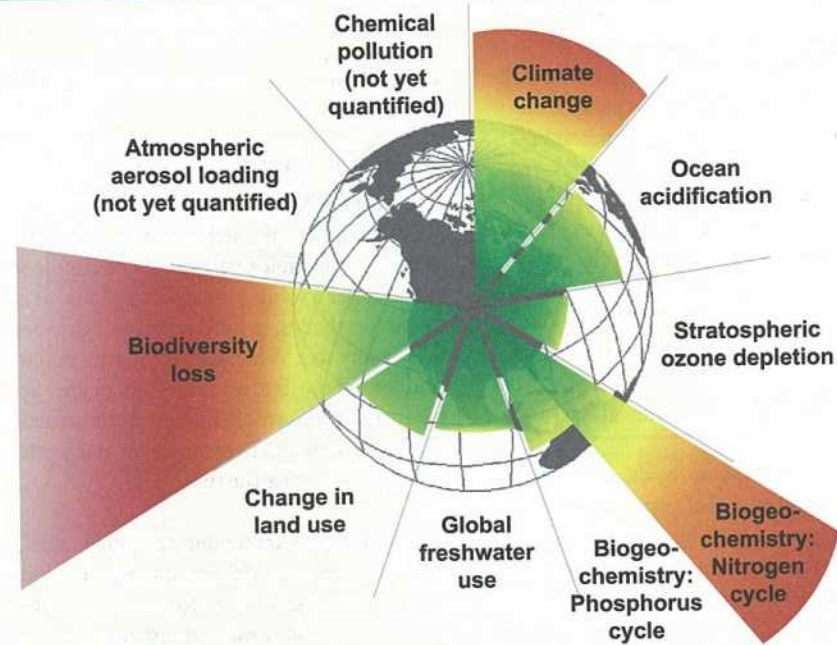
To achieve sustainability, we must incorporate natural capital, and the ecosystem goods and services that it provides, into our economic and social accounting and our systems of social choice. In estimating these values we must consider how much of our ecological life support systems we can afford to lose. To what extent can we substitute manufactured for natural capital, and how much of our natural capital is irreplaceable? For example, could we replace the radiation screening services of the ozone layer if it were destroyed? Because natural capital is a public good it is not handled well by existing markets. Special methods must be used to estimate its value and new institutions are needed to manage it. Methods to estimate the value of natural capital range from surveys and questionnaires to elicit the preferences of current resource users (i.e. willingness-to-pay (WTP) to methods based on energy analysis (EA) of flows in natural ecosystems (which do not depend on current human preferences at all). (Farber and Costanza 1987, Costanza et al. 1989, Costanza 2004). This method looks at the total amount of solar energy captured by natural ecosystems (their Net Primary Production or NPP) as an estimate of their potential to do useful work for the economy. NPP is the energy that powers all the other things ecosystems do, including the full range of services and thus it is an estimate of the maximum economic value of the natural system. Because of the inherent difficulties and uncertainties in determining these values we are better off with an intelligently pluralistic

approach that acknowledges and utilizes these different, independent approaches.

VALUATION OF ECOLOGICAL SYSTEMS AND SERVICES The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. Some argue that valuation of ecosystems is either impossible or unwise. For example some argue that we cannot place a value on such 'intangibles' as human life, environmental aesthetics, or long-term ecological benefits. But, in fact, we do so every day. When we set construction standards for highways, bridges and the like, we value human life – acknowledged or not – because spending more money on construction would save lives. These are statistical lives, however, not particular lives and one should not confuse the two.

People also often talk about 'economic value', 'ecological value', and 'social value' as if they were separate things. Nothing could be further from the truth. As the discussion above makes clear, the 'value' or 'benefit' we are talking about here is the contribution to sustainable human well-being. None of these elements (ecological, social/cultural, economic) can make a contribution to that goal without interacting with the others. What we can ask is: what is the relative contribution of, for example, natural capital to sustainable human well-being, in combination with other forms of capital (built, human, social), in a particular context. We have to look at these things in context and as part of an integrated, whole system of humans embedded in cultures embedded in the rest of nature.

Another often-made argument is that we should protect ecosystems for purely moral or aesthetic reasons, and we do not need valuations of ecosystems for this purpose. But there are equally compelling moral arguments that may be in direct conflict with the moral argument to protect ecosystems. For example the moral argument that no one should go hungry. All we have done is to translate the valuation and decision problem into a new set of dimensions and a new language of discourse. So, while ecosystem valuation is certainly difficult, one choice we do not have is whether or not to do it. Rather, the decisions we make, as a society, about ecosystems imply tradeoffs and therefore valuations. We can choose to make these valuations explicit or not; we can undertake them using the best available ecological science and understanding or not; we can do them with an explicit acknowledgment of the huge uncertainties involved or not; but as long as we are forced to make choices we are doing valuation. The valuations are simply the relative weights we give to the various aspects of the decision



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problem. Society can make better choices about ecosystems if the valuation issue is made as explicit as possible. This means taking advantage of the best information and models we can muster and making uncertainties about valuations explicit too. It also means developing new and better ways to make good decisions in the face of these uncertainties. Ultimately, it means being explicit about our goals as a society, both in the short-term and in the long-term.

The point that must be stressed is that the economic value of ecosystems is connected to their physical, chemical, and biological role in the long-term, global system – whether the present generation of individuals fully recognizes that role or not. If it is accepted that each species, no matter how seemingly uninteresting or lacking in immediate utility, has a role in natural ecosystems (which do provide many direct benefits to humans), it is possible to shift the focus away from our imperfect short-term perceptions and toward the goal of developing more accurate values for long-term ecosystem services. Ultimately, this will involve the collaborative construction of dynamic, evolutionary models of linked ecological, economic systems that adequately address long-term responses and uncertainties, like those mentioned above. Institutions to Manage Ecosystems and Their Services One hears a lot of talk these days about ‘ecosystem service markets.’ The problem is, conventional markets are not the right institution

for managing many ecosystem services other than provisioning services like fish and wild foods. Services like air quality regulation, natural drainage, nutrient cycling and pollination by insects are often ‘non-rival’ and not easily excludable and are therefore best thought of as ‘public goods’ or, more generally, a part of ‘the commons’ (Farley and Costanza 2010, Farley et al. this volume). While we can and should use economic incentives (fees and payments) when appropriate to manage the commons, we need a different institutional form than ‘markets’ within which to do this – something more akin to an ‘ecosystem trust’.

Ruhl et al. (2007) explain how American property law, regulation, and social norms all work against protecting ecosystem services. One particularly interesting counter-trend is the ‘public trust doctrine’, an idea that law professor Joseph Sax identified in the 1970’s as the only legal doctrine with the breadth and substance to be useful as a comprehensive approach to natural resource (and ecosystem service) management. This doctrine holds that natural resources should be treated as community property, not private property, and should be held in trust for the community. However, so far the U. S. Supreme Court has declined to move in this direction. Recent proposals to expand the ‘commons sector’ of the U. S. and global economy by creating ‘common asset trusts’ to manage the atmosphere, water, and other natural capital assets

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(structured like the Alaska Permanent Fund or the many existing Land Trusts) may be one way of implementing this doctrine (Barnes 2006, Barnes et al. 2008, Farley et al. this volume). For example, a bill has been introduced in the Vermont Senate to create a ‘Vermont Common Asset Trust,’ based on the public trust doctrine, to ‘propertize’ (but not privatize) the state’s natural and social capital assets in order to better manage them on behalf of their common stakeholders (both living and future). Trusts are widely-used and well-developed legal mechanisms designed to protect and manage assets on behalf of specific beneficiaries (Souder and Farifax 1996). Extending this idea to the management and protection of whole ecosystems and the services they provide, is a new but straightforward extension of this idea. Trusts would define whole ecosystems as common property assets, managed by trustees on behalf of all current and future beneficiaries. Once these common assets are assigned property rights, we can use all the existing property law to manage them more effectively. For example, we can charge fees for damages and make payments for enhancement. This gives Payment for Ecosystem Services (PES) schemes a broader institutional framework within which to operate and can help to drastically reduce transaction costs, both for national and international systems.

For example, at the international scale, an ‘Earth Atmospheric Trust’ has been proposed (Barnes et al. 2008) that would form the framework for an international cap/auction/dividend and trade system and provide the funding for payments to enhance and protect the atmosphere, like carbon sequestration in the Amazon rain forest. The trust would also pay dividends to all people on earth on a per-capita basis to help reduce poverty.

While trusts may not be the only or the best institution for managing ecosystem services, they seem to be a move in the right direction. We need to think much more creatively about the design of institutions that are better suited to the characteristics of ecosystem services.

TOWARD A SUSTAINABLE AND DESIRABLE FUTURE A new model of the economy and prosperity consistent with our new full world context (Table) would be based clearly on the goal of sustainable human well-being. It would use measures of progress that clearly acknowledge this goal, i.e. GPI (Genuine Progress Indicator) instead of GDP. It would acknowledge the importance of ecological sustainability, social fairness, and real economic efficiency. Ecological sustainability implies recognizing that natural and social capital are not infinitely substitutable for built and human capital,

and that real biophysical limits – planetary boundaries – exist to the expansion of the market economy. Climate change is perhaps the most obvious and compelling of these limits.

Social fairness implies recognizing that the distribution of wealth is an important determinant of social capital and quality of life. The conventional development model, while explicitly aimed at reducing poverty, has assumed that the best way to do this is through growth in GDP. This has not proved to be the case and explicit attention to distribution issues is sorely needed. As Robert Frank has argued (Frank 2007), economic growth beyond a certain point sets up a ‘positional arms race’ that changes the consumption context and forces everyone to consume too much of positional goods (like houses and cars) at the expense of non-marketed, non-positional goods and services from natural and social capital. Increasing inequality of income actually reduces overall societal well-being, not just for the poor, but across the income spectrum (Wilkinson and Pickett 2009). For example, psychologist Tim Kasser in his 2003 book (Kasser 2003) ‘The High Price of Materialism’ points out that people who focus on material consumption as a path to happiness are actually less happy and even suffer higher rates of both physical and mental illnesses than those who do not. Material consumption beyond real need is a form of psychological ‘junk food’ that only satisfies for the moment and ultimately leads to depression, Kasser says.

Real economic efficiency implies including all resources that affect sustainable human well-being, not just marketed goods and services. Our natural systems and social networks are not part of the market, but contribute heavily to our well-being. The current economic model ignores these non-marketed contributions and therefore does not achieve real economic efficiency. A new, sustainable, ecological, economic model would measure and include the contributions of natural and social capital and could better approximate real economic efficiency.

The new economic model would also acknowledge that a complex range of property rights regimes are necessary to adequately manage the full range of resources that contribute to human well-being. For example, most natural and social capital assets are public goods. Making them private property does not work well. On the other hand, leaving them as open access resources (with no property rights) does not work well either because then there is no incentive to conserve. This is what Garret Hardin (1968) called the ‘tragedy of the commons’ – really the tragedy of open

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access resources. What is needed is a third way to propertize these resources without privatizing them. Several new (and old) common property rights systems have been proposed to achieve this goal (Dietz et al. 2003) including various forms of common property trusts (Farley et al. this volume).

The role of government also needs to be reinvented. In addition to government's role in regulating and policing the private market economy, it has a significant role to play in expanding the 'commons sector', that can propertize and manage non-marketed natural and social capital assets, like the atmosphere, oceans, ground and surface water, the internet, the airwaves, and many others (Farley et al. this volume). It also has a major role to play as facilitator of societal development of a shared vision of what a sustainable and desirable future would look like. As Prugh et al. (2002) have argued, strong democracy based on developing a shared vision is an essential prerequisite to building a sustainable and desirable future.

The conventional economic model is not working, for either the developed or the developing world. It is not sustainable and it is also not desirable. It is based on a now obsolete empty world vision and it is leading us to disaster. We need to accept that we now live in a full world context where natural and social capital are the limiting factors. We could achieve a much higher quality of life, and one that would be ecologically sustainable, socially fair, and economically efficient, if we shift to a new sustainable development paradigm that incorporates these principles. The problem is that our entire modern global civilization is, as even former President George W. Bush has acknowledged, 'addicted to oil' and addicted to consumption and the conventional development model in general. An addictive substance is something one has developed a dependence on, which is either not necessary or harmful to one's longer-term well-being. Fossil fuels (and excessive material consumption in general) fit the bill. We can power our economies with renewable energy, and we can be happier with lower levels of consumption, but we must first break our addiction to fossil fuels, consumption, and the conventional development model, and as any addict can tell you: 'that ain't easy.' But in order to break an addiction of any kind, one must first clearly see the benefits of breaking it, and the costs of remaining addicted, facts that accumulating studies like the IPCC reports, the Stern Review (2007), the Millennium Ecosystem Assessment (2005) and many others are making more apparent every day.

What else can we do to help break this addiction? Here are just a few suggestions.

- Create and share a vision of a future with zero fossil fuel use and a quality of life higher than today. That will involve understanding that GDP is a means to an end, not the end itself, and that in some countries today more GDP actually results in less human well-being (while in others the reverse is still true). It will require a focus on sustainable scale and just distribution. It will require an entirely new and broader vision of what the economy is, what it's for, and how it functions.
- Convene a 'new Bretton Woods' conference to establish the new measures and institutions needed to replace GDP, the World Bank, the IMF, and the WTO. These new institutions would promote:
- Shifting primary national policy goals from increasing marketed economic activity (GDP) to maximizing national well-being (GPI or something similar). This would allow us to see the interconnections between built, human, social, and natural capital, and build real well-being in a balanced and sustainable way.
- Reforming tax systems to send the right incentives by taxing negatives (pollution, depletion of natural capital, overconsumption) rather than positives (labor, savings, investment).
- Expanding the commons sector by developing new institutions that can propertize the commons without privatizing them. Examples include various forms of common asset trusts, like the atmospheric (or sky) trust (Barnes et al. 2008), payments for depletion of natural and social capital and rewards for protection of these assets.
- Reforming international trade to promote well-being over mere GDP growth. This implies protecting natural capital, labour rights, and democratic self-determination first and then allowing trade, rather than promoting the current trade rules that ride roughshod over all other societal values and ignore non-market contributions to well-being.

We can break our addiction to fossil fuels, overconsumption, and the current development model and create a more sustainable and desirable future. It will not be easy; it will require a new vision, new measures, and new institutions. It will require a directed evolution of our entire society (Beddoe et al 2009). But it is not a sacrifice of quality of life to break this addiction. Quite the contrary, it is a sacrifice not to.

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TABLE. BASIC CHARACTERISTICS OF THE CURRENT ECONOMIC MODEL AND THE 'ECOLOGICAL ECONOMICS' MODEL

	CURRENT ECONOMIC MODEL	ECOLOGICAL ECONOMICS MODEL
Primary policy goal	More: economic growth in the conventional sense, as measured by GDP. The assumption is that growth will ultimately allow the solution of all other problems. More is always better.	Better: Focus must shift from merely growth to 'development' in the real sense of improvement of quality of life, recognizing that growth has negative by-products and more is not always better.
Primary measure of progress	Gross Domestic Product (GDP).	Index of Sustainable Economic Welfare (ISEW) / Genuine Progress Indicator (GPI) or similar.
Scale/carrying capacity of humans in the biosphere	Not an issue since markets are assumed to be able to overcome any resource limits via new technology and substitutes for resources are always available.	A primary concern as a determinant of ecological sustainability. Natural capital and ecosystem services are not infinitely substitutable and real limits exist.
Distribution of wealth/poverty	Token recognition, but relegated to 'politics' and a 'trickle down' policy: a rising tide lifts all boats.	A primary concern; directly affects quality of life and social capital and is often exacerbated by growth: a too rapidly rising tide only lifts yachts, while swamping small boats.
Economic efficiency/allocation: how scarce resources are used	The primary concern, but generally including only marketed goods and services (GDP) and institutions.	A primary concern, but including both market and non-market goods and services and effects. Emphasizes the need to incorporate the value of natural and social capital to achieve truly efficient use of all our scarce resources.
Property rights	Emphasis on private property and conventional markets.	Emphasis on a balance of property rights regimes appropriate to the nature and scale of the system, and a linking of rights with responsibilities. A larger role for common property institutions in addition to private and state property.
Role of Government	To be minimized and replaced with private and market institutions.	A central role, including new functions such as a referee, facilitator and broker in a new suite of common asset institutions.
Principles of Governance	<i>Laissez faire</i> market capitalism.	Lisbon principles of sustainable governance.