

THE CAMBRIDGE NATURAL CAPITAL PROGRAMME

Understanding and managing the business risks and opportunities
relating to ecosystems and natural capital



UNIVERSITY OF
CAMBRIDGE

PROGRAMME FOR
SUSTAINABILITY LEADERSHIP

About the Cambridge Natural Capital Programme

It is increasingly accepted that we need a step change in the level of practical actions and policy that can deal with long-term risks to business, customers and wider society from the destruction of the natural resource base. This major new business-led programme brings together a cross-sectoral group of leading companies to explore how to bring about these transformational changes.

Phase 1 of the programme, between September 2010 and June 2011, explored four areas that programme members identified as critical for delivering progress through collaboration and system-wide actions. These were:

- Developing a boardroom narrative
- Examining long-term business risks and opportunities

- Mainstreaming natural capital investment
- Building resilient value chains.

Phase 2 of the programme is acting on key recommendations from this first phase, including a number of recommendations outlined in this report. For more details of the second phase of work visit <http://www.cpsl.cam.ac.uk>

The programme has been developed by the University of Cambridge Programme for Sustainability Leadership and is a business-run initiative.

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Business Risks and Opportunities Collaboratory Members



Executive summary

The growing pressures on ecosystem services and natural capital are expected to generate a range of future risks and opportunities for businesses. Although not currently well understood by most companies, the ability to understand, anticipate and respond to these challenges will undoubtedly improve competitive positioning and return additional shareholder value in future.

Risks and opportunities

The degradation of ecosystems, and the free services they provide, can create significant supply chain risks for businesses. Scarcity of certain raw materials and inputs such as water could adversely affect volumes, costs and margins. Governments may restrict access to land and/or charge for ecosystem services, further increasing the risk to business performance. Companies impacting and dependent on fragile ecosystems could suffer reputational damage and lose market share due to the changing demands of customers, consumers and civil society.

Governments and NGOs now recognise the need for action to limit loss and degradation of natural capital. This is already leading to the introduction of policies, regulation and mandatory standards and these will increase. Companies must carefully consider the potential negative or positive influence of these key stakeholders when developing strategies for the management of ecosystem risks and opportunities. They should pay equal attention to the opportunities associated with the successful management of ecosystem services. Reputational benefits for a company and its brands, innovation and new product development, market share growth, new business ventures and consultancy can all deliver significant competitive advantage.

The need for collaboration

The challenges of ecosystem degradation call for collaboration both within and across sectors and with other stakeholders. Businesses must share information, learn from each others' experiences and jointly influence governments and other stakeholders.

Companies are encouraged to use the CPSL risk inventory and scenario planning tools. Together with insights from the Collaboratory work, these will help to clearly identify their impact and dependency on the ecosystems services which benefit their businesses. Is the long term provision of these ecosystem services threatened and if so, how can an individual business respond? Each company needs to decide who to collaborate with, who to influence and how to develop a business case for intervention.

Businesses with well developed strategies and capabilities in relation to ecosystems and natural capital have a critical role to play in showing leadership and influencing their peer group and supply chains. For these lead companies, benefits will definitely accrue in the form of public acknowledgement, reputation building and enhanced brand value.

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1. The Challenge

The fast changing landscape

The growing pressures on ecosystem services and natural capital¹, and efforts by governments to manage them, will generate a range of risks and opportunities for business at local, national, regional and global levels. A combination of public expectation that such risks will be well managed, and changes to policy and regulation, will also increase the potential exposure of companies.

The changes to this environmental infrastructure that will occur in the coming decades will accelerate, partly due to increasing population, but also due to rapidly increasing affluence and consumption in emerging economies. This fast changing landscape of risk and opportunity is not currently well understood by most businesses. In future, companies which are able to understand, anticipate and respond to these changes will undoubtedly improve their competitive positioning and ability to return value to shareholders.

Exploring risks and opportunities

The Millennium Ecosystem Assessment was the first comprehensive effort to audit the scale of current and future impacts of human activities on the productivity of the environmental infrastructure of the economy. In 2010 the World Economic Forum, together with PricewaterhouseCoopers, set out a risk matrix that attempts to relate the various categories of ecosystem services risk to the main business sectors. It identified 96 possible risks and 44 sectoral exposures.

Some of these risks are substantive, that is, a consequence of adverse changes to ecosystem services and natural capital. Others are a consequence of the success or failure of governments in adopting effective policy measures to prevent or reduce pressure on ecological systems. Both kinds of risk can have a direct or indirect impact across business operations, affecting costs, revenues and value.

The intent of the Business Risks and Opportunities Collaboratory was to explore the landscape of risk and opportunity for business generated by the intensifying pressures on ecosystem services and natural capital. It sought to:

- understand the evolving dynamics of ecosystem services risk and opportunity for business and to develop a more complete risk inventory
- determine possible and likely policy responses by government and civil society to these risks
- examine the capacity of businesses to understand and manage these risks
- identify the key elements of a core business case for enhancing corporate capability to address natural capital issues
- examine the balance between collaborative and cooperative responses

¹**Natural Capital:** the sum total of nature's resources and services, underpinning human survival and economic activity (e.g. agricultural crops, vegetation, wild life, fossil fuels, mineral deposits). **Ecosystems:** A dynamic complex of plant, animal, fungal, and micro-organism communities and their associated non-living environment interacting as a unit. **Ecosystem services** are the benefits that we gain from the many resources and processes supplied by ecosystems e.g. clean drinking water and processes such as decomposition of wastes.

2. The Collaboratory Process

Ecosystem risks and company strategy

To date, the private sector has been focusing heavily on climate risk. Increasingly, risks associated with the loss of biodiversity and ecosystem services will need to be considered, particularly as impacts on ecosystems and natural capital will occur early in the climate change timeline.

Businesses face three key pressures in relation to ecosystems and natural capital:

Operational pressures (e.g. supply chains), which have a knock-on effect on costs

Market pressures affecting volumes and revenues

Reputational pressures which affect business value.

Tensions also exist between collaborative and competitive pressures, which can be specific to individual sectors and companies or apply to business in general.

Sectoral perspectives on the challenge differ. For example, audit firms and service related companies may focus on the impacts of their clients' businesses as much, if not more, than their own. For extractives and agribusiness, the focus is likely to be their direct impact on individual ecosystems.

Sharing the vision

Companies need to develop beyond traditional Corporate Social Responsibility (CSR). A business needs a big-picture 'vision' which sets out what it wants to be in the world, even though, in the short term, such a vision may not always appear beneficial to the company. Ecosystem damage and loss of biodiversity is a moral as well as a business issue. Businesses cannot abdicate responsibility for their actions by claiming that they do not access, or make use of all ecosystems.

Businesses with well developed strategies in relation to ecosystems and natural capital

have a critical role to play in showing leadership and influencing their peer group and supply chains. For these lead companies, benefits will definitely accrue in the shape of public acknowledgement, reputation building and enhancing brand value.

Challenges of ecosystem degradation should not be viewed from an individual company perspective. Collaboration will be required both within and across sectors and with other stakeholders. In future, supply chain partners will need to be carefully selected to ensure that they share the vision of natural capital conservation. A supplier's sustainability credentials may become as important as the price of its product and leading companies will need to educate and share learning with their supply base.

Speaking the right language

Language is vital in articulating the 'ecosystems challenge'. The narrative needs to be fully understood within individual businesses and easily communicated to external stakeholders. It is unrealistic to expect companies and stakeholders to fully understand all the complexities around the value of ecosystems, which are often ratios rather than absolutes. Ecosystem risks and opportunities have to be expressed in the language of business, using traditional terms such as return on investment, profit and loss, a set of quantifiable metrics and a reporting process.

The Role of Government in managing the risk of declining ecosystem services²

Governments are keen to help business develop secure supply chains and play an important role in influencing markets. The natural resources agenda provides opportunities to develop new markets and new technologies and to increase dialogue between the public, private and NGO sectors. Links between biodiversity and social capital need strengthening, since they are dependent on each other. The link between

biodiversity and climate change has also not been fully explored and documented.

Governments now realise that a strong economic case exists for action to limit loss and degradation of natural capital. The challenge is to refine the case so as to encourage specific actions from different business sectors. Governments must also address increasing demand and consumption, since humankind will need to produce more while consuming the same (or less) to enable a global population of around 9 billion by 2050 to have a quality life.

Policy has a clear role to play, especially in relation to standards, market instruments and mitigation projects. The public sector needs to communicate clearly why business should pay for the protection of natural capital as the services that these public goods provide are currently 'offered' for free.

Governments expect major companies to demonstrate leadership both in the way that they assess and analyse their impact and in how they decide to improve their processes. They must act as role models for SMEs in tackling these issues. The public sector also needs to learn from business about anticipating and responding to future consumer needs.

How are civil society organisations responding to the problem?³

Ecosystem value and wider habitat preservation is a comparatively modern focus for this sector. The sector is now moving to tackle the bigger root causes, primarily :

- Limits – and society's failure to recognise what they are.
- Justice – the inequitable balance of global power, with the powerful dominating the less powerful.
- Economics – why the current global system does not address the very apparent market failures.

In future it is likely that business and society will be angry with organisations that have held back, for instance with the emissions trading systems.

Setting standards

NGOs are heavily focused on standards and whether certification is the answer - if so, certification by whom and for whom? Does it encourage the required sector shifts? The world in general is moving towards more mandatory standards which hopefully will relieve the frustration experienced by business over the bureaucracy of voluntary processes. If they see a business opportunity, companies can then go beyond the set minimum standards. Since certifying all raw materials in all countries is an impossible task, a next step might be voluntary verification to a company's own standards. However, such verification could be viewed as biased, so an independent body would need to validate and endorse this type of certification.

²Summary from a presentation given to Collaboratory members on 14th Oct 2010 by Alexandra Vakru, Chief Economist, Instruments & Impact Assessment, European Commission, DG-Environment

³Summary from a presentation given to Collaboratory members on 14th Oct 2010 by Craig Bennett, Director of Policy & Campaigns Friends of the Earth UK

Civil society is expected to focus increasingly on international trade policy and changing the global economy. Where does the power lie? How do we involve local communities? How do you translate the big challenges at an individual level? There are also CSR issues – for example, people being driven off land to make it available for biofuel plants.

Due to the difficulty in valuing ecosystem benefits in any investment decision, a biodiversity ‘credit’ system could be established, possibly through regulatory incentives. These incentives could, for example, be extended to farmers who give areas of their land to forest. Ecosystems use and value to business concerns much more than just forests, although forests are currently best understood. It also covers, for example, marine environments.

It is clear that companies must carefully consider the potential influence of NGOs (negative or positive) when developing strategies for the management of ecosystem risks and opportunities.

Companies need to consider opportunities as well as risks

The Collaboratory process focused on the risks associated with ecosystem services and natural capital and how to identify and understand the type and level of risk. It explored how companies could develop strategies to mitigate or avoid such risks.

This is only one side of the story. In future, Collaboratory members need to pay equal attention to the opportunities associated with ecosystem services. Opportunities are not just restricted to reputational benefits for a company or its brands. Innovation and new product development, trading of ecosystem services credits, operational efficiency, market share, new business ventures and consultancy services can all deliver significant and distinct competitive advantage.

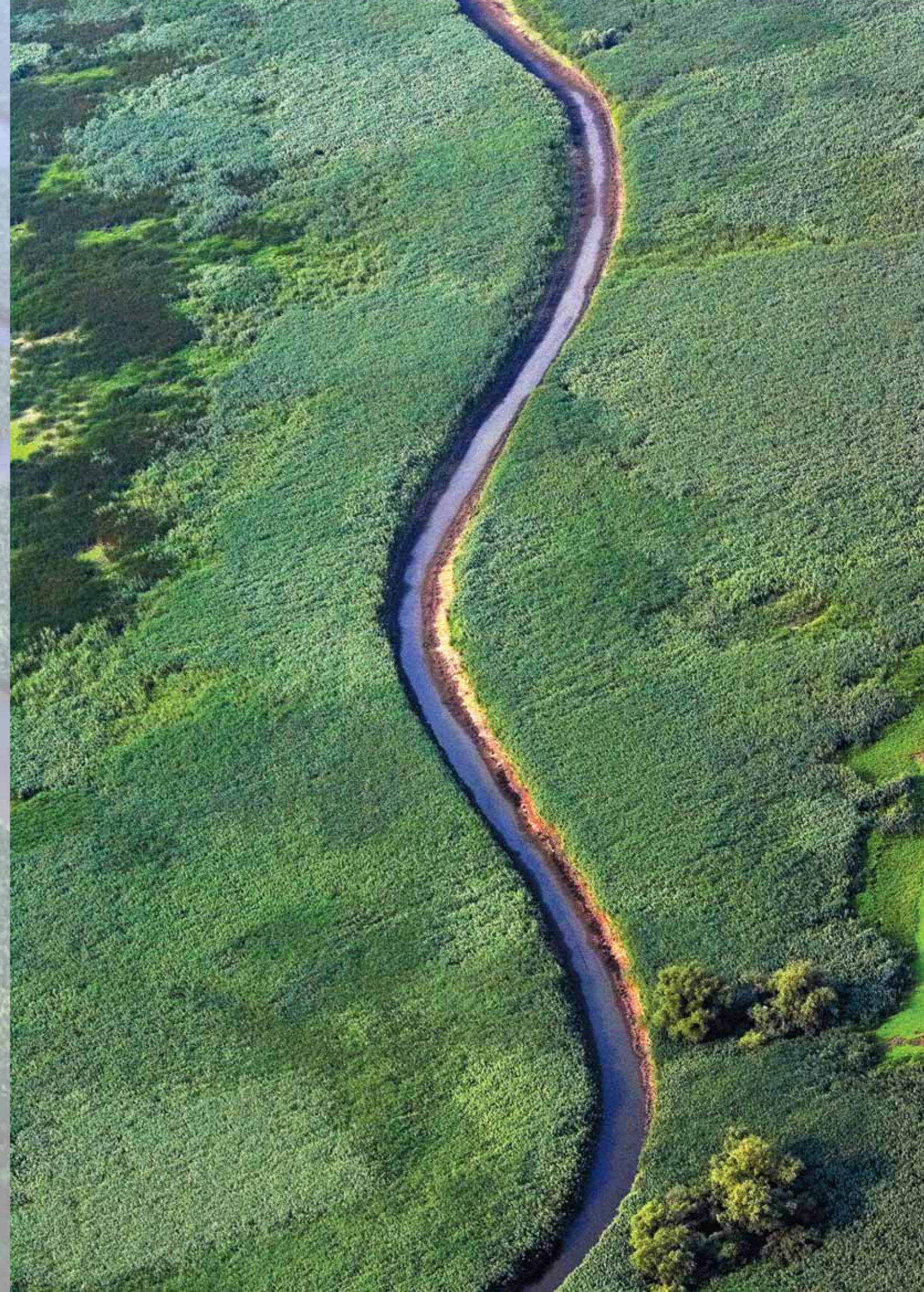
The importance of cross sector collaboration

Although each company within the Collaboratory is at a different stage in its response to the challenges of ecosystem degradation and loss, members identified a number of key areas for potential collaboration:

- Learning from each others’ experiences and sharing information from the different sectors in a pre-competitive approach
- Framing the narrative for use with senior management
- The identification of specific values and metrics
- Influencing governments and other stakeholders
- Development of generic toolkits for use within individual companies/industries
- Harnessing CPSLs academic and professional expertise

Collaboratory members also agreed the importance of:

- Understanding the extended impacts of a business (i.e. up and down its supply chain)
- Mapping of the different risks – moving beyond reputational risk, to risks relating to supply chains and licence to operate.
- Effective scanning of the business horizon to fully understand the stresses on the system, and the likely increase in pressures over the coming years. To achieve this, system stresses will need to be considered individually, sectorally and more widely.



3. A toolkit to better understand business risks and opportunities

Preparing a risk and opportunity inventory

Collaboratory members, representing a broad range of business sectors, decided to individually complete a risk and opportunity matrix based on the various 'categories of risk' for their company or sector. Some companies needed to consider risks relating to more than one sector. For example, oil producers increasingly relying on biofuels, needed to consider agriculture as well as oil and gas in their risk analysis.

Completing the risk and opportunity matrix involved a number of important steps:

1. Agree the boundary of the business
2. Decide whether to use a complete value chain or life cycle approach
3. List inputs to the business where no price is paid

4. Identify which resources are scarce or depleted or likely to become so
5. Identify the company's impacts and dependencies on ecosystem services
6. Identify potential risks and opportunities to the business
7. Discuss with internal management

A generic example of a completed risk matrix for global agribusiness can be found in (Appendix 1)

The following table summarises the business risk matrices completed by Collaboratory members. It identifies the business risks associated with ecosystem degradation across a number of different industries. Some interesting trends can be observed.

BUSINESS RISK												
Company type	Raw Material Availability	Business Volume	Margin Pressure	Water Scarcity	Land Availability	Land Degradation	Govern. Policy	Consumer Pressure	Customer Pressure	Reputation	Finance	Stability
Global Food FMCG	X	X	X	X				X	X	X		
Agribusiness Supply Chain	X	X	X	X	X	X	X	x	X		X	x
Professional Services		X	X			x			X	X		
Mining Company		X	X	X	X	X	X	x	X	X	x	x
Oil & Gas		X	X		X	X	X	X	X	X	x	x
East African Tea Producer	x	X	X	X		X	x	x	X	X		x
Kenyan Horticulture	x	X	X	X	x	X	X	x	X	X		x
UK Fresh Produce Retailer	X		X				x	X		X		
Construction			X	X	X		x	x	X	X	x	

X = major or direct risk x = minor or indirect risk

Summary

- The highest number of risks were identified by companies operating inside a particular ecosystem or heavily dependent on ecosystems for raw materials.
- Scarcity of raw materials and inputs such as water create risks to business volumes and costs.
- Access to land and land degradation risks affect agribusiness and extractive industries
- Stakeholder risks (Government, customers, consumers) are common to most industries.
- Reputational risk is common to all sectors.
- Distance from the actual ecosystem risk increases the options a company has to avoid such risk. (e.g. a retailer or FMCG company may be able to change its sources of supply)
- In the case of professional services companies, risks are often associated with the behaviour of customers and suppliers rather than in-house operations.

The completion of a risk matrix should encourage other companies to think more deeply about their impact and dependency on ecosystem services. Which ecosystems are their company or industry impacting? What are the adverse impacts of their company or industry? What are the true risks and opportunities associated with ecosystem degradation? What can they do about it? What do they want to do about it? Who should they collaborate with? (Industry peer group, other industries, NGOs, Government, etc). Who might they influence and how? What will it cost and what are the likely benefits?

Limitations and challenges

Although the use of individual risk matrices was certainly beneficial, the exercise highlighted a number of limitations and challenges of using such a tool.

- **Materiality of risk:** The completed risk matrices did not identify many short term material risks. Is this because most ecosystems are not at the point of total collapse and therefore these risks are not registering yet even though they may do in the future?
- **Cumulative Risks:** What is the cumulative risk for a company whose operations impact and depend on a range of different ecosystems? What is the cumulative effect of competitors and other industries on a single ecosystem?
- **Timeframe:** Policy can have a dramatic effect in bringing the timeframe of a risk suddenly much closer e.g. the Water Act in Australia (see generic risk matrix) where a problem is recognised and new Government policy rapidly implemented. In these cases risks become material overnight. Organisations have the option of waiting for a risk response to become a requirement, by which time the effects will be much greater, or by recognising the risks early they can respond ahead of competitors.

The use of exploratory scenarios

Increasingly, ecosystem business risks are regarded as important. But there can often be a real gap between those who fully understand the risk and Senior Management and other members of the company who have less understanding. This gap must be bridged by illustrating the dynamic landscape of risk, its materiality, and the potential threat to monetary and shareholder value. Communicating a qualitative as well as a quantitative story can make it much more tangible for business leaders.

Collaboratory members suggested that a generic tool could be used to examine the detailed risks and opportunities for particular sectors, markets and companies. An exploratory scenario tool was developed to

interrogate the landscape of risk and to investigate the interconnections between aspects of current and future practice, technology and policy. The tool was designed to incorporate the effects of policy and timescale and their absence, and to develop a picture of current material risks and how these might change in the future. The aim was to strengthen business analysis and decision making. The scenarios incorporate the diversity of business sectors and geographical location.

The central question the scenarios were designed to answer is:

The health and productivity of our ecosystems and natural capital underpins the global economy. What will the impact on business look like in 2030 from the changes in ecosystems and natural capital and our measures to maintain their productivity?

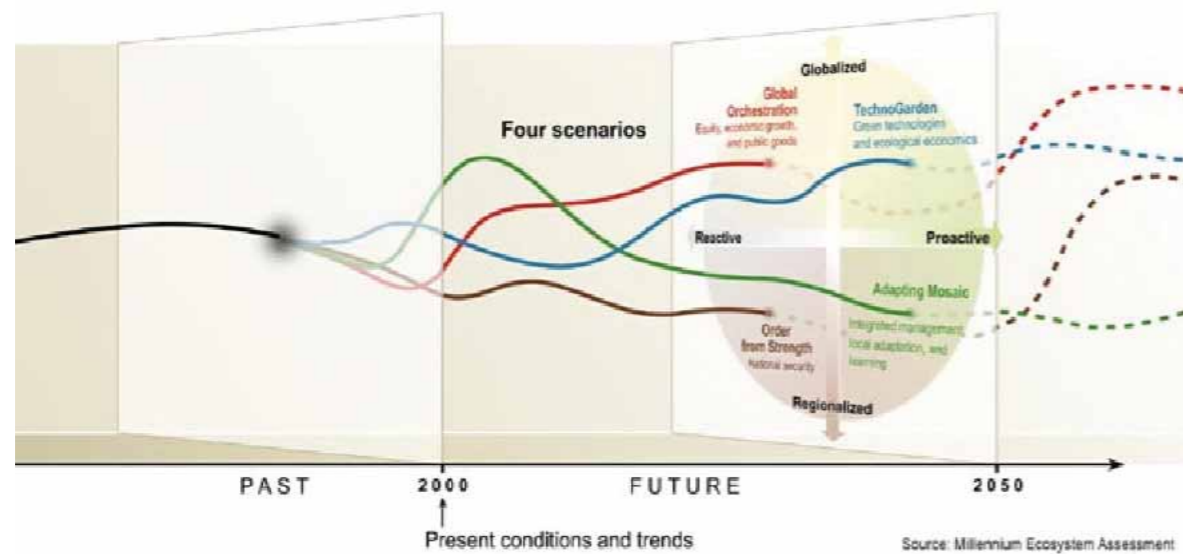
It was agreed to collate the wide range of business perspectives on the impact of degraded ecosystems and natural capital on

individual businesses during Cambridge Natural Capital roundtables of the 22nd of April and 2nd of June 2010.

This material, together with information gathered from Business Risks and Opportunities matrices completed from different sector viewpoints, combined with the latest scientific data, were used to build the scenarios to image a future in 2030. The scenarios also include ecosystems and natural capital work focused on locations, sectors, timescales or aspects such as health.

The new scenarios build on the work already carried out for the Millennium Ecosystem Assessment (MEA), Ecosystems and Human Wellbeing scenarios in 2005. The four scenarios are based on the following two axes of uncertainty:

- Globalised vs. regionalised activity and responses
- Reactive vs. proactive attitudes, behaviours and actions



Source: Millennium Ecosystem Assessment

Collaboratory members decided to use the four MEA scenarios titles as starting points to develop new scenario narratives that visualised a possible future end state in 2030 and these are summarised below.



Global Orchestration*: Globalised, with emphasis on economic growth and public goods



Order from Strength*: Regionalized, with emphasis on national security and economic growth



Adapting Mosaic*: Regionalized, with emphasis on local adaptation and flexible governance



Techno Garden*: Globalised, with emphasis on green technology

'Global Orchestration' Summary Scenario Narrative

The past 20 years have shown that some ecosystem services can be maintained or improved by appropriate macro scale policies. Notable successes occurred in reducing or controlling many global pollutants and in slowing, or in some cases reversing, loss of marine fish stocks. In some situations, it turned out that ecosystem services improved as economies developed. On the other hand, it appears that global action focused primarily on the economic aspects of environmental problems is not enough. In some regions and nations, ecosystem services have deteriorated despite economic advancement. Also, it was sometimes difficult to adjust large-scale

environmental policies for local and regional issues. Despite some significant environmental disasters, this lesson has not yet been learned. As we look to 2050 and beyond, multi-scale management of ecosystem services is a top challenge for environmental policy.

'Order from Strength' Summary Scenario Narrative

Since 2000, the availability of ecosystem services has fallen below minimal needs for human well-being in some regions of the world while being maintained or even improved in other regions. Widespread loss of faith in global institutions and fear of terrorism led rich countries to favour policies that ensured security and erected boundaries against outsiders. In better-off areas, there have been some breakdowns of ecosystem services. It turned out that climate change was often more rapid than response capacity, leading to local degradation of ecosystem services in some places, even in rich nations. Overall, the current global condition of ecosystem services is highly variable and, on average, declining. Even the places in the best condition are at risk, although citizens of wealthy nations enjoy a tolerable level of ecosystem services and human well-being. As we look to 2050 and beyond, Earth's ecosystem services seem fragmented and imperilled. Problems exist at all scales, from global fisheries collapses to regions of the world where ecosystem services are sorely in need of restoration and other regions where ecosystem services are currently healthy but under threat. We have learned that it is impossible to build walls that are high enough to keep out all the world's ills, but also that it is sometimes a reasonable policy to focus minimal resources on carefully protecting a few areas rather than only partially protecting everywhere.

*From Ecosystems and Human Well-Being: Scenarios by the Millennium Ecosystem Assessment. Copyright © 2005 Millennium Ecosystem Assessment. Reproduced by permission of Island Press, Washington D.C.

'Adapting Mosaic' Summary Scenario Narrative

The past 20 years have brought a mix of successes and failures in managing ecosystem services. Approaches to management have been heterogeneous. Some regions strengthened the centralized environmental agencies that emerged late in the twentieth century, while others embarked on novel institutional arrangements. Some approaches turned out to be disastrous, but others proved able to maintain or improve ecosystem services. Some nations are starting to try to emulate the successes of other nations. As a result, the world in 2030 is a diverse mosaic with respect to ecosystem services and human well-being. A considerable variety of approaches exists. Regrettably some regions still cannot provide adequate ecosystem services for their people. Other regions are doing well, and remarkable successes have occurred on every continent. With respect to global-scale environmental problems, progress has been slow. As we look to 2050 and beyond, policy and ecological science face a twin challenge: to rebuild ecosystem services in the regions where they have collapsed and to increase and transfer the lessons of regional success to problems of the global commons.

'Techno Garden' Summary Scenario Narrative

Significant investments in environmental technology seem to be paying off. At the beginning of the century, doomsayers felt that Earth's ecosystem services were breaking

down. As we look back over the past 20 years, however, we see many successes in managing ecosystem services through continually improving technology. Investment in technology was accompanied by significant economic development and education, improving people's lives and helping them understand the ecosystems that make their lives possible. On the other hand, not every problem has succumbed to technological innovation. In some cases, we seem to be barely ahead of the next threat to global life support. Even worse, new environmental problems often seem to emerge from the most recent technological solution, and the costs of managing the environment are continually rising. Many wonder if we are, in fact, on a downward spiral, where new problems arise before the last one is really solved. As we look to 2050 and beyond, we need to cope with a situation in which problems are multiplying faster than solutions. The science and policy challenge for the next 20 years is to learn how to organize socio-ecological systems so that ecosystem services are maintained without taxing society's ability to invent and pay for solutions to novel, emergent problems.

'Learning from the Scenarios'

The four narratives give examples of possible future end-states based on the key driver axes previously discussed. The full narratives are in Appendix 2 together with advice on how companies can apply the scenarios to a specific industry or organisation and the various methods a stakeholder can use to engage with the scenarios and learn from them.

4. Next steps

Using the risk inventory and scenario planning tools

Companies are encouraged to use the risk inventory and scenario planning tools together with insights from the Collaboratory work to deepen their understanding of the business risks and opportunities associated with ecosystem services and natural capital. Corporate capability should be enhanced in order to address natural capital issues and future strategy should encompass a company's response to likely risks and opportunities.

Identifying impact and dependency on ecosystems services

More specifically, companies should more clearly identify their impact and dependency on the ecosystems services which benefit their businesses. Is the long term provision of these ecosystem services threatened and if so, how can an individual business respond? The company needs to decide who to collaborate with, who needs to be influenced and how to develop a business case for intervention.

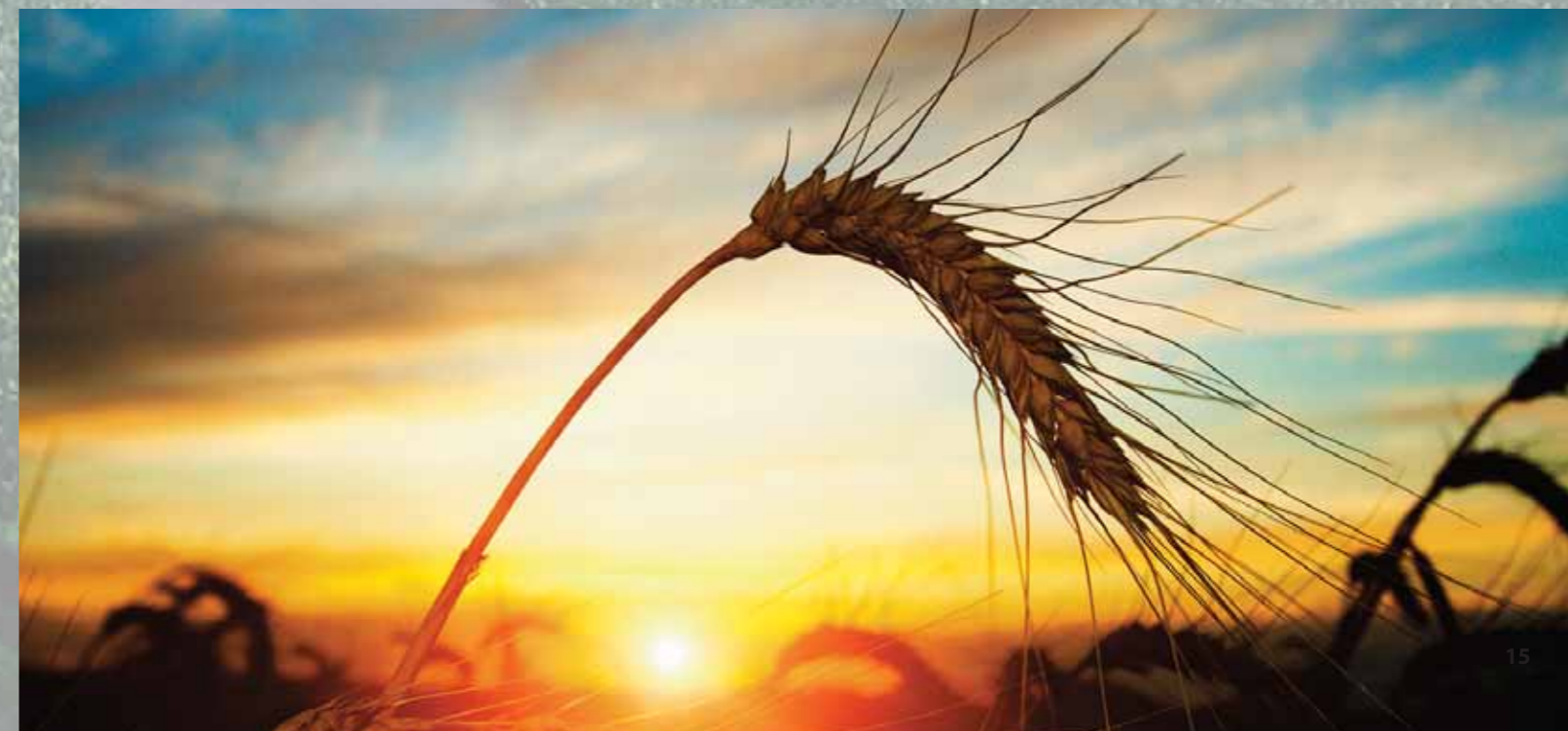
Exchanging information and shared learning

Collaboratory members should continue to exchange information and share learning,

particularly in the use of the risk inventory and scenario planning tools. They may also like to explore ways of integrating ecosystem services and natural capital into current environmental management systems such as ISO 14001. An annual horizon scan of ecosystem issues is also recommended.

Ongoing Support from CPSL

CPSL will offer ongoing support in the form of workshop facilitation for companies and business sector groups wishing to use the Collaboratory Scenarios and also provide research into the likely policy instruments and other government options that could emerge in each of the four scenarios. In addition CPSL will promote learning from companies/sectors using the scoping and scenario tools and feed these into the work of the new Natural Capital Leaders Platform. The Platform will seek to influence key international policy making and to build on the content and practice of members through collaborative working between July 2011 and June 2012.



Appendix 1: Cambridge Natural Capital Programme - Business Risks Matrix 2010

Adapted from Biodiversity and business risk: A Global Risks Network briefing, World Economic Forum, January 2010

Category	Risk	Agricultural supply chains
Physical Risk	Reduced productivity Biodiversity loss, ecosystem degradation and consequent loss of ecosystem services can adversely impact productivity across a range of sectors.	Ecosystem services are vital to support agricultural production and processing. Adverse weather, i.e. rainfall reduction leads to product scarcity and price volatility.
	Scarcity and increased cost of resources For companies reliant on plant and animal commodities including genetic materials, scarcity and increasing costs pose a significant threat to on-going viability.	Low volumes of water in rivers flowing through East African tea estates reduces the amount of hydroelectricity generation = increasing costs.
	Disruption of operations Years of ecosystem degradation has left many areas vulnerable to what were once termed 'natural disasters'.	Changing weather patterns – torrential rain, extended droughts and frost. Sedimentation of lakes, rivers and streams can disrupt operations, significantly reduce volumes and increase costs.
Regulatory and legal risk	Restricted access to land and resources Many business models rely on access to natural ecosystems and areas of high biodiversity and in a number of regions this access is becoming more difficult to obtain.	Land allocation for production is becoming increasingly dependent on recognised best practices – i.e. timber concessions granted only on Forest Stewardship Council (FSC) compliance and palm oil on Roundtable for Sustainable Palm Oil (RSPO) certification
	Litigation Companies are frequently subject to litigation as a result of their exploitation of biological resources or their adverse impacts on ecosystems and the associated human health consequences.	
	Reduced quotas A number of sectors are subject to quotas governing the extraction of biological resources. These quotas restrict business growth and when tightened they can have a dramatic effect on company prospects in the short term.	The introduction of water quotas for agricultural irrigation in Australia led to a reduction in cotton production (esp. 2005/ 08 during drought). Cotton declined from 3 million bales peak to 0.5 million. Now back to 1.7 million – result was closures of cotton gins and unprofitable businesses
	Pricing and compensation regimes Governments around the world are introducing new compensation regimes and market based instruments to help address threats to ecosystems and biodiversity by putting a price on the environmental damage caused by companies. Such mechanisms will significantly increase costs for sectors and operators affected.	There is a start in timber / palm land concessions through contract not allowing the carbon titling to be allocated to the concession owner and remaining the property of the government to ensure income possibilities. Rising cost of water in emerged economies. Carbon capping

Category	Risk	Agricultural supply chains
Market risk	Changing consumer preferences As consumers become increasingly aware of the environmental credentials of companies and their products there is evidence that buying habits are already changing. If this trend continues, sustainably extracted natural materials will eventually be a core requirement for market access in the sectors affected.	Promotion of third party certification and links to these by large multinational brands having significant impact across supply chains. Increases complexity and cost for agricultural producers and processors.
	Purchaser requirements A number of major purchasers are introducing or enhancing sustainable procurement guidelines which present significant risks for suppliers that will struggle to comply.	Many companies (e.g. Nestlé, Unilever, Mars, Starbucks) now have supplier codes detailing compliance and audit which places a burden on the supply chain. Non compliance can lead to loss of market access. Full compliance can increase costs.
Other risks	Reputational risk Association with adverse impacts on biodiversity and ecosystems can result in severe damage to a company's brand and restrict its 'social license to operate'.	Sustainability initiatives and communication vital to companies – esp public companies. Corporate reputation can be seriously damaged by association with damage to sensitive ecosystems.
	Financing risk Risks outlined above may have an adverse impact on a company's cash flows reducing its credit quality and consequently increasing the cost of accessing new finance. Major lenders are also tightening environmental requirements for access to corporate loans, particularly signatories to the Equator Principles, and insurers are increasingly sensitive to risks associated with biodiversity loss and ecosystem degradation.	Clear linkage of business practice to current and future opportunities for financing. Due diligence of companies has increased in order to access (obtain working capital) basic financing and affordable financing. Increasing costs of commodities (cocoa/cotton etc.) therefore more procurement finance required. NGO campaigns targeting banks that finance certain commodity areas i.e. HSBC due to palm and forest products
	Supply chain risk Risks outlined above can have dramatic adverse consequences for downstream operators threatening security of supply chains or leading to increased costs.	Downstream companies needing to know their suppliers and how they operate. Growth in electronic traceability to exchange information between supplier and customer.
	Risks to stability The possibility that failure to manage these risks could make a community or country too unstable to provide essential raw materials, serve as a market or act as a host for operations.	Agriculture is often the single largest employer in developing countries. Any significant decrease in production levels, could lead to huge job losses and a threat to stability.

Appendix 2: Cambridge Ecosystems and Natural Capital Programme - Business Risks and Opportunity Scenarios

Introduction

The central question that sets the context for these scenarios is:

What could be the impact on business in 2030 from the changes in ecosystems and natural capital and our measures to maintain their productivity?

When considering the future, it is critical to gain an understanding of the longer-term consequences of current decision making. In the longer-term the world in general and natural systems, in particular, could be very different to anything that might be expected from looking at and projecting the future today. There is often a preoccupation within business with 'picking winners', rather than identifying flexible and adaptive responses to future challenges. This is the consequence of a dominant corporate worldview that the objective should be to identify the 'right answer' and then aim to get as close to it as possible. In view of the possible variations of the environment and the public and governmental responses, the strategies developed by business need to be 'future proofed'. Responses based on short-term signals or trends could result in over-investment in strategies or technologies that may become redundant or inappropriate in the longer-term. Hence, we have embarked on a process of scenario planning to frame our thinking.

Scenarios can be defined as the disciplined process of thinking through alternative, plausible futures that are fundamentally diverse and internally consistent. They reflect different perspectives of the past, present and future, and elaborate different strategic agendas in each one. As a concept, scenarios can refer to both a description of possible

future states (end states) and a description of the developments that have led to such end states (scenario paths, or storylines). As one of the disciplines within futures (or prospective) studies, scenarios are exploratory and learning tools, not to be confused with forecasts or predictions.

The strengths of this technique and its advantages are due to its ability to deal with some key issues underlying the failing of traditional methods for forecasting and predictions:

- **Complexity** – The exploring and learning achieved through the scenario process enables decision-makers to gain a better understanding of the increasingly complex environments in which they operate
- **Uncertainty** – Rather than ignoring or quantifying uncertainty by (arbitrarily) assigning probabilities, scenarios fully accept uncertainty, striving to understand and include it in the thinking and planning process through the development and exploration of multiple futures
- **Change and Discontinuity** – The scenario development process goes beyond traditional extrapolation techniques and allows the consideration and exploration of alternative futures determined by different developments (in technology, society, politics etc.) which often representing significant ruptures with the past.

It is important to note that the scenarios should not be viewed as 'good' or 'bad' but rather 'extreme-plausibility'. Each scenario will have relative benefits and negative consequences as well as potential benefits and potential risks. The goal is to consider that if the determining factors were pushed to the extreme, this would be the outcome, without judgement. The purpose is not to

dwell on good or bad drivers, outcomes, or 'past decisions' (in the narratives as 'how did we get here') but rather to understand that if those drivers and past actions were in place, what factors or decisions would be required in order to adapt and be successful from the point of view of the stakeholder in the future?

Futures work can help policy makers and corporate entities look at today's challenges from different perspectives and allow them to test various responses to minimise cost or maximise benefits. While no one can predict what will happen, future research can help to identify potential risks and opportunities; thereby assisting policymakers and businesses in developing long-term strategies with greater confidence.

The scenarios presented do not aim to predict the future or find the one best answer but rather provides a tool for helping to take a long view under great uncertainty. They allow stakeholders to consider that any scenario may happen and so through the process be better prepared for what they don't believe will happen. This sort of exploration is intended to support strategic decision making and allow government and industry to prepare themselves more effectively for the future. It can also inspire stakeholders to play a more active role in shaping a better future- for themselves, for their company, and for their industry.

Living in the Scenario

Each scenario must be read by the stakeholder or stakeholder group. Often however, this may just seem like reading a story and the reader(s) may find it difficult to engage with the scenario. After reading each scenario, the stakeholder(s) should consider their life pattern; family make-up, work pattern, recreation activities, consumer habits, etc. Imagine that it is 2030. Using the scenario narrative, try to envision answers to the following questions based on information provided in the scenario narrative:

- Where do you live? What is your home like? What is the community like in which your

home sits?

- Where do you work? What is your job like? What do you spend most of your time doing?
- Where is your work in relation to where you live? How do you transition between the two?
- What sorts of food do you eat? Where does it come from?
- What is your biggest concern for your health and well-being?
- What is your biggest concern for your community?
- Do you feel optimistic about your future and prospects or pessimistic?
- It may be helpful to write down thoughts in relation to these questions as a reference for future investigations using the scenarios.

Strategies for Business

Once the stakeholder or group has a good grasp of each of the scenarios, they should consider the following questions in relation to their specific business for EACH scenario.

- Within your industry, given the constraints of this scenario who is 'winning' or doing best? (*What aspect/sector/feature of your industry is winning or doing best?*)
- Within your industry, given the constraints of this scenario who is 'losing' or doing worst? (*What aspect/sector/feature of your industry is doing worst?*)
- Where (geographically) do you want to be? What geographic factors or conditions assist in success for your industry? (*Consider answers from small/local levels and conditions to regional/national/global levels and conditions.*)
- What are the significant opportunities in this scenario for your industry? (*Think of non-traditional business structures, innovations, investments, markets. Also identify new knowledge areas or possible emerging technologies.*)
- What are the significant threats in this scenario for your industry? (*Consider answers at all levels of operations and considering local to global issues.*)



'Global Orchestration' Scenario Narrative

Summary:

The past 20 years have shown that some ecosystem services can be maintained or improved by appropriate macro scale policies. Notable successes occurred in reducing or controlling many global pollutants and in slowing, or in some cases reversing, loss of marine fish stocks. In some situations, it turned out that ecosystem services improved as economies developed. On the other hand, it appears that global action focused primarily on the economic aspects of environmental problems is not enough. In some regions and nations, ecosystem services have deteriorated despite economic advancement. Also, it was sometimes difficult to adjust large-scale environmental policies for local and regional issues. Despite some significant environmental disasters, this lesson has not yet been learned. As we look to 2050 and beyond, multi-scale management of ecosystem services is a top challenge for environmental policy.

How did we get here?

At the beginning of the twenty-first century, poverty and inequality, together with environmental degradation and climate change, were pressing problems on the agendas of global and national decision-makers. Concerns about social tensions arising from inequalities in and uneven access to global markets were growing, as these tensions were often seen as the underlying causes of uncontrolled migration, conflicts, and even terrorism. Leaders were also concerned about inequalities among people, including differential access to technology and education and other drivers of inequality. There were great debates about the best approach to solving these problems.

Eventually, globally orchestrated policy

reforms took hold as the dominant strategy. Policy reforms were used to reshape the world's economic and governance systems. The emphasis of these reforms was on creating markets that allowed equal participation and provided equal access to goods and services. The reforms also targeted the creation of more transparent governance systems worldwide as the necessary foundation of economic growth. As the world became increasingly connected financially, it was necessary to create global policies to deal with problems arising from the connections. Thus, one result of globalized economic systems was a strengthening of global and regional standard setting bodies such as the World Trade Organization. The focus on policy reforms and faith in global institutions also led to strengthening of the United Nations and some other multinational alliances.

Regulatory frameworks have helped to define and determine global and national stakeholder roles, responsibilities, relations, and rewards improving the connectivity within sectors and industries. Due to their rapidly developing and growing economies, these frameworks have tended to favour BRIC countries, to a perceived global benefit.

Political Landscape

Governments found themselves making decisions about how to handle terrorism and conflicts among nations. Should rich countries focus on borders and protection or should they assist with development in poorer countries to spread goodwill? Generally, rich nations leaned toward helping poor nations meet their basic needs, as this was thought to be the better long-term solution. Trade practices that had hindered economic development in poor countries were discontinued. These reforms were followed by increased wealth in many poor countries, which led to secondary improvements in governance and

democracy. In most regions of the world, governments invested more heavily in public goods, such as education and public transportation.

Trade expanded globally, driven by removal of subsidies and increasing demand for goods and services around the planet. Economies in China, India, Brazil, and Southeast Asia began to grow rapidly again and were assisted by international frameworks with a bias towards these developing nations. A focus on education and, in some cases, political reform helped civil society grow in poorer countries. In countries that profited from increased market access and production opportunities, a wealthier middle class began to develop which in turn brought about further political reforms.

With an eye towards greater global environmental health and well-being, most nations have developed embedded centralized land-use planning authorities which optimize and facilitate use of individual land areas for different commodities and services as well as allowing greater flexibility and partnerships in and across border areas.

Physical Landscape

Driven by policies aimed at increasing gross domestic product and human well-being, agricultural areas expanded in poor countries, leading to increased human impacts on terrestrial ecosystems. Agricultural specialization increased, driven by the selection of high-yield and commercially valuable crops and livestock. Local ecological knowledge was often replaced by uniform industrial methods.

Consequently, by the 2020s, wild varieties of agricultural species existed primarily in gene banks, and the number of domestic varieties in use was greatly reduced. Diverse landraces

persisted mostly in marginal areas. By 2025, many small farms had consolidated into large agricultural operations assisted by the implantation of centralized land-use planning. All farms, small and large, had become more highly mechanized and industrial. In this decade it is expected that the rate of increase in agricultural will slow down due to replacement of traditional agriculture with more-efficient industrial systems.

A concept of environmental balance grew out of the push for agricultural productivity and uniformity and the loss of local ecological knowledge. Today in 2030 the prevailing policies for dealing with preserving the natural genetic diversity and other natural assets like vegetation and soil systems and their associated fauna is to preserve them in parks and museums. In the late 2010's a number of gene banks were established to preserve the vast majority of wild varieties of crops previously used by humans. As the rate of agricultural expansion is beginning to slow, particularly in rich countries, and as people move from the countryside into cities, there is starting to be investment in terrestrial ecosystems to promote recovery from intensive human use. Ecosystem restoration is driven by people's interest in increasing the supply of fuel-wood and other biomass products, in addition to the expansion of intensively managed spaces for recreation.

In contrast to the agricultural land recovery, coastal marine ecosystems and wetlands continue to decline significantly because the increased urban growth has been mostly concentrated in a 100-kilometer band along the coastline. Water stress, an area of continual growing demand is managed through transparent and workable individual and organizational water allowance schemes.

Social Landscape

By the 2020s, a growing middle class was demanding cleaner cities, less pollution, and a more beautiful environment. This demand was assisted by a change in consumption behaviour brought about by the implementation of individual carbon allowances, individual ecosystems, and natural capital allowances. Popular interest was particularly focused on problems that occurred in and around urban settings and those that directly affected human health. Problems of intensified agricultural systems and the slow loss of wilderness have received only limited attention. Environmental problems that are difficult to reverse, such as biodiversity loss, have been more or less ignored by the general population because so many other things are going well.

Increases in wealth and in the availability of technology resulted in the continuing improvement of health around the planet. Regional inequalities in health were prevalent until the mid-2020s. Obesity-related diseases remain a threat, particularly in rapidly developing areas, as new food choices become available and societies shift their eating habits to less healthy diets. Emerging infectious diseases are also a risk. The potential for the origination and spread of novel pathogens is high in areas where ecosystem function was disregarded. It turned out that disruption of ecosystem regulation processes increased the likelihood of exposure to pathogens originating from wild animals and plants, and the movement of exotic species around the world through widespread trade further facilitated the spread of pathogens. While these surprises occurred in rich and poor countries, the capacity to respond was higher in rich countries, and hence the impact was much higher in poorer countries. However there have also been positive surprises, such as the success of genetically modified organisms in reducing the agricultural expansion.

Access to Environmental Resources

This process of greater global coordination was aided by the rapid adoption of internationally regulated set-aside zones in order to protect and restore trans-national boundary ecosystems in crisis. The international regulations developed affected extraction licenses, land title, and land use agreements and operated by utilising a modest compensation scheme.

The value of healthy ecosystems and natural systems has been globally recognised which has driven a push for more efficient land use. Agricultural land is consolidated not only to produce crops and livestock but to capture investment flows for managing key ecosystem services through use of expanded global incentives like REDD+ from the 2010's.

Today in 2030, industrial water permits are restricted to low-water-stress zones. They are closely regulated and have incorporated a more complex water shed impact component in addition to the base traditional extraction volume. These regulations require companies to rigorously demonstrate their water shed mitigation measures or face severe financial penalties.

The Global Natural Raw Materials Inventory was completed in 2025 and has been updated each year since. Sectors such as mining, agriculture and construction are subject to national and international quotas governing the extraction of minerals and natural resources at all stages of their supply chain.

Since the late 2010's, there has been full TEEB implementation with requirements for individual company ecosystem impact disclosure and a change towards true-cost accounting (and pricing) for all brands. Today in 2030, all medium to high impact products are gone from the shelves. Many items from further afield than a

neighbouring country become luxury items-like vegetables, bottled water or beer.

Since peak oil in 2005, the price of oil has risen exponentially leading to coordinated global investment in renewable energy sources. Even with strong international cooperation and agreement, it has been a struggle to produce enough energy in some areas due to rapid modernisation which has kept energy demand reduction high on government, business, and social agendas.

Business Response

Since the second global financial crisis in the early 2020s the global economy has been redesigned and now 'Prosperity without Growth' is the new mantra. There are a range of economic incentives to reward companies that design their business models around a one planet approach to ecosystems and natural resource and who offer value in terms of their contribution to individual and collective prosperity.

For companies with global reach, environmental risk zoning is now common- especially in areas where the ecosystem is still fragile. Global companies have adapted by developing new models of long-term business investment particularly where there is a synergy between ecosystem investment and national prosperity.

To address the risks associated with accessing new land and natural resources successful companies have invested in understanding this new regulatory framework landscape and work towards anticipating ecosystem stresses, offering to rehabilitate environmentally degraded land with the associated increased costs.

High oil prices have forced many companies to shift to alternative energy sources. Where this was not possible, companies tried to

pass the cost on to the consumer which has met with mixed response. There has been increasing demand and research investment in alternatives to key products such as fertilizers and pesticides. Because supply has not been able to keep up with demand, oil company profits remain high.

In consumer based industry, a growing global wealth has meant a steady rise of new markets, but particularly for those that market low impact goods and services in particular to those rapidly modernising areas of the globe.

Consumer Response

There is a perceived partnership between provider and consumer where sustainable lifestyle decisions are often made by companies on behalf of consumers. Companies - together with increasing 'natural' disasters and public sector information campaigns - have persuaded their customers in developing countries that they must consume less and have a strong individual responsibility to live a sustainable lifestyle. For retailers choice editing is the norm and individuals have accepted for some time their individual carbon, ecosystem and natural resource allowances. Those that exceed this allowance are perceived as selfish and are offered lifestyle mentoring support to address this issue. Many in wealthier countries donate their underused allowance to poor countries.

There has been a growing market for low impact products and services fuelled by the continually expanding global middle class. Consumers are more globally aware and wish to prosper but without unduly draining their individual natural capital allowances. This has led to many new markets, especially in developing countries as their middle classes have rapidly grown.

Drivers towards 2050

Despite economic policies designed ultimately to lead to a better environment, the simplification of ecosystems has eventually led to a decrease of environmental security as ecological surprises became more common. One surprise of the past 20 years was the high impact that widespread trade had on hastening the spread of invasive species. It seems that reduced diversity limited the

options of ecosystems to respond to ever increasing ecological surprises, although it is hard to tell if the problem was this or simply increased population pressure. People in poor countries are generally doing better than they were in 2000, but, looking to 2050, we wonder whether the early policies to increase economic growth will provide the necessary resilience to cope with future surprises.





'Order from Strength' Scenario Narrative

Summary:

Since 2000, the availability of ecosystem services has fallen below minimal needs for human well-being in some regions of the world while being maintained or even improved in other regions. Widespread loss of faith in global institutions and fear of terrorism led rich countries to favor policies that ensured security and erected boundaries against outsiders. Even in better-off areas though, there have been some breakdowns of ecosystem services. It turned out that climate change was often more rapid than response capacity, leading to local degradation of ecosystem services in some places, even in rich nations. Overall, the current global condition of ecosystem services is highly variable and declining on average. Even the places in the best condition are at risk, although citizens of wealthy nations enjoy a tolerable level of ecosystem services and human well-being. As we look to 2050 and beyond, Earth's ecosystem services seem fragmented and imperiled. Problems exist at all scales, from global fisheries collapses to regions of the world where ecosystem services are sorely in need of restoration and other regions where ecosystem services are currently fine but threatened. We have learned that it is impossible to build walls that are high enough to keep out all the world's ills, but also that it is sometimes a reasonable policy to focus minimal resources on carefully protecting a few areas rather than only partially protecting everywhere.

How did we get here?

At the beginning of the twenty-first century, terrorism, war, and loss of trust in global institutions led many people to believe that

there was a need for powerful nations to maintain peace and achieve equity. Governments of the industrial world reluctantly accepted that militarily and economically strong democratic nations could maintain global order, protect lifestyles in the industrial world, and provide some benefits for any developing countries that elected to become allies. Countries were often unwilling to participate in international and global institutions as they concentrated on building strength as nations. As a result, global institutions began to stagnate as people lost confidence in them and their power eroded.

The EU and the United States turned inward, striving to preserve national security. Trade policies veered toward increasing protectionism. Religious fundamentalism and nationalism were mutually reinforcing in some nations. In some cases, parts of civil society saw this inward focus as dangerous and tried to oppose it, but they were mostly silenced by already strong national governments. Just as the focus of nations was turned to protecting borders, environmental policies concentrated on securing resources for human consumption.

Building strong nations was a priority, as many felt that environmental challenges could not be adequately addressed without first strengthening nations and economies. Conservation focused on parks and preserves.

By sometime around 2018, this had increased the separation between the rich, powerful countries and the poverty stricken ones, with very few countries left in between. Societies were also stratified within nations: rich and powerful people and poor people existed within both rich and poor nations. Within nations, rich and powerful people

increasingly turned to gated communities as a way to protect themselves from outsiders. The most globally powerful have purchased their land resources and use a significant portion of their wealth to protect their resource from those who would challenge their ownership. The equality gap continues to widen.

Political Landscape

Governments are preoccupied with the new world order and fiercely protective of their perceived land and rights. Initiatives and subsidies to promote national independence and security are common amongst wealthy nations leading to strong partnerships between national-based companies and governments. This has led to increasingly tighter connections between governments and business at all scales.

Rich nations use their wealth and power to exploit less powerful nations for their own benefit. For example, some wealthy nations attempted to make their lands more livable by moving food production to poor countries. The price of food rose as conflict in poor areas affected their ability to produce food. In some cases, this led rich nations to attempt to stabilize poorer ones through a combination of military and economic intervention. In other cases, rich nations simply produced more of their own food.

During times when powerful countries have been more assured of their security, they have turned somewhat to global issues, particularly those that would obviously affect themselves. Sometimes funding was made available to help poor countries with particularly pressing problems. The focus for this funding is often on conflicts or refugee problems (which were seen as having secondary impacts on rich countries). Generally, when funding is available for poorer areas, the focus is on physical safety rather than social welfare issues. Migration is

a major political issue with masses of people trying to reach wealthier areas and newly prosperous areas which can lead to destabilization. It is closely controlled both by legislative measures and increased border security.

Physical Landscape

In the rich world, the drive for security and protection, and the unwillingness to change consumption patterns, has led to the privatization of access to many natural resources, as businesses stepped in to help governments assure consistent access to resources. In turn, governments protected the economic interests of these businesses. The inward focus of wealthier nations did lead to some benefits, including high levels of protection, easy access to goods and services inside the wealthy areas, and pockets of very well preserved wilderness in rich countries and in places that wealthy people wanted to visit on holiday. The spread of invasive species was also a lot lower than researchers had predicted in 2000, a surprise attributed to the decrease in trade among countries. The rate of successful invasions was higher than in 2000, since degraded ecosystems were more susceptible to successful invasion when exotic species were present.

The Amazonas Reserve, The Limpopo Biodiversity Reserve and the Sumatra Global Values Conservation Area are just three examples where multinational companies have purchased title in poorer regions to land rich in biodiversity to manage for their own use in perpetuity for current and future generations. These large areas across the globe offer mega-corridors for wildlife and in situ conservation for some of the world most important species. These areas represent well managed areas of outstanding natural beauty and are visited by wealthy elite tourists every year- a lucrative side service developed to cater to the wealthy of

overcrowded prosperous nations looking to escape their walled-in enclaves.

There has been major global degradation of many large-scale environmental systems, for example global fisheries collapse. This has been due to the lack of partnership over eco-systems across borders. However, where eco-systems fall completely within a national or regional border, they are often doing well.

As the attention of governments was on economic and military strength, there was less focus on the environment. Global issues (such as climate change) and international issues (such as large river management) were almost always impossible to address as at least one key nation was unwilling to cooperate. Ironically, global climate change increased less than had been expected at the turn of the century, due to a larger than expected proportion of the world's population being forced to live a simpler and less materialistic existence.

Social Landscape

The world outside the rich people's high razor-wired walls experienced a lot of conflict during this period. The disputes were largely over access to natural resources like water, oil, and fuel wood. Many in poorer countries felt that the way out was to immigrate to a rich country or become part of the elite in their own country, which historians believe entrenched the compartmentalization. With most poor people spending all their time and energy trying to become one of the elites, there were few left to argue for other priorities. Some elites did demand better treatment of the poor and were sometimes able to effect change. Significant economic problems persisted in the poor world due to corruption, disease, and pollution. As poor countries spent most of their time attending to crises of disease and other problems, widespread improvements in economic well-being became rare. Although fertility had

been starting to drop in poor countries at the beginning of the twenty-first century, the collapse of nascent social safety nets resulted in increases in fertility; population growth rates reversed course and began to increase.

Powerful countries often coped with their problems by shifting the burdens to other, less powerful countries, increasing the gap between the rich and poor. In particular, resource intensive industries were moved to poorer countries or to poorer parts of wealthy countries. This taxed poor people's environments further, leading to widespread migration from collapsed places to new parts of poorer countries as the wealthy closely control and regulate their immigration allowances. This migration created stresses that sometimes led to environmental degradation in the new places. For example, refugees who left one place for another increased the pressure on the new area's environment until it collapsed. Disease, particularly contagious diseases, became rampant in poor areas.

Access to Environmental Resources

Some global environmental issues that affected rich countries have begun to be addressed, through cautious agreements among rich nations, and this has led to some improvements on global environmental issues. However, progress has been slow on those issues that are not of direct concern to the powerful.

Unfortunately, unsustainable consumption of the increasing few continues to undermine the livelihoods of the majority. With limited supplies of water and other key resources, there always seems to be conflict, eroding the social license to operate. Businesses find the cost of litigation between companies competing for the same resources to be preferable to social conflict, although this has had a slowing effect on business growth. Stakeholder relationships within sectors and

industries is increasingly complex with frequent potential for internal conflict and divergence of opinion which can generate reputational risk.

Business Response

Security of natural raw materials supply is critical for business. There is close alignment between business strategies to develop new markets and wider security and development aid agendas in developing countries and emerging economies.

The companies that built close and mutually beneficial relationships with individual nation states have flourished. In some cases previously strong multinational corporations with their roots in mercantilism have continued to thrive, building preferential trade agreements with particular geographical regions and by giving more individual business authority to national branches. They share the responsibility with governments to secure and protect their access to affordable national resources creating a business model of strong self-sufficiency.

Many agro and extractive companies now secure tenure of the land which is vital particularly in turbulent parts of the world if they are to derive even short term benefits from their investments. In consolidating these tenures in one location companies have been able to reduce the costs of protecting these resources from those who might challenge this ownership.

Consumer Response

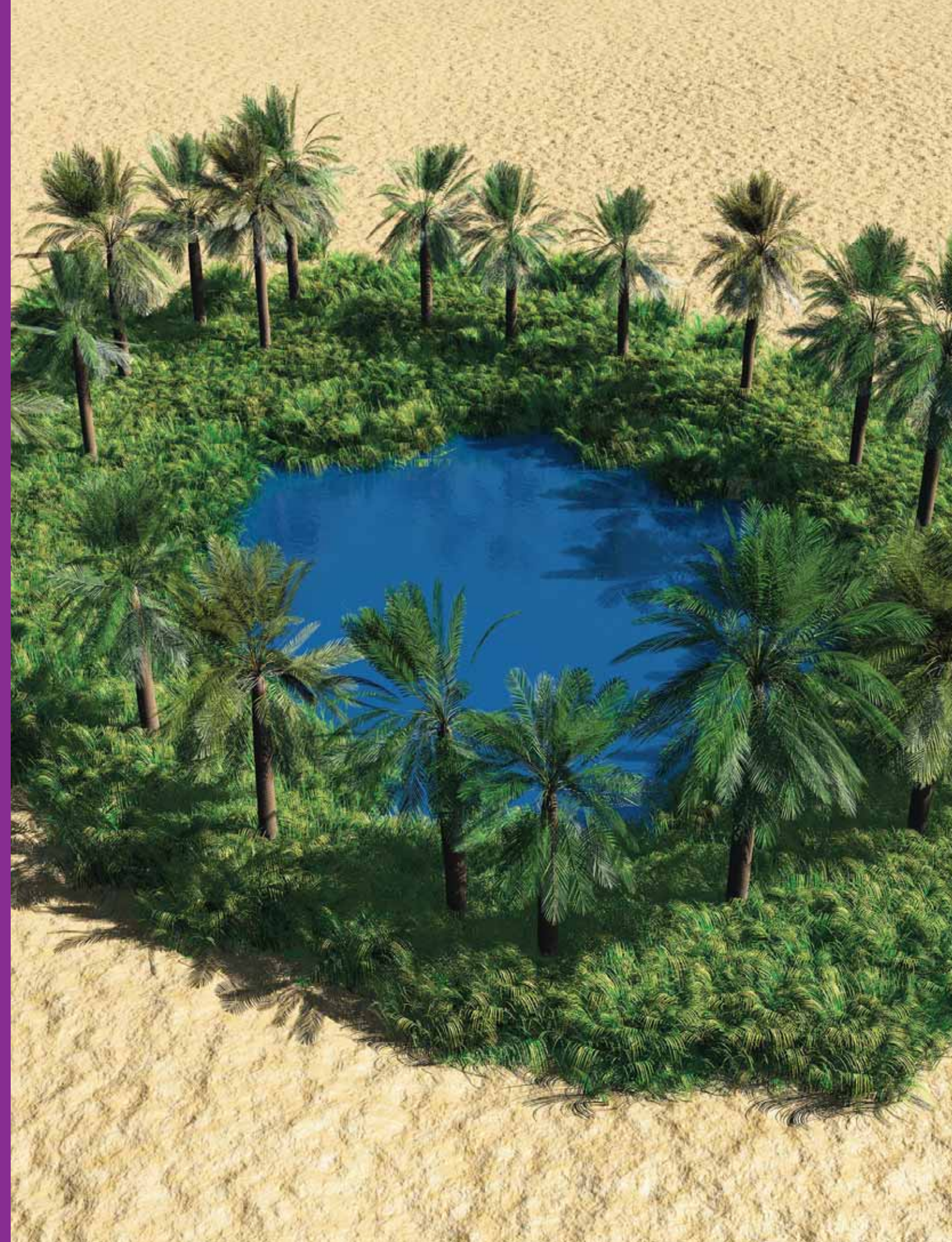
The rigid separation between the 'haves' and 'have nots' has resulted in two distinctly separate main markets for most global business; wealthy developed country markets with high priced high value products, and Base of the Pyramid markets with self-contained production and supply chains within this market. The wealthy refuse to compromise on quality and availability.

The low-end markets are dominated by cheap local products or cheap products produced cheaply in non-wealthy countries or areas.

Drivers towards 2050

Now, in 2030, some poorer regions are finally beginning to stabilize, and are considering forming coalitions and trade agreements to better their situation. This is especially true for nations that have crossed the digital divide. Some Asian, South American, and African nations which established digital networks, gave their people an advantage in terms of access to global markets and information. These countries in particular have been more likely to gain more stability. Unfortunately, as soon as things start getting better in a region, many people want to immigrate to these areas. Thus, countries often are forced to create strong laws against immigration in order to keep their society safe and orderly. The future of these regions is uncertain.

Today, it is apparent that there was not a linear trend toward higher and higher walls, even though it sometimes felt that way. Instead, we saw episodes of rapid change and periods of relative stability. There were some fluctuations of increasing and decreasing compartmentalization as the powerful countries periodically invested in keeping conditions tolerable for the poor in order to reduce illegal immigration and other problems. There were also activist groups and intellectual dissidents in wealthy nations that tried to support the poor and poor nations. Looking forward to 2050, these activist groups are one of the main sources of hope in an otherwise bleak situation. People and ecosystems are generally doing worse than in 2000, but some hope can be found in the activists working to support the poor and improve management.



'Adapting Mosaic' Scenario Narrative

Summary:

The past 20 years have brought a mix of successes and failures in managing ecosystem services. Approaches to management have been heterogeneous. Some regions strengthened the centralized environmental agencies that emerged late in the twentieth century, while others embarked on novel institutional arrangements. Some approaches turned out to be disastrous, but others proved able to maintain or improve ecosystem services. Some nations are starting to try to emulate the successes of other nations.. As a result, the world in 2030 is a diverse mosaic with respect to ecosystem services and human well-being. A considerable variety of approaches exists, and regrettably some regions still cannot provide adequate ecosystem services for their people. Other regions are doing well, and remarkable successes have occurred on every continent. With respect to global-scale environmental problems, progress has been slow. As we look to 2050 and beyond, policy and ecological science face a twin challenge: to rebuild ecosystem services in the regions where they have collapsed and to increase and transfer the lessons of regional success to problems of the global commons.

How did we get here?

Opportunities for, and interest in, learning about socio-ecological systems were a defining feature of the early twenty-first century. People had great optimism that they could learn to manage socio-ecological systems better, but they also retained humility about limits to human control and foresight and the prospects for surprise. Learning to improve socio-ecological systems came at a great cost. There were failures as well as successes, and learning diverted some of society's resources.

Economic growth is probably lower than it could have been had decision-makers put all our investments toward manufactured capital, but the promise of benefits of better socio-ecological systems are considered worth the trade.

At the turn of the century, some people in the rich world held beliefs that promoted regionalization of trade, nationalism, and local or regional management of natural resources. Global trade barriers for goods and products were increased, but trade barriers decreased within regional blocs such as ASEAN, NAFTA, and the EU. In contrast, global barriers for information flow nearly disappeared due to improving communication technologies and the rapidly decreasing cost of information access. Political focus followed the economic emphasis on regional or national trade.

The regionalization of markets and politics was associated with a decline in the relative power of global international institutions. The decline was partly linked to loss of confidence in the effectiveness of global governance and dissatisfaction with distortions of global markets. But the strengthening of interactions within nations and within regional blocs was also an important factor in the relative de-emphasis of global institutions. Dissatisfaction with the results of global environmental summits and other global approaches led many people to perceive global institutions to be ineffective at environmental management. Climate change negotiations had broken down by 2010. International agreements failed to prevent the depletion of most marine fisheries, and regulation of trans-boundary pollutants proved ineffective.

Political Landscape

Within some nations, power devolved to local authorities. There was variation among nations and regions in styles of

management, including natural resource management. Some managed with rigid centralized bureaucracies. Others focused on market incentives or other economic measures. Still others attempted some form of adaptive management for the nation or region as a whole. Some local areas explored actively adaptive management, investigating alternatives through experimentation. Some were passively adaptive, investing in a certain amount of monitoring but dealing with change in a reactive way. Still other locales largely ignored the environment, dealing with crises only as they arose.

The fragmented and inconsistent global and national structures have led to very complex stakeholder relationships for governments and business. Local decision making drives land use choices rather than market mechanisms. There has been increased legislative conflict, especially as regions can change policy quickly and sometimes unexpectedly leading to diminished citizen and consumer confidences in both governments and industry.

Migration issues are a high political area of concern as people from degraded areas seek to move to more prosperous areas. This is particularly problematic in areas that fall in the boundary area of climatic zones which have had particular problems with crops and water courses becoming non-viable due to the steady progression of climate change effects. Some areas respond by using highly regulated immigration quotas while other areas are more restrictive with high border security.

Physical Landscape

There is a great diversity in the outcome of these varied approaches to managing socio-ecological systems. Some notable disasters were poorly handled. Sometimes, methods that succeeded in one region failed when imported to another region because of unforeseen differences in social practices,

politics, or ecosystems. Reactions to resource breakdowns have also been diverse. Perversely, failed practices were sometimes sustained by subsidies from other regions or other sectors of the economy. In other cases, breakdowns were followed by innovations that seem to be turning situations around. This has resulted in periodic migration 'crisis' which have led to a diversity of immigration restrictions and requirements.

Groups began to experiment with innovative local and regional management practices that put special emphasis on investments into human and social capital, such as education and training. Information about success stories was shared among locations. Information sharing was facilitated by cheap communication tools such as the Internet. The experiments varied in their success. As more and more experience and knowledge were collected, the conditions for success were better understood and experiments became more successful on average. Food production became more localized, feeding into national or regional markets that valued clean, green production processes. Environmental technologies were developed based on local needs and conditions, leading to a gradual improvement in management of socio-ecological systems and natural resources.

Throughout this period, there has been relatively little focus on global commons problems such as climate change, marine fisheries, and trans-boundary pollution. Crucial ecological feedbacks were acting over spatial extents that were too large to be noticed by local institutions. As a result, large-scale environmental crises are more frequent. Regional water shortages have been exacerbated as each area looks out for its own interest at the expense of its neighbours and the water system as a whole. Technological disasters occurred in some natural resource systems. Climate shifts led to more storm surges in coastal areas. Top

predators vanished from most marine ecosystems, leaving jellyfish as the apex predator for vast areas of the world. Coastal pollution increased drastically, which led to further degradation of coastal fisheries and severe health risks to humans from eating shellfish, shrimp, and other filter feeders. There were also outbreaks of new diseases, such as rapidly evolving bacteria resistant to antibiotics. Luckily, climate change was not as bad as it could have been because people were trying to curtail local pollutants like nitrogen oxides and sulphur dioxide, which also act as agents of climate change. But sometimes the global phenomena affected local socio-ecological systems in severe ways.

Social Landscape

Behaviours are very much driven by a social desire for localism. There have been some successes and some failures with some very strong new market bases in the BRIC countries. Cheap technology and information transfer is something that connects disparate communities and demand for access to communication and knowledge is fairly widespread. Countries that have done well managing their local resources have re-invested in their populations improving overall health and education but they are in danger of migratory pressures when located next to areas or regions that have not been as successful which threatens to destabilise their newfound prosperity.

By the 2020s, global tourism had begun to encourage development and application of local learning as a celebration of diversity in reaction against global homogenization and the sameness of products. Travelling was seen as a means to experience heterogeneity, but, in the end, had negative feedbacks due to increased transportation and human impact on poorer regions.

Access to Environmental Resources

The negative large-scale environmental events are largely seen as being caused by inadequate management of the global environmental commons. There is a small but growing international framework of trade and political institutions providing a foundation on which global environmental management institutions could be rebuilt but it is still expected to take many years with the rebuilding being slow and tenuous, due to slowly changing institutions that often needed disaster as a goad to action. The emerging institutions for international environmental management are looking to build on local and regional experiences, both the successes and failures. The emerging institutions are more focused on ecosystem units; watersheds, air basins, and coastal regions, rather than states or nations, are starting to become the basis for management.

There is a significant uneven distribution of global freshwater which has been exacerbated by a lack of joined up thinking in respect to larger watershed areas. Regional water scarcity has increased and is a significant problem. Companies seek to secure local agreements with other resource users to ensure access although competition is strong and financial impacts are significant.

Business Response

Political influence on market has been by focusing on developing local trade rules and land use arrangements with a great deal of flexibility for local interpretation. This has led to important non-market rights. Those companies that can negotiate local agreements with a wide range of stakeholders benefit by securing access to raw materials but agreements are rarely long term in nature leading to frequent risk of supply. Cost of raw materials is highly variable and a complex range of pricing and compensation regimes often operates across

a single supply chain. Productivity is highly variable from one ecosystem to another. This diversity of markets and resource availability has had a mixed effect on business and industry. Those businesses located in well performing regions and locales have benefitted from good management of resources and a growing, more affluent, local population. Alternately, those businesses located in poorly managed regions have seen reduced productivity or even collapsed further exacerbating local market conditions. To mitigate these extremities, businesses are starting to be more interested in finding new markets in other parts of the world and consumers are demanding a greater diversity of choices. The renaissance of global business is leading to greater internationalization of governance and negotiation of new international trade agreements with highly complex stakeholder and legislative relationships developing. There is pressure for some global barriers to trade to erode, to assist the economy to become more globalized.

Companies with investments in important regional ecosystems for raw materials with close proximities to thriving and successful communities have benefitted from a growing consumer market. Some companies have been particularly vulnerable from sourcing their raw materials from particular areas where ecosystems are degraded or where conflict over natural resources is common. To address this, companies have been forced to diversify and develop strategies for mitigating these risks by sourcing materials from multiple risk areas. Companies have become much more mobile in their business and supply chains. This has been more inefficient and costly but has helped to maintain a supply of key commodities and kept successful companies from folding.

Consumer Response

Consumer behaviour has echoed this push for localism and decisions are often made with local conditions and resource availability in mind, there is a strong desire and demand for 'local' products. However, local does not always mean sustainable and 'sustainable lifestyle' decisions vary widely from one location to the other. In some cases such behaviour is influenced by individual choice and social ethos and in others it is acceptable for governments and others to make those choices for consumers. This is framed by the local context and in particular the link between local consumption behaviour and the health of local ecosystem and natural capital. Where there is a perception of individual or collective value derived from ecosystems then demand for higher environmental standards from companies is standard.

Drivers towards 2050

In the year 2030, Earth's socio-ecological systems seem poised at a branch point. Local ecosystem management is varied in many regions, but there is a growing force of emerging institutions for global environmental management. While problems exist, the situation is better than in 2000. On the other hand, global environmental problems have become more pressing. It seems possible that new approaches will emerge for addressing them, built in part on the varied experiments of the recent decades.



'Techno Garden' Scenario Narrative

Summary:

Significant investments in environmental technology seem to be paying off. At the beginning of the century, doomsayers felt that Earth's ecosystem services were breaking down. As we look back over the past 20 years, however, we see many successes in managing ecosystem services through continually improving technology. Investment in technology was accompanied by significant economic development and education, improving people's lives and helping them understand the ecosystems that make their lives possible. On the other hand, not every problem has succumbed to technological innovation. In some cases, we seem to be barely ahead of the next threat to global life support. Even worse, new environmental problems often seem to emerge from the most recent technological solution, and the costs of managing the environment are continually rising. Many wonder if we are in fact on a downward spiral, where new problems arise before the last one is really solved. As we look to 2050 and beyond, we need to cope with a situation in which problems are multiplying faster than solutions. The science and policy challenge for the next 20 years is to learn how to organize socio-ecological systems so that ecosystem services are maintained without taxing society's ability to invent and pay for solutions to novel, emergent problems.

How did we get here?

Early in the twenty-first century, increased recognition of the importance of ecosystem services led to increasingly formalized patterns of human/ecological interactions. The trend to formalization led to definition of a wide variety of ecological property rights, which were assigned to a variety of

communal groups, states, individuals, and corporations. These rights often prompted ecosystem engineering to maintain provision of the desired ecosystem services. Investment in ecological understanding and natural capital meant that environmental problems were often identified before they became severe.

Such property rights systems eased industrial countries away from protective subsidies and improved income opportunities for developing countries. They also led to increasing government control through "green" taxes and subsidies of research and development. Policies emphasizing research and development led to significant scientific efforts, particularly in the use of technological control to maintain consistent resource flows. There was also a strong belief that "natural capitalism"—a focus on looking for profits in working with nature—could be profitable for both individuals and society. Big business became interested in research and development of new technologies to produce or enhance production of ecosystem services. The impossibility of maintaining exclusive access to information drove ever more rapid innovation during the early period. It was a time of rapid gain and spread of knowledge around the globe. Global communication, combined with open trade policies, allowed the developing world to apply some of the new technologies and start developing their own.

Political Landscape

Governments found themselves pre-occupied with the state of the planet. In response to negative consequences of intensive agriculture in the industrial world—including land degradation, eutrophication of lakes and estuaries, and disease outbreaks—demand for ecological agriculture began to increase. In the 1990s, governments in several European countries

had already begun to change or remove agricultural subsidies following a series of agricultural crises in Europe (mad cow disease, foot-and-mouth disease, swine flu, contamination of food with halogenated organic compounds).

Research in 2020 clearly identified the need for organisations and institutions with the necessary technical and financial resources to act as stewards of key global ecosystem services. National and international government admitted they lacked the capacity to play this role for some time and increasingly people expected business to offer leadership in this area. Through global lease agreements, 20 of the largest global companies, known as ECOCOs, now individually, and in some cases in partnership with other companies, manage and maintaining global ecosystems and several local ecosystems. Their key role is to maximize the provisioning, regulating, cultural and support benefits from ecosystem services. With a collective global value of US\$33 Trillion these ECOCOs have huge assets and are able to attract considerable investment and raise substantial revenues from nation states and other companies deriving benefits from healthy ecosystems. There is significant investment in development of technologies to increase efficiency of use of ecosystem services and widespread use of 'payments for ecosystem services' and well developed market mechanisms.

Ecological agriculture unfolded in two intertwined planes. Due to the increasing focus on ecosystem services, people began to realize that agricultural systems were embedded within landscapes and that agriculture could not just produce food or fibre at the expense of all other potential services. This led to policies that encouraged farmers to create a landscape that produced a variety of ecosystem services rather than focusing on food as a single service. The goal

of multi-functionality moved government agricultural policy away from a focus on the volume of agriculture production to a focus on agricultural profitability.

Physical Landscape

Despite initial concerns that multifunctional agriculture would destroy farming as a way of life and reduce yields, its profitability and lowered risk encouraged many farmers in Europe and North America to convert their operations. This trend began in the 1990s, and its expansion first in Europe and then North America meant that by 2010 nearly half of European and 10% of North American farms were focusing on a multifunctional existence. By 2025, these numbers had jumped to nearly 90% in Europe and 60% in North America. The diversification of agricultural production and lower yields increased the profitability of farming—particularly smaller-scale farming—and reduced the power of large-scale agribusiness.

As population continued to grow and demand for resources intensified, people increasingly pushed ecosystems to their limits of production. This ecological engineering was done privately at local, small, or regional scales by a variety of private, public, and community and individual actors and was done within different types of property rights schemes at different locations. Some areas established property rights schemes based on command and control, common property, or market-based schemes, while others remained open access.

Ecological agriculture and the end of widespread subsidies opened the rich world to agricultural inputs from poor countries, and this spurred radical changes in agriculture in Eastern Europe and later in Africa and Latin America. Increased ability of developing countries to export agricultural production encouraged investment in

intensification. The demand of industrial countries for at least nominally safe and ecologically friendly production helped stimulate intensification efforts to increase production in environmentally friendly ways. Some of these developments came from the use of genetically modified crops. Despite initial opposition in the EU, the absence of all but a few minor ecological problems led to their widespread use. As crop production for the developing world remained somewhat less sensitive to ecological issues, some local ecological degradation resulted from the agricultural intensification. Water pollution, eutrophication, deforestation, and erosion became significant problems in some locations.

Regional differences within rich and poor worlds continued to exist due to culture, governance, environmental factors, and the way that property rights were organized. Prosperous regions benefit from technologically managed ecosystem services 'owned' by the private sector and results in a higher quality of service for those able to pay. The world has seen short-term consumption level reductions but the trend is returning to upwards. However, the trend is for "sustainable consumption" which is being driven by taxation of unsustainable behaviours and population growth.

Not all local ecosystems are attractive to ECOCOs or have been able to attract payment for the ecosystem services they provide and as a result many become degraded beyond a point from which they can recover. For example, development of green agriculture spread most rapidly in North European countries. East European countries were well positioned to export agricultural products to the EU and were the first to intensify. In Africa the situation was quite heterogeneous; some countries in southern Africa intensified their agricultural production rapidly, while other African countries were unable to respond to these

opportunities due to local problems in governance, lack of infrastructure, or water shortages and droughts which has led to a global increase in the equality gap between those with access to technology and those without.

Social Landscape

The highly managed urban garden approach sometimes led to destruction of local, rural, and indigenous cultures. Since the dominant values tended to be functional, culture for culture's sake was not highly valued. For those with technological skills, there is a new global market for 'techno-immigrants' and those in poorer areas with access to training have moved en masse to Brazil, China, India, etc. bringing these regions to the forefront of technological innovation. The degree of this cultural loss was variable across regions, but some loss was inevitable everywhere. This lowered the adaptive capacity of local ecosystem management by diminishing society's capability to detect subtle changes in local ecological processes, particularly in terms of detecting gradual changes in slow processes. On the other hand, sensitive and cheap ecological monitoring did allow for the rapid accumulation of short-term ecological knowledge.

In areas dominated by the ECOCOs there has been widespread investment in health and education with a strong emphasis on birth control and technology skills. This has slowed population growth in many areas; more than what was thought possible in the early part of the century. Populations in areas outside of the interest of the ECOCOs have suffered from a widening equality gap lacking in education and access to the new 'global skills network'. Without the right skills, it is very difficult for these people to move to more prosperous regions. In these areas populations continue to grow and health issues and infectious diseases are rampant.

Access to Environmental Resources

The engineering approach took hold in urban and suburban areas. The best urban management focused on creating low or positive impact on ecosystems using green architecture and on diverse transportation strategies and urban parks as functional ecosystems. In rich countries, new housing developments begin to include rain gardens and wetland areas to clarify runoff and provide wildlife habitat. The specific activities that people engaged in varied by location, based on the ecosystem services they desired and the difficulty of providing those services. In general, rich countries focused on providing water regulation services and cultural services, while developing countries focused more on the production and regulation of water and the production of provisioning services. In general, low water use technological innovation, particularly in agriculture, has removed much of the global water shortage threat, although this has resulted in a higher price for food in order to incorporate payment for these technologies, again widening the equality gap.

Highly engineered systems turned out to be very vulnerable to disruptions, however. Even successful management was at risk from loss of process diversity, loss of local knowledge, and people's dependence on stable, consistent supplies of ecosystem services. Ecosystems tended to be simplified because the more obscure and apparently unimportant processes were not supported or maintained. At the same time, increasing social reliance on the provision of ecosystem services led to declines in alternative mechanisms of supplying them. These factors combined to greatly increase the risk of a major breakdown in provision of ecosystem services. The problems were especially severe at the boundaries between ecosystems and across scales, where local effects of management interacted with large-scale fluctuations in ecosystem

conditions and function.

While there has been what is now viewed as short term consumption level reductions, the current trend is upward. The technologically managed ecosystem products like water, raw materials, oil and gas, are owned and managed by the ECOCOs or their subsidiaries and has resulted in a mostly stable and higher quality of service, but only for those able to pay.

Business Response

The engineering 'norm' that has developed over the past 20 years is far more sophisticated, subtle, and adaptive than many traditional attempts at ecological engineering. The new ecological engineers were schooled in the engineering approach of "fast, cheap, and out of control" and used advances in computer, communication, and materials sciences to permit human infrastructure to be increasingly flexible, dynamic, and adaptive, like wild ecosystems. Innovations such as pop-up infrastructure allowed people to intervene in ecological dynamics rapidly and flexibly. Industry that has stayed on top of and has funded and promoted these emerging technologies has gone from strength to strength while businesses that have not adopted this technological mind-set have mostly faded away. Occasionally a business has suffered from a bad technology but with the field changing so rapidly, it is rare for a business to only be investing in one direction.

Many in the business community are optimistic that technology will offer major solutions to environmental problems and with considerable investment believe there should even be some significant rewards. However, there is an underlying risk that these technologies merely promote mono-culture agricultural strategies, leading to particular vulnerabilities to the impacts of climate change.

New markets have developed in land investment. The role of farmers has broadened to cover provision of ecosystem services, beyond simply providing food. Land that can provide ecosystem regulating services can attract higher investment returns than if it were used for food production alone.

Consumer Response

In general there has been wide scale public buy-in for more sustainable lifestyles. This initially resulted in consumption reduction throughout the 2020's. However, as the global market appears more stable, the current consumption trend is upwards. Consumer behaviour is seen to be very responsive to global marketing initiatives and there have been extensive advertising campaigns by the ECOCOs to promote more sustainable lifestyles and encourage greener choices. Many basic goods, and food in particular, are expensive due to an incorporated tax used to pay for ecosystem services but this is now accepted as normal.

Consumers share the belief in the power of high-tech gadgetry to improve their lifestyle choices and there has been a surge of consumer oriented technical products to facilitate 'green living'. Consumers use their personal communication and information units to instantly scan products to get full details about them in order to make more informed decisions. They instantly have access to product green credentials, natural resource use data, carbon costs, company profiles and consumer reviews which they actively use and engage with.

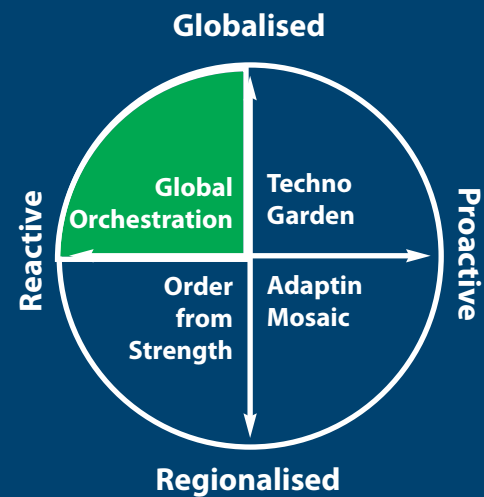
Drivers towards 2050

Looking back from the year 2030, it seems that we did a pretty good job managing and understanding a rapidly changing world. There are some persistent or growing social and ecological problems, like the loss of local knowledge about ecosystem services and eutrophication of fresh waters and coastal oceans or the growing disenfranchised populations in ecologically poor areas. But in general people around the world have better access to resources and we seem to be thinking more about multi-functionality and systems approaches rather than single goals. Looking forward to 2050, there is great hope for continuing improvement in ecosystem management. We will need to cope with a situation in which problems (caused by new technologies) are sometimes multiplying faster than solutions. The science and policy challenge for the next 20 years is to learn how to organize socio-ecological systems so that ecosystem services are maintained without taxing society's ability to invent and pay for solutions to novel, emergent problems.

Appendix 3: Scenario Quick Guide

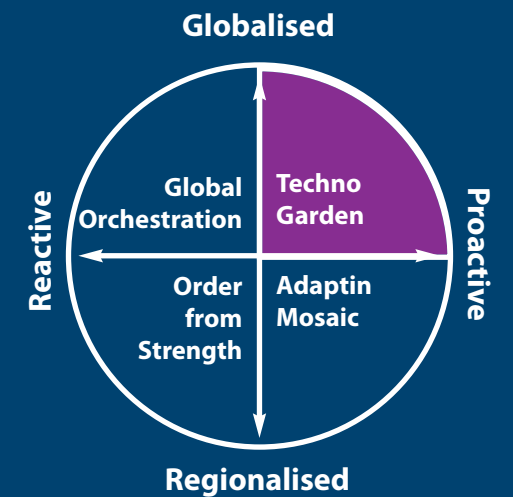
Global Orchestration

The past 20 years have shown that some ecosystem services can be maintained or improved by appropriate macro scale policies. Notable successes occurred in reducing or controlling many global pollutants and in slowing, or in some cases reversing, loss of marine fish stocks. In some situations, it turned out that ecosystem services improved as economies developed. On the other hand, it appears that global action focused primarily on the economic aspects of environmental problems is not enough. In some regions and nations, ecosystem services have deteriorated despite economic advancement



Techno Garden

Investments in environmental technology seem to be paying off. At the beginning of the century, doomsayers felt that Earth's ecosystem services were breaking down. However, looking back over the past 20 years, we see many successes in managing ecosystem services through continually improving technology. Investment in technology was accompanied by significant economic development and education, improving people's lives. On the other hand, not every problem has succumbed to technological innovation. In some cases, we seem to be barely ahead of the next threat to global life support and new environmental problems often seem to emerge from the most recent technological solution.



'Punch-lines':	"One planet approach" "We're all in this together" "Prosperity without growth"
Political landscape:	Globalized, with emphasis on economic growth and public goods.
Environmental landscape:	Large-scale, high productivity agricultural mono culture. Water allowance schemes.
Social landscape:	Growing middle class, increase in wealth, technology access, improvement in health although increased spread of pathogens.
Access to environmental resources:	International regulations with monitored quotas, detailed reporting requirements, true cost accounting and severe financial penalties.
Business response:	Corporate responsibility, long term investments, added value requirements, new markets.
Drivers to 2050:	Environmental security due to increased reliance on mono culture.

'Punch-lines':	"Knowledge is power" "We are all connected"
Political landscape:	Globalized, with emphasis on green technology and corporate input.
Environmental landscape:	Large-scale agribusiness, genetically modified crops, technologically managed ecosystems, low-water innovation, but still some areas of deprivation.
Social landscape:	Loss of local cultures, techno-immigrants, cheap global communication, slowed population growth.
Access to environmental resources:	Highly engineered systems vulnerable to disruptions, global diversity of ecosystem products and services means more stable provision, but at a cost.
Business response:	Investment in emerging computer, communication, and material science technologies.
Drivers to 2050:	How to address problems brought about by technology at a continuing affordable cost.

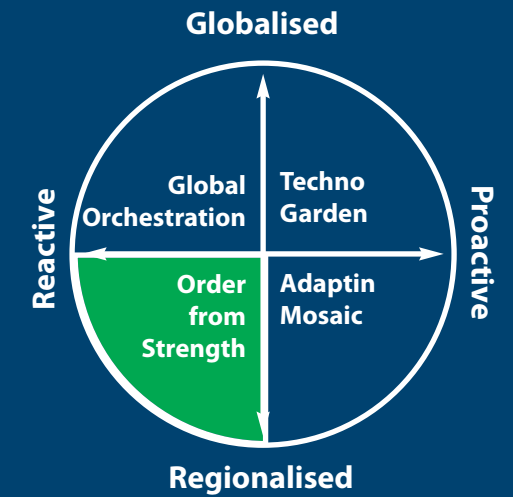
Adapting Mosaic

The past 20 years have brought a mix of successes and failures in managing ecosystem services. Some regions strengthened the centralized environmental agencies that emerged late in the twentieth century, while others embarked on novel institutional arrangements. Some approaches turned out to be disastrous, but others proved able to maintain or improve ecosystem services. As a result, the world in 2030 is a diverse mosaic with respect to ecosystem services and human well-being. A considerable variety of approaches exists, and regrettably some regions still cannot provide adequate ecosystem services for their people. Other regions are doing well, and remarkable successes have occurred on every continent.



Order from Strength

Since 2000, the availability of ecosystem services has fallen below minimal needs for human wellbeing in some regions of the world while being maintained or even improved in other regions. Widespread loss of faith in global institutions and fear of terrorism led rich countries to favor policies that ensured security and erected boundaries against outsiders. Even in better-off areas though, there have been some breakdowns of ecosystem services. Climate change was often more rapid than response capacity. Overall, the current global condition of ecosystem services is highly variable and declining on average. Even the places in the best condition are at risk, although citizens of wealthy nations enjoy a tolerable level of ecosystem services and human well-being.



'Punch-lines':	"We know how to do it best" "Local knowledge is local power"
Political landscape:	Regionalized, with emphasis on local adaptation and flexible governance.
Environmental landscape:	Neglect of multi-regional systems, crisis more frequent, water shortages exacerbated.
Social landscape:	Desire for localism with high migration pressures.
Access to environmental resources:	Uneven distribution and access to ecosystem products and services. Complex network of securing local agreements.
Business response:	Short term agreements due to high risk of supply, need for diversification.
Drivers to 2050:	Rebuild ecosystem services in the regions where they have collapsed and increase and transfer the lessons of regional success to the global commons.

'Punch-lines':	"Safety and security first" "National strength is national success"
Political landscape:	Regionalized, with emphasis on national security and economic growth.
Environmental landscape:	Major global degradation of many large-scale environmental systems with small pockets of health.
Social landscape:	Increased global inequality, rapid disease, pollution and population growth in poor countries.
Access to environmental resources:	Shortages and disputes over resources common, issues affecting wealthy nations more likely to be addressed, wealthy buy up resources increasing equality gap.
Business response:	Greater investment in and control over local resources, developing local trade agreements.
Drivers to 2050:	Social pressure for supporting the poor and improving wider ecosystem management.

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