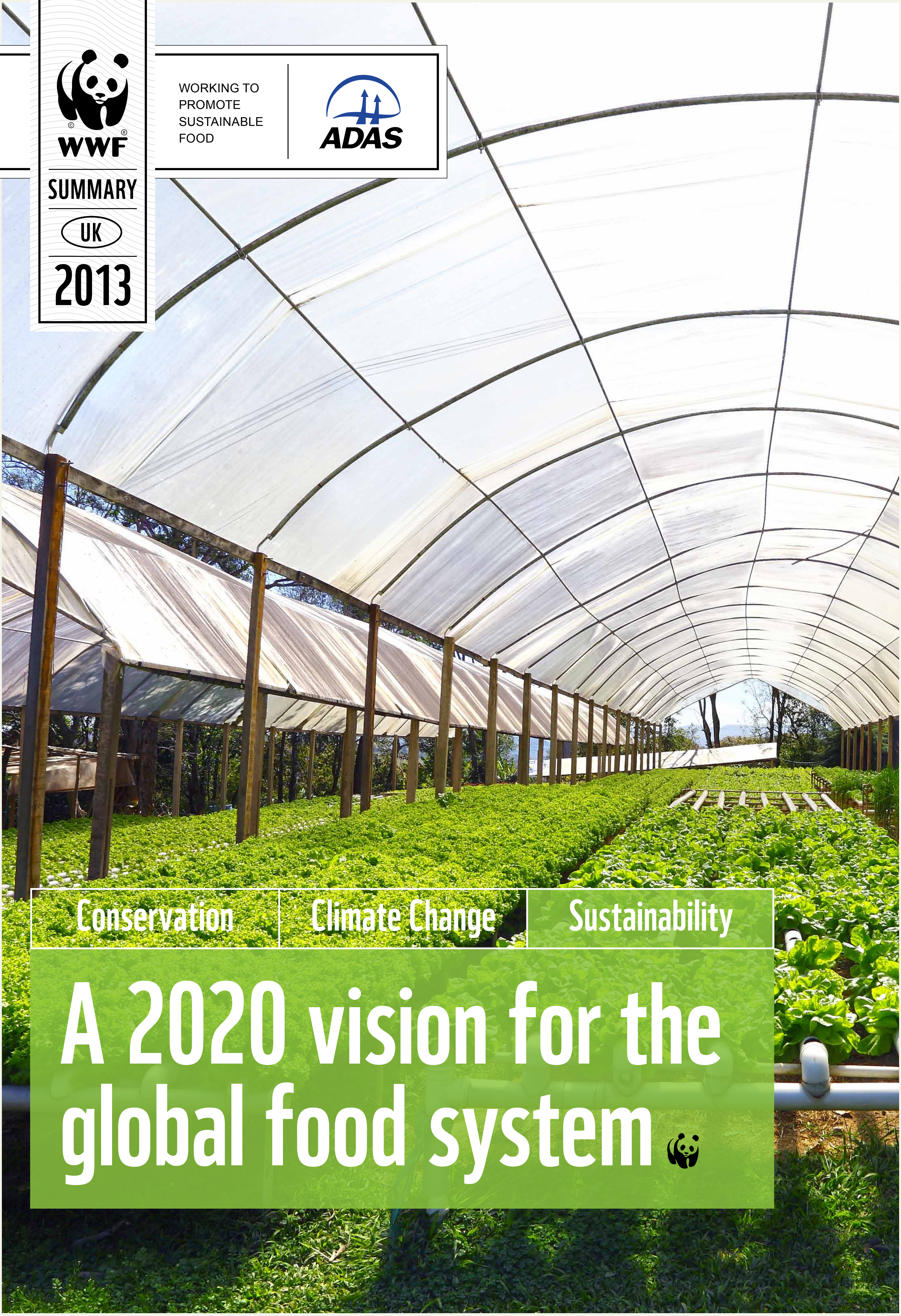

WWF

WORKING TO PROMOTE SUSTAINABLE FOOD

ADAS

SUMMARY

UK

2013

Conservation | Climate Change | Sustainability

A 2020 vision for the global food system

WWF AND FOOD

At WWF, we've been working to protect the natural world for over 50 years. Since 1961 we've developed from conserving wildlife to protecting the ecosystems that sustain nature, and tackling the major threats to the natural world such as climate change.

100% RENEWABLE ENERGY BY 2050 IS ONLY ACHIEVABLE IF WESTERN DIETS BECOME LESS RESOURCE INTENSIVE

As part of this work we investigate the drivers of these threats, such as unsustainable consumption – including a focus on food. Addressing the way we produce and consume food is key to our goals of conserving biodiversity, reducing water use and cutting emissions of greenhouse gases. We've already focused on food in four major reports in the last three years:

***How low can we go?* (2009)**

This report looks at the role of the food system in meeting the UK government's 2050 carbon targets. We conclude that production and technological changes are vital but the targets will not be met without a change in food consumption patterns.

wwf.org.uk/howlow

***Living Planet Report* (2012)**

Our biennial report on the health of the world's biodiversity and humanity's demands on natural resources clearly recognises the need to reduce meat consumption.

wwf.org.uk/lpr

***Living Forests Report* (2011)**

in which we show that dietary changes are needed if the world is to achieve zero net deforestation by 2020. Many parts of the world need to eat less meat, while sub-Saharan Africa and South Asia should see a per capita increase.

wwf.org.uk/livingforests

***The Energy Report* (2011)**

in which we highlight that our vision of 100% renewable energy by 2050 is only achievable if Western diets become less resource intensive.

wwf.org.uk/energyreport

Our One Planet Food programme aims to reduce the environmental impacts inherent in the food system. We take a whole value chain approach from production to plate. This includes looking at commodities such as palm oil and sugar, and the direct and indirect impacts of production, including land-use change. It also covers the increase in demand for meat and dairy and how our eating habits have changed rapidly in recent years as we eat more processed foods than ever before. The current food system is unsustainable in the long term: 'business as usual' is no longer an option or desirable.

HOW CAN WE FEED 9 BILLION BY 2050?

Purpose

A lot of studies look to 2050, and how to feed nine billion people and produce 70% more food. This is based on business as usual: it assumes we will not tackle waste, consumption, distribution, smallholder productivity or gender empowerment, and that the rest of the world will start consuming a more Western diet – high in meat and dairy and processed food and low in fresh fruit and vegetables. This is unproven and may not be possible in a resource-constrained world, with oil becoming a rare, expensive commodity that can no longer be the backbone of agricultural production, climate change reducing many regions ability to produce large amounts of food and water becoming scarcer. This is the 'perfect storm' of water, energy and food insecurity outlined by John Beddington, the government's chief scientific adviser.

This work is looking to the medium term: a food system that can feed over seven billion people by 2020 with a climate-positive impact. It takes a global perspective. ADAS, the UK's largest independent provider of environmental consultancy, rural development services and policy advice has conducted an in-depth literature review looking across the food chain at the current food system and predicted changes to it, the key findings of which are outlined. ADAS then used the evidence to look at four scenarios that were assessed to determine whether they can produce a low-carbon and sustainable global food system by 2020.

The scenarios were:

1. Continue on existing path – a baseline scenario where demand patterns do not change and more people move towards a Western-style diet.

2. Aspire to have organic and high animal welfare production – reflecting demand for aspirational production systems such as high animal welfare standards and organic production.

3. Improve production efficiency and reduce meat and dairy consumption – taking into account changes in production, technology and consumption, including GM and biotechnology, aquaculture, predicted production efficiencies and changes in meat and dairy consumption.

4. Take account of environmental impacts which may not decrease greenhouse gas emissions – this also looks at reducing other environmental impacts associated with the food system, such as water scarcity and biodiversity loss, which may not result in low-carbon food.

We all have a responsibility towards the natural world. Those businesses engaged in the Global Forest Network UK present a model for coming together to reduce the impact on the forests from which they source the timber and paper that we, as individuals, consume.

Indeed it was notable at the UN's Rio+20 summit in 2012 that progressive businesses, rather than governments, were presenting the most innovative and committed responses to defining ways humanity can progress towards a cleaner, greener future. It will be these commitments that set us on the path to a brighter future.

FOOD: PAST, PRESENT AND FUTURE

Major shifts in dietary patterns are occurring, including a move from basic staples to more diversified diets. Drivers include urbanisation, increasing incomes, market liberalisation and trade policies.

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CHANGING DEMAND

- Demand is increasing in response to population growth, income growth, and urbanisation.
- Major shifts in dietary patterns are occurring that have considerable health consequences.
- Growth in the consumption of livestock products on a per capita basis has exceeded growth in the consumption of other major food commodity groups.
- Over the last four decades fish consumption has been rising in line with the general trends of increased world food consumption.
- Aquaculture constitutes about 40% of aquatic animal food for human consumption and is expected to grow further.

40%
AQUACULTURE CONSTITUTES ABOUT 40% OF AQUATIC ANIMAL FOOD FOR HUMAN CONSUMPTION

Increase in global food prices

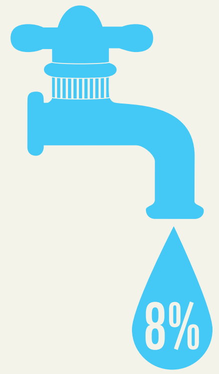
Despite global food prices declining from their peak levels of 2008, as well as the recent economic recession, global food prices are still high relative to recent historical levels. In the short to medium term, prices for feed and food will remain higher than in the recent past (IFPRI, 2008; OECD-FAO, 2008; World Bank, 2008). The Organisation for Economic Co-operation and Development (OECD) and the Food and Agricultural Organization of the United Nations (FAO) expect food commodity prices to remain at current levels or to increase in the medium term: the days of cheap food in the West are over (FAO, 2009d).

GLOBAL FOOD PRICES ARE STILL HIGH RELATIVE TO RECENT HISTORICAL LEVELS AND ARE EXPECTED TO STAY HIGH, AT LEAST OVER THE MEDIUM TERM

Increase in calories

Dietary energy in terms of calories per capita per day has been rising steadily on a worldwide basis. However, the Foresight report by the British Government Office for Science highlighted the inequalities of the global food system: one billion are hungry and one billion suffer from hidden hunger while 1.5 billion are over-consuming.

The baseline projection of the global food system to 2050 has been widely cited and is based on business as usual assumptions with no major policy changes. This projection suggests that, by 2050, the world's average daily kilocalorie availability could rise to 3,130. This is an 11% increase over the 2003 level but this would still leave some 4% of the population in low-income countries chronically undernourished.



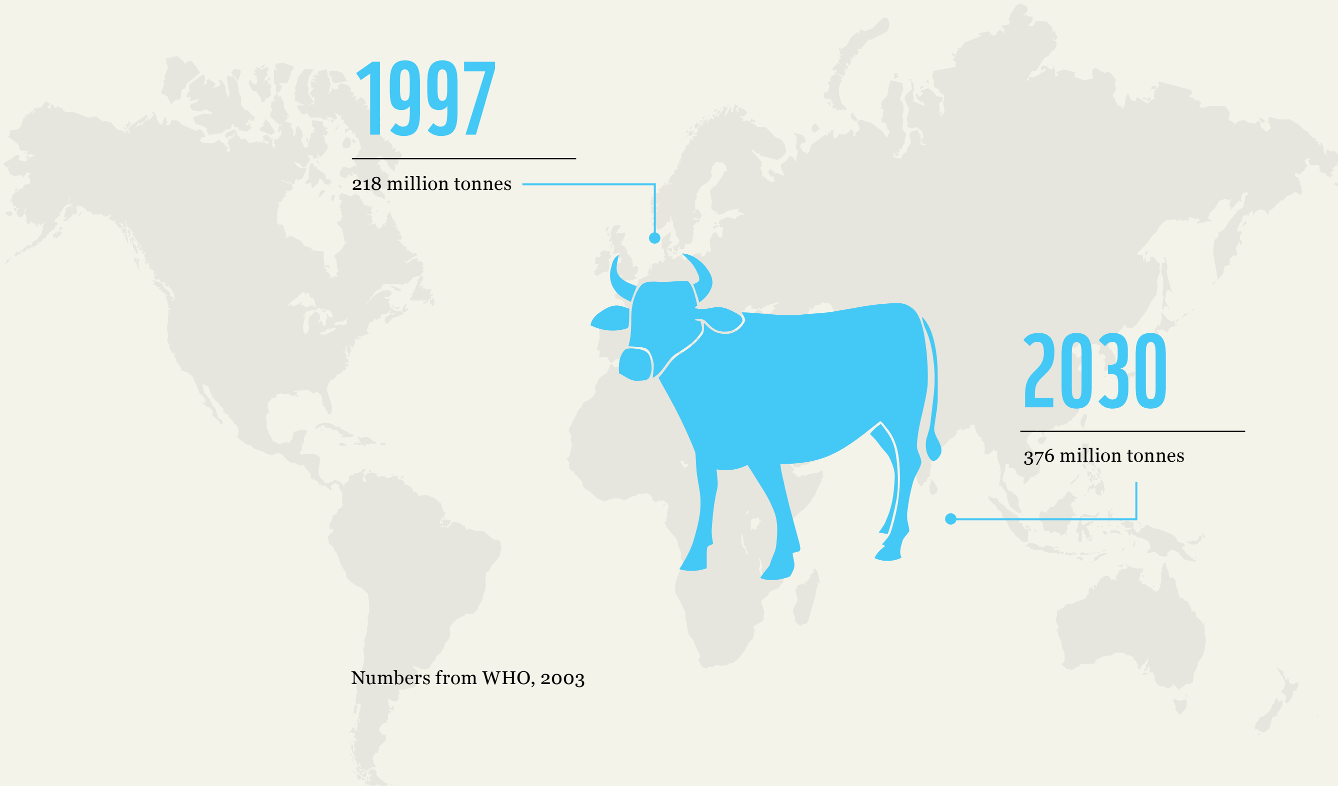
LIVESTOCK PRODUCTION ADDS TO THE STRESS ON WATER RESOURCES, ACCOUNTING FOR 8% OF GLOBAL HUMAN WATER USE EITHER DIRECTLY OR INDIRECTLY

Livestock

Demand for livestock products has increased in the last 50 years (FAO, 2009d). The most substantial growth in livestock consumption has occurred in East and Southeast Asia. In contrast developed countries have seen much more modest growth in per capita consumption of livestock products albeit from a higher base than in developing countries (FAO, 2009d). For the majority of people in the world, particularly in developing countries, livestock products provide high value protein and a wide range of essential micronutrients.

Demand for livestock products looks set to continue to grow, again with the majority of this increase envisaged to come from developing countries (FAO, 2009d). Global annual meat consumption is expected to increase from 218 million tonnes in 1997-1999 to 376 million tonnes by 2030 (WHO, 2003).

Predicted increase in global demand for livestock products



Numbers from WHO, 2003

ENVIRONMENTAL IMPACTS OF PRODUCTION

- There are trade-offs between agricultural output and ecosystem services. Increasing yield often comes with an environmental consequence.
- There are trade-offs between different ecosystem services. Modern land-use planning is increasingly considering multi-functional landscapes.
- Biodiversity is an increasingly important environmental indicator.

Environmental effects of agriculture can be direct or indirect. Direct effects include emissions from making fertiliser, field machinery use and ploughing. Indirect impacts are more difficult to identify, such as emissions from indirect land-use change: this might occur, for example, when decreased crop yields lead to increases in production area elsewhere.

The need to increase agricultural productivity in the future will have environmental consequences. Besides global warming potential, the impacts of food production include soil erosion, the loss of biodiversity and habitats and the availability of water.

Water constraints

Water plays a key role in agriculture. The FAO (2009a) estimates irrigated agriculture covers 20% of arable land and contributes to nearly 50% of crop production.

Increasing output from agriculture for a growing world population will require an increase in water use, or greater efficiency. Yet by 2050 there will be 18% less available water for agriculture due to increased demand from other users if we are to maintain existing river systems (Strzepek and Boehlert, 2010). The decrease is predicted to affect current water-scarce areas. Concurrently, there may be an increase in demand for water of up to 200% in developing countries by 2050.

IRRIGATED AGRICULTURE COVERS 20% OF ARABLE LAND BUT CONTRIBUTES TO NEARLY 50% OF CROP PRODUCTION

Reduce meat consumption, save water

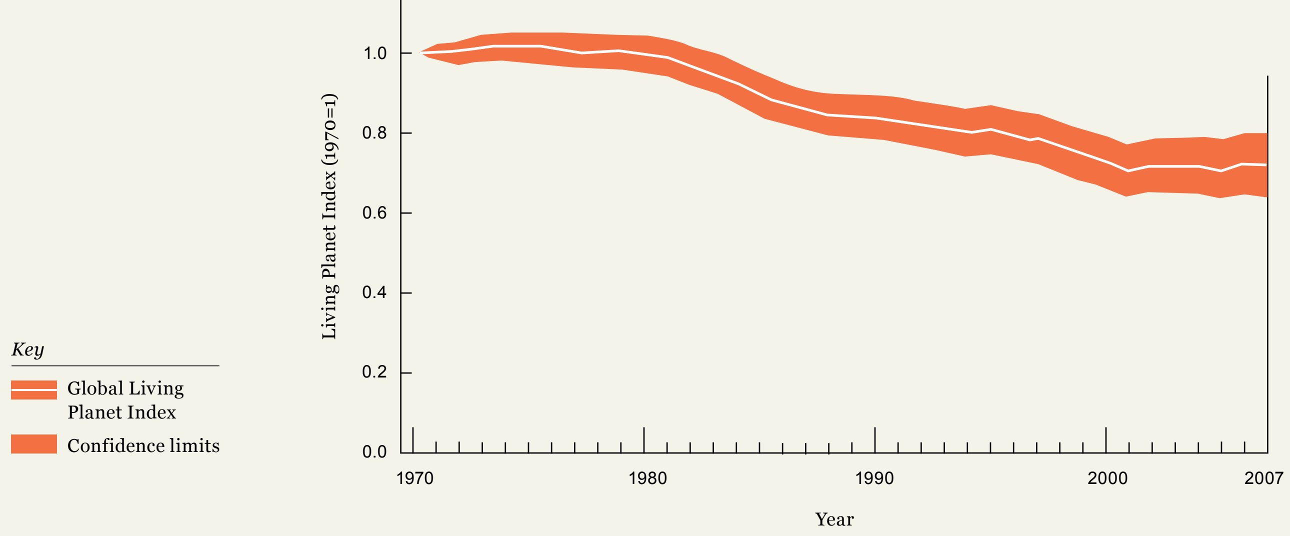
Livestock farming is a significant consumer of water. Globally, the livestock sector uses 8% of the globally available water supply; 7% is used in feed production (Steinfeld et al., 2006). There is a disparity in water production systems: one cubic metre of water can produce anything from 0.5kg of dry animal feed in North American grasslands to around 5kg in some tropical systems. Better management of livestock systems can help conserve water resources, but there is still a strong argument for a reduction in meat consumption to allow water to be used in high-yield agricultural crops.

Biodiversity constraints

Biodiversity is a major consideration in future agricultural growth. The International Year of Biodiversity in 2010 was marked by the release of the updated Living Planet Index (WWF et al., 2012), which showed a decline in species populations of approximately 30% from 1970 to 2007 (Figure 1). Biodiversity is difficult to measure, but WWF has attempted to quantify this by an index based on 9,014 populations of 2,688 species of birds, mammals, reptiles and fish. The decline in the Living Planet Index is an indicator of the declining health of ecosystems.

Global Living Planet Index (1970-2007)

Figure 1:
Source: WWF et al., 2012.



Ecosystems services

Agroecosystems are both providers and consumers of ecosystem services. They are often highly managed ecosystems principally designed to provide food, forage, fibre, bioenergy and pharmaceuticals. In turn, agroecosystems depend strongly on services provided by natural, unmanaged ecosystems. These underpinning services include genetic biodiversity for use in breeding crops and livestock, soil formation and structure, soil fertility, nutrient cycling and the provision of water. Natural ecosystems may also purify water and regulate its flow into agricultural systems, providing sufficient quantities at the appropriate time for plant growth (Power, 2010).

Future constraints

It is very probable that rising food security concerns will place biodiversity and protected areas under increasing pressure. Maintaining ecosystem services in these circumstances will require an economic and policy climate that favours diversification in land uses and diversity among land users across the globe (Swift et al., 2004).

TRENDS IN THE AVAILABILITY OF AGRICULTURAL LAND FOR FOOD PRODUCTION

- Availability is affected by policies that affect the primary drivers of competition for land – population growth, dietary preference, protected areas, forestry policy.
- Technology for increasing per area productivity is necessary.
- There is considerable uncertainty in drivers, pressures, data and models.
- Policy responses need to reflect conflicting demands on land use and provide a guide to land-use intensity.

AGRICULTURAL LAND FOR GROWING FOOD AND FEED CROPS FOR LIVESTOCK AND FOR PASTURE OCCUPIES ABOUT 5,000 MILLION HECTARES, OR 38% OF THE TOTAL GLOBAL LAND AREA

Drivers of production

Future policy decisions in the areas of agriculture, forestry, energy and conservation are likely to impose different demands for land to supply multiple ecosystem services. Agricultural land for growing food and feed crops for livestock and for pasture occupies about 5,000 million hectares, or 38% of the total global land area, with almost 13% of the total global land area being used for crops (Government Office for Science, 2011). It is clear that per area agricultural productivity needs to be maintained where it is already close to optimal or increased in the large areas of the world where it is sub-optimal (Smith et al., 2010). To do so without damaging the environment is not easy. However, investment in agricultural knowledge, science and technology can yield significant cost-benefit advantages when biodiversity damage is avoided, with this positive ratio increasing significantly when carbon benefits are accounted for (McVittie et al., 2011).

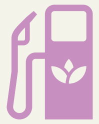
Biofuels

Biofuels are the largest source of new demand for agricultural commodities, with production more than tripling over the period 2000-2008. Biofuel production accounts for about 7% of global coarse grain use (rising to 12% by 2018), 9% of global vegetable oil use (rising to 20% by 2018) and 2% of global cropland (rising to 4% by 2030) (FAO, 2009b). They have contributed both to the recent spike in agricultural commodity prices and to the expectation that prices will remain higher in the future than they would be in the absence of increased biofuel production.

Countries have adopted policies to stimulate biofuel production and consumption for one or more of the following reasons: to reduce dependence on fossil fuels, to reduce greenhouse gas emissions in the transport sector, and to create demand for surplus agricultural crops (Fonseca et al., 2010).

First-generation biofuels from sugar and starch crops (ethanol) and oilseed crops (biodiesel) compete directly with demand for these crops as food or feed (Fonseca et

al., 2010). At the same time, some of the resources previously available to livestock at a low cost are becoming increasingly costly, because of growing competition for these resources from other economic sectors and activities such as biofuel production (FAO, 2009d). The most obvious consequence of large-scale liquid biofuel production for the livestock industry is higher crop prices, which raise feed costs. Biofuel production also increases returns on cropland, which encourages conversion of pastureland to cropland (FAO, 2009d). One silver lining is that biofuel production also produces outputs which are useful in other areas of agriculture, such as rapemeal, a high-protein feed produced when the oil is extracted from rapeseed.



BIOFUEL PRODUCTION ACCOUNTS FOR ABOUT 7% GLOBAL COARSE GRAIN USE 9% VEGETABLE OIL USE 2% GLOBAL CROPLAND

Conversely, second-generation biofuels, which are not currently commercially available, use biomass from non-food sources, including woody biomass, waste matter from food crops and residues from other non-food processes. Second-generation biofuels promise to deliver higher yields. These crops require land, although some may be grown on poor land that would normally not be used for food production (Fonseca et al., 2010).

Other drivers of land use

Land has competing uses and the changing mosaic of land use involves trade-offs between a number of sectoral interests with agricultural production competing with industry, transport, energy, mining and forestry.

A 2020 vision for the global food system

TRENDS IN AGRICULTURAL YIELDS

- Agricultural output has kept pace with rapid rises in global food demand over the past 50 years – but will this be the case over the next 50 years?
- There is a good prospect of achieving approximately 50% increase in crop production without the need for extra land (assuming no land is taken to produce bioenergy).
- Socio-economic factors are a key component of the food production system and government needs to adopt a holistic policy.
- Breeding should allow large increases in crop yields in a CO2-“enriched” environment with most airborne pests and disease remaining controllable assuming crop protection chemicals remain available.
- Transgenic breeding could help control soil-borne pathogens.
- The yield gap between potential and actual yield needs to be reduced.

THE ‘GREEN REVOLUTION’ OF THE 1960S RESULTED IN YIELD INCREASES FOR MAJOR CEREALS (WHEAT, RICE, MAIZE) OF 100% TO 200%

Trends in crop yields

The green revolution

Over the last 50 years, agricultural output has kept pace with the rapid rises in global food demand. This has largely been achieved through increases in yield rather than area (Audsley et al., 2009). The introduction of hybrids in the 1950s saw significant rises in sorghum and maize yields in the USA (Edgerton, 2009), while the ‘green revolution’ of the 1960s marked the introduction of high-yielding varieties of wheat and rice, resulting in yield increases for major cereals (wheat, rice, maize) of 100% to 200% (Nelson et al., 2010; FAO, 2009a). However, yield growth rates were unequally distributed across crops and regions. Since the advancement of the green revolution, the relative growth in yield increase has declined steadily and has now fallen below the rate of population growth.

Temporal variations in yield trends

While the levelling-off or reduced rates of improvement in cereal crop yields is common throughout the world, the timing and reasons for such turning points differ according to region. Despite the adoption of similar farming practices in most of the major grain producing countries, yields are still very variable (Edgerton, 2009).

For most of the world’s main food crops, yields have grown significantly faster during periods of higher demand growth (Lywood et al., 2009). These variations reflect the range of measures available to growers to enhance yields of each crop, which are typically not fully deployed during periods of low demand growth and low relative price.

Spatial variations in yield trends

Socio-economic, technological and environmental factors all affect the spatial variation in crop yields. However, while agro-environmental factors such as soil type and rainfall impose varying limits to productivity for the different regions of the world, evidence suggests that socio-economic factors have a greater influence on the spatial trends in yield. Numerous factors compound this issue (GoScience, 2011b):

- Lack of access to credit
- Poorly defined property rights
- Lack of insurance
- Paucity of weather forecasts
- Inefficient tax and subsidy regimes
- Lack of regulation
- Lack of specific agriculture policy expenditure and investment.

Future trends in crop yields

Technology

Technological developments are likely to become more significant in helping to increase yield potential again. In the US, the combination of marker-assisted breeding, biotechnology traits and advances in agronomic practices has the potential to double corn yields over the next two decades (Edgerton, 2009).

Improving yields in corn and other crops on a global basis would allow farmers to meet global demand for feed, fuel and food while minimising the need to bring large amounts of new land into crop production.

Climate change

Climate change will have a greater, yet uncertain impact on yield potential (Nelson et al., 2010; FAO, 2009a) as we move toward and beyond 2020.

A study by the International Food Policy Research Institute (Nelson et al., 2010) affirms that agricultural productivity is strongly determined by both temperature and precipitation. Uncertainties related to temperature were found to cause a greater contribution to climate change impact uncertainty than those related to precipitation for most crops and regions; in particular, the sensitivity of crop yields to temperature was a critical source of uncertainty.

2°C

If temperatures rise by more than 2°C, global food production potential is expected to contract severely and yields of major crops like maize may fall globally

According to the Intergovernmental Panel on Climate Change (IPCC), if temperatures rise by more than 2°C, global food production potential is expected to contract severely and yields of major crops may fall. The declines will be particularly pronounced in lower-latitude regions. In Africa, Asia and Latin America, for instance, yields could decline by 20-40% if no effective adaptation measures are taken. In addition, extreme weather events such as droughts and floods are becoming more frequent, causing greater crop and livestock losses (FAO, 2009e).

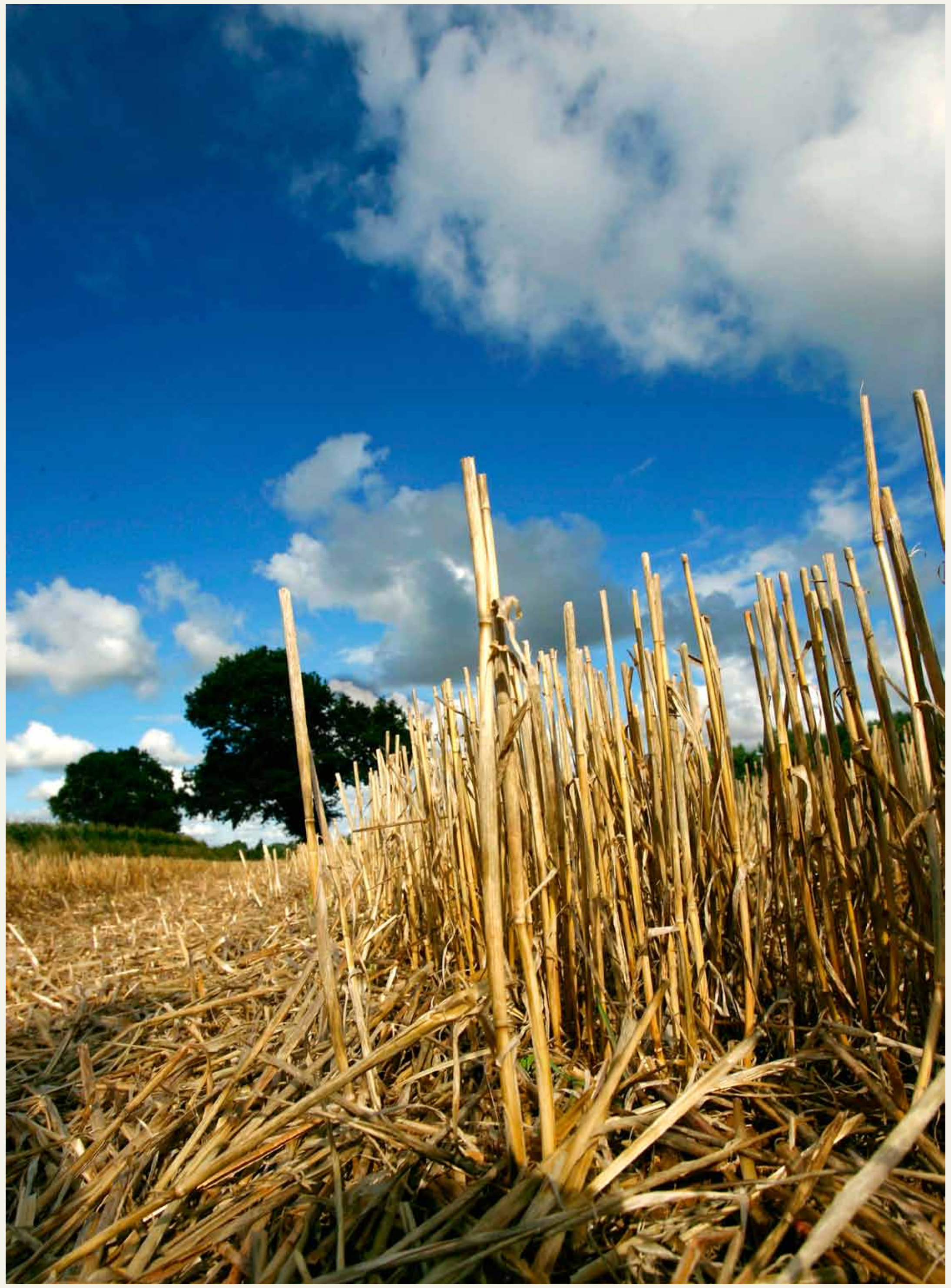
Availability of fertiliser

Agricultural yields could affected in the future by the availability of fertiliser, in particular phosphorus. The ‘peak’ in the supply of mined phosphate rock could be as soon as 2033. After this point, the non-renewable resource will be both scarce and expensive. Dwindling stocks of phosphorus could have an effect on agricultural yields and food security. The location of the remaining rock phosphorus causes additional problems, as 87% of known reserves are found in just five countries.

It is possible to reduce our dependency on phosphorus by changing the way we farm, eat and dispose of waste such as human excreta. Organic farming is one method that reduces fertiliser use, alongside other benefits, but it will not produce the high yield levels required globally for a growing population that demands a Western-style diet.

Soil erosion/loss

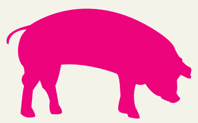
Increase in land available for agriculture is relatively low in comparison with global crop yield increases; according to the Foresight report, global crop yields grew by 115% between 1967 and 2007, with the area of land in agriculture increasing by only 8%. Soil erosion means less land is available to grow crops, and that threatens food security. The International Soil Reference and Information Centre (2009) estimates that around a quarter (24%) of vegetated land on Earth has undergone human-induced soil degradation, creating additional uncertainty for future global crop yields.



Over the last 50 years, agricultural output has kept pace with the rapid rises in global food demand. This has largely been achieved through increases in yield rather than area. But what do the next 50 years hold?

POTENTIAL OF TECHNOLOGICAL CHANGES

- Increasing input efficiencies
- Improving efficiency by breeding higher-yield and more robust plants and animals
- Using water more efficiently
- Increasing resilience to abiotic and biotic stresses.



HIGHER-YIELDING ANIMALS PRODUCE LESS POLLUTION PER UNIT OF PRODUCE

Addressing the production gaps

Addressing production gaps will require the deployment of new technologies, but also the dissemination of existing technologies so small farmers in developing countries can access them. Key areas for technological intervention to improve production output include water scarcity and post-production losses (FAO, 2009e).

Although much yield improvement has already been achieved by variety development, there is substantial scope for further technology development before theoretical limits are reached for wheat (Sylvester-Bradley and Wiseman, 2005) and maize (Edgerton, 2009). There is even greater opportunity for other crops including minor cereals such as sorghum and millets, roots and tubers such as cassava and yams, which have received less attention, and are very important for food security, particularly in sub-Saharan Africa (Government Office for Science, 2011).

The technology challenge extends beyond the agricultural sector. In developing countries there is a need for research and extension services to support the appropriate development of technologies and enable them to be disseminated where needed (FAO, 2009a).

50% AN AMBITIOUS PROGRAMME AIMS TO INCREASE YIELDS OF RICE AND WHEAT BY UP TO 50%

Increasing input-use efficiencies

Increasing input-use efficiencies in agricultural production will be essential as natural resources become scarce, with prices of non-renewable resources like fossil fuels and phosphorus expected to increase over the next decades. Conservation farming using zero tillage offers a major opportunity to reduce fuel use in agriculture by an average of 66% to 75% as well as sequestering soil carbon. Precision agriculture and integrated pest management systems provide new tools for further improving efficiency and reducing pesticide inputs (FAO, 2009e).

An increase to the area of irrigated land may be necessary to achieve yield increases in future. Technology will be required to ensure water management and use is efficient and sustainable.

FOOD WASTE

- Food waste lost across the supply chain (post-harvest losses) is the dominant form of waste in developing countries.
- Household waste dominates in industrialised countries and becomes a more prominent problem as incomes rise in developing countries.

50% REDUCTION IN POST-HARVEST LOSSES, INCLUDING CONSUMER LOSSES, IS A REALISTIC GOAL

There is significant scope for reducing supply chain losses: a 50% reduction in post-harvest losses, including consumer losses, is a realistic goal (Lundqvist et al., 2008). Food waste must be limited to reduce its environmental impact and increase the overall availability of food. Reducing waste will ease unnecessary pressure on resources by reducing overproduction (Goletti, 2003). Food waste could be used as a substitute for animal feed, although feed safety regulations create limitations.

RESULTS

The project team assessed four scenarios to determine whether they can produce a low-carbon and sustainable global food system by 2020.

Scenarios (2020)		Changed consumption pattern	Technology to maximise production	Positive environmental impact		
No	Description			GHG emissions	Water	Biodiversity
1	Continue on existing path					
2	Aspire to have organic and high animal welfare production	✓				✓
3	Improve production efficiency and reduce meat and dairy consumption	✓	✓	✓		
4	Take account of environmental impacts which may not decrease greenhouse gas emissions	✓	✓	✓	✓	✓

Table 1:
Summary of scenarios

The four scenarios are described, and then used to analyse how the world food system may change by 2020 and 2030. Changes by 2020 are then used to predict changes in diet by 2020.

Summaries of the scenarios

SCENARIO 1

Continue on existing path

This is based on business as usual in Western countries and a shift in developing countries towards a Western-style diet, high in fat and non-extrinsic milk sugars and low in fish, fruit and vegetables. The dual impact of consuming more food and shifting towards a Western-style diet creates health problems but also results in a large increase in greenhouse gas emissions from the need to produce a larger number of calories per individual for an increased world population, and from increased consumption of high-impact foods. The scenario includes an increase in meat and dairy consumption, both of which have high greenhouse gas emissions at production. Another negative environmental trade-off is that the increase in land required for food production will have a negative impact on biodiversity. In terms of health, an increase in average world calorie intake per person will exacerbate obesity and related illnesses such as heart disease and diabetes. **Continuing on the existing path will not deliver a low-carbon and sustainable food range.**

SCENARIO 2

Aspire to have organic and high animal welfare production

This scenario outlines a change in demand which encapsulates aspirational production systems, specifically organic and high animal welfare. Products for which demand is predicted to significantly decrease in this scenario are potatoes, milk and dairy, and meat.

The increase in organic and animal welfare standards required to meet this scenario, starting from a very low baseline, is exceedingly challenging on a world scale. Even within the EU, agreeing and implementing such regulation would be challenging.

There is no doubt we should be striving to make gains in animal welfare, to reduce our use of inputs, to manage soils better and to farm more efficiently. Scenario 2 is, however, not an effective way to achieve this because it is production led, and the necessary changes in consumption are unlikely. **Scenario 2 will not deliver a low-carbon and sustainable food range.**

SCENARIO 3

Improve production efficiency and reduce meat and diary consumption

This describes a food system which incorporates changes in production, technology and consumption.

It is the first scenario to address the need to change consumption as well as production, and uses WWF's Livewell diet as a template for a sustainable and healthy diet. From a production and carbon emissions perspective, this scenario maximises resource efficiency through adopting best production technologies. It assumes that there is no increase in farmed area, but the effect of urbanisation on farmed area is unclear. Use of technology could include genetically modified (GM) crops. In Europe, GM technology is a controversial topic but use of such technology seems to be accepted in some other parts of the world.

The main weakness of Scenario 3 is that it does not take into account the impact of food production on local water scarcity and biodiversity. **It will deliver a low-carbon food range – but not a sustainable one.**

SCENARIO 4

Take account of environmental impacts which may not decrease greenhouse gas emissions

Scenario 4 is similar to Scenario 3, but also looks at the issue of unsustainable water use and impacts on biodiversity at a local scale. This scenario could be further improved by requiring enhanced animal welfare standards.

Scenario 4 is the preferred option as it will deliver a low-carbon and sustainable food system. It minimises adverse impacts of food production on the environment at a local scale, particularly in regards to biodiversity and water. Improvement in animal welfare standards could be achieved under this scenario and should be implemented alongside the food-range guidelines that this scenario leads to.

CONCLUSION

It will be possible to feed the world sustainably in 2020, but it is going to require changes in how we produce and consume food. It is clear that business as usual will not work and will have negative environmental and health consequences. These in turn will have economic consequences as we pay for lost ecosystem services and the direct and indirect costs of poor health. Opposed to this, the aspirational scenario, though aiming at a desirable outcome, will not achieve the desired result as it is production led.

What is clear is that we need to look at production and consumption. This will be an uncomfortable conclusion for some. In the developed world we need to change what we put on our plates, and the Western diet should not be exported to the rest of the world: it's not sustainable, healthy or affordable. We should move toward a contraction and convergence model that offers a variety of foods, while respecting cultural traditions and farming methods. The sooner we make this change the easier it will be. By coupling these changes in consumption with technology and production changes, we can have a low-carbon food system that respects animal welfare, conserves biodiversity and water, and makes us healthier.

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Food security depends on conservation and sustainable use of fish resources.
Bay of Málaga, Colombia. Chocó Ecoregional Programme

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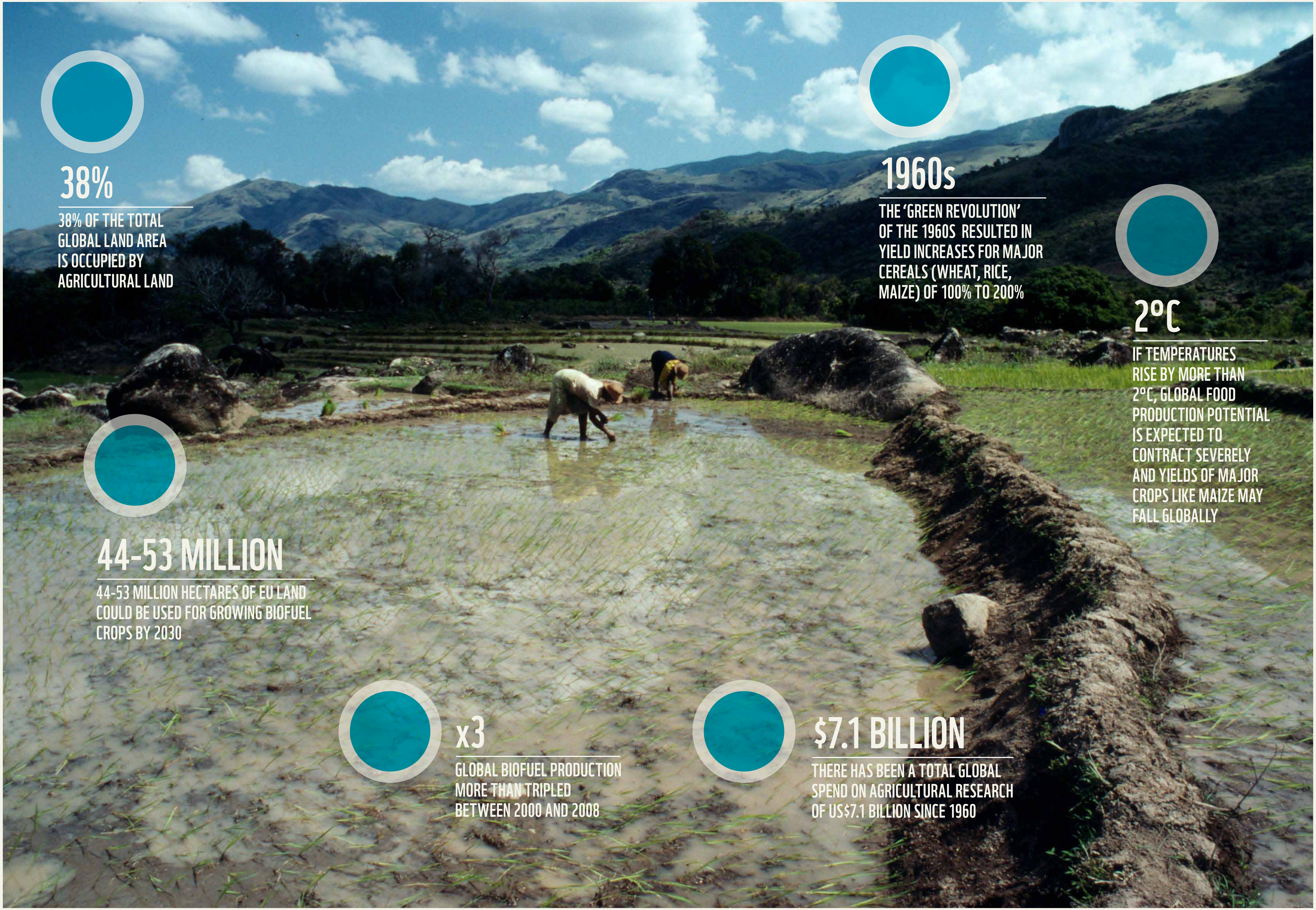

38%
38% OF THE TOTAL GLOBAL LAND AREA IS OCCUPIED BY AGRICULTURAL LAND
1960s
THE 'GREEN REVOLUTION' OF THE 1960S RESULTED IN YIELD INCREASES FOR MAJOR CEREALS (WHEAT, RICE, MAIZE) OF 100% TO 200%
2°C
IF TEMPERATURES RISE BY MORE THAN 2°C, GLOBAL FOOD PRODUCTION POTENTIAL IS EXPECTED TO CONTRACT SEVERELY AND YIELDS OF MAJOR CROPS LIKE MAIZE MAY FALL GLOBALLY
44-53 MILLION
44-53 MILLION HECTARES OF EU LAND COULD BE USED FOR GROWING BIOFUEL CROPS BY 2030
x3
GLOBAL BIOFUEL PRODUCTION MORE THAN TRIPLED BETWEEN 2000 AND 2008
$7.1 BILLION
THERE HAS BEEN A TOTAL GLOBAL SPEND ON AGRICULTURAL RESEARCH OF US$7.1 BILLION SINCE 1960

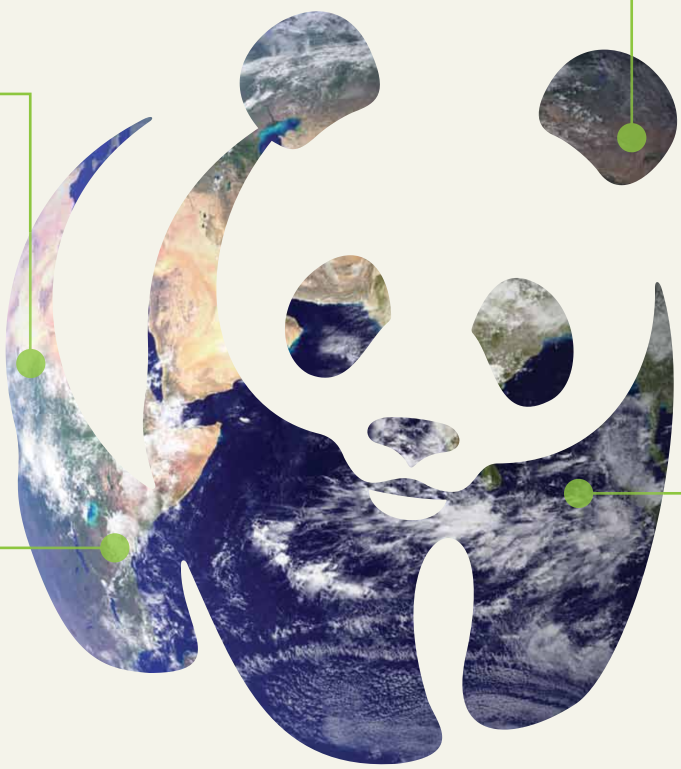
Global food in numbers

20%

Irrigated agriculture covers 20% arable land but contributes to 50% of crop production

ZERO

If we embrace a dietary shift, zero net deforestation is possible by 2020



2020

It is possible to feed the world sustainably by 2020 if we change how we produce and consume food

50%

A 50% reduction in post-harvest losses is a realistic goal

WWF

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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