DEDICATED TO MAKING A DIFFERENCE

Tackling **climate change** on the **ground**

Corporate case studies on land use and climate change

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World Business Council for
Sustainable Development

Contents

Executive summary

The World Business Council for Sustainable Development (WBCSD) recognizes the critical linkages that exist between land use and climate change (including agricultural and forestry activities). Indeed, changes in the Earth's climate system affect how our land is managed, and how our businesses operate. Over the years, the WBCSD has been the leading business voice at climate negotiations. The organization has traditionally focused on energy rather than land use and climate change, therefore this report is a first step in providing some content to these important discussions.

This document is an attempt to demonstrate how business is tackling these linkages through a series of best practice case studies from a broad range of its member companies. It is an information piece for policy-makers, business and civil society who might see value in leveraging these efforts to mitigate and adapt to climate change – indeed a number of these cases could potentially be replicated elsewhere. The publication is an online living document that will hopefully include more cases in the future.

Business can help to overcome the challenge of managing land while reducing greenhouse gas (GHG) emissions and adapting to the effects of climate change by developing innovative technologies and approaches and creating measurement and planning tools. But business is only part of the solution. It must collaborate with governments, the scientific community, civil society and others to also develop land-use practices that address climate change.

This version of the report consists of the following case-studies, categorized under three broad headings: Technology and innovation; Practices and approaches and Tools and measurement.

Technology and innovation

1. Make more sugar with less impact – Syngenta has demonstrated a cost-effective and sustainable way of making sugar from tropical sugar beet that can then be used for food or fuel production.
2. Create a product that helps reduce emissions – Dow AgroSciences has developed two products to control specific bacteria that convert nitrogen during nitrification, thereby controlling the amount of GHGs being emitted from plants.
3. Provide seed treatments for more efficient resource use – Bayer CropScience's seed treatment technology reduces fuel and water use in crop management; it saves labor time and costs, and increases the ability of healthier plants to absorb more carbon.
4. Increase efficient use of phosphate – Novozymes has developed a product that allows phosphate – an essential non-renewable nutrient for crops – to be released when the plant grows. This reduces the need for fertilizer and fuel, and increases yields.
5. Help crops adapt to changing climates – BASF has developed crops that are tolerant to unfavorable climatic conditions and at the same time have high yields.
6. Develop advanced biofuel from waste and residue – Novozymes has launched a product family of enzymes that cost-effectively break down the complex matrix of cellulose to produce second generation biofuels.

Practices and approaches

1. Conserve water and reduce methane emissions in rice paddies – PepsiCo has succeeded in reducing methane emissions as well as water use in rice cultivation in India by using direct seeding.
2. Plant more trees to compensate for emissions – Novartis has reduced its carbon footprint through afforestation in Argentina and also helped to establish a natural forest ecosystem to foster biodiversity while generating a profitable, long-term wood product business for the local community.
3. Adapt to local climatic conditions and reduce impacts – Unilever uses drip irrigation and has identified drought-tolerant tea varieties for tea production, resulting in water savings.
4. Keep soils healthy, they will store more carbon – Syngenta has led research in understanding the role soils play in tackling climate change and actively promotes conservation tillage, as well as eco-efficient water and fertilizer use.
5. Offset GHG emissions through land-use activities – Energias de Portugal (EDP) has initiated a GHG mitigation project that sows permanent pastures with biodiverse, legume-rich seed mixtures to help achieve national emission targets.
6. Explore alternative energy sources – combined heat and power – Novartis is taking measures to reduce its scope 1 emissions by shifting from fossil to renewable fuels for producing heat and electricity.
7. Join efforts to have greater impact – Kimberly-Clark is partnering with non-business stakeholders and other companies to help tackle climate change by sequestering carbon and protecting ecosystem services through sustainable forest management.

Tools and measurement

1. Assess mitigation options in a practical way – Unilever has developed a tool to assess site-specific GHG emissions and carbon-sequestration to help farmers understand what mitigation measures are feasible.
2. Use models to identify where carbon footprint is – Weyerhaeuser carried out a carbon footprint assessment to identify the areas of significant carbon sequestration and emissions in their business operation in Uruguay.
3. Insure yourself against changing climatic conditions – Sompo Japan Group's weather risk management product is a special type of crop insurance that allows for a much poorer demographic to protect itself against changing weather conditions.
4. Understand the impact of hydropower on climate change – EDF is exploring the tools required to understand the emissions and impacts of a large hydropower development and to compensate for the inevitable impacts that occur.

Through these case studies, the WBCSD endeavors to demonstrate that business is developing innovative technologies, solutions, methods and tools in different areas of agriculture and forestry to address climate change effects through mitigation (including sequestration) and adaptation.

Introduction

Changes in the Earth's climate system affect how our land is managed, and how our businesses operate.

As the population continues to grow, global demand for the essentials in life – such as energy, food, timber and water – will do so in parallel. Climate change will increase competition for these resources.

Land-use activities are a major source and sink of global emissions from human activities. Curbing deforestation and applying sustainable land-use management practices can reduce greenhouse gas (GHG) emissions, while planting trees and managing forests can help remove GHGs (mainly CO_2) from the atmosphere by sequestering them in plants and vegetation. The main challenge is to shift land use from a major global source of emissions to a major sink, through such activities as improving sequestration potentials, sustainable landscape planning and restoring degraded lands.

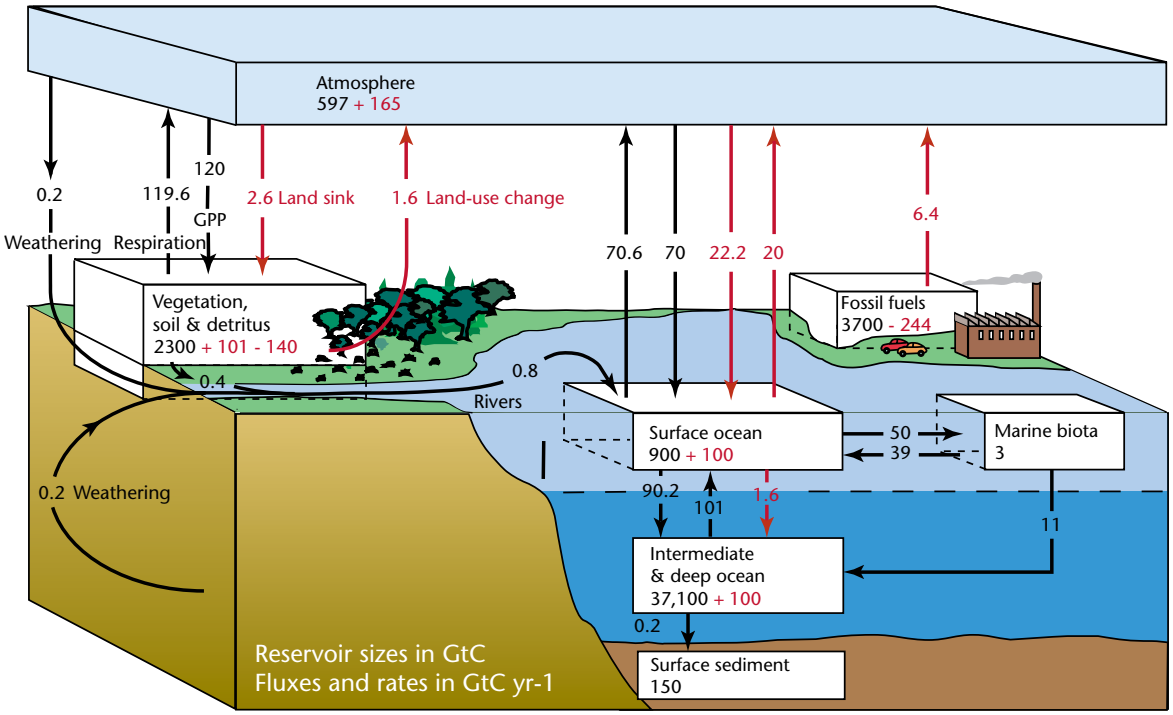
Several types of land use emit carbon dioxide, nitrous oxide and/or methane, the great majority being through conversion of forests or perennial grasslands to agriculture or settlements, or the permanent loss of above- and below-ground biomass carbon stocks. The main sources of emissions include fertilizers (both man-made and natural), agricultural soils (for example, that release nitrous oxide, N_2O, during the natural processes of nitrification and de-nitrification), livestock (methane, CH_4, is a by-product of digestion by ruminants), wetland rice cultivation (anaerobic decomposition in flooded rice fields produces methane), manure management methods, burning of savannah, conventional plowing and crop-residual management.

According to the IPCC Fourth Assessment Report, land-use change (including deforestation) is responsible for 25% of human-caused CO_2 emissions.[1]

Within the United Nations Framework Convention on Climate Change (UNFCCC), land-use activities (referenced as *Land Use, Land-Use Change and Forestry* – LULUCF) are considered a potential and relatively cost-effective mitigation option. According to Article 3.3 of the Kyoto Protocol,[2] net changes in GHG emissions by source and removal by sinks through direct human-induced LULUCF activities, limited to *afforestation, reforestation* and *deforestation occurring since* 1990, can be used to meet Parties' emissions reduction commitments. Furthermore, the coverage of LULUCF activities was extended, in Article 3.4, to include forest management, cropland management, grazing land management and revegetation.

To date, land-use activities have not been prioritized in the international climate change negotiations. This is primarily due to their potential reversibility, the temporary nature of carbon stocks and the difficulty in differentiating human-induced activities from naturally occurring ones. There is also a concern that the lower cost of mitigating emissions from land-use activities could undermine political will to take action in the energy sector.

Figure: Global carbon cycle[3]



The global carbon cycle for the 1990s (atmospheric carbon content and all cumulative fluxes since 1750 are as of end 1994) showing the annual carbon fluxes in gigatonne carbon per year (GtC yr–1) of a few major sources.

Note: GPP stands for Gross (terrestrial) Primary Production (annual).

Source: IPCC, Working group 1 report; 2007

Considering the significant amount of emissions from land-use activities and their consequent impact on climate change, the land-use sector should be given greater importance in international climate change negotiations. Farmers around the world need innovative technologies and solutions to cope with the risks of a changing, and increasingly uncertain, climate.

In addition, according to the International Food Policy Research Institute, if agricultural interests, particularly those of smallholder farmers, are not properly included in the international negotiations, resulting climate change policies could also threaten the poor.[4]

Possible impacts of climate change on land use can include changes in the growing season and the distribution of pests, which in turn affect yields. Numerous opportunities exist to maintain and increase yields through optimal management of crop calendars to avoid extreme hot periods, developing new varieties of plants that can tolerate a range of conditions, and good soil management to overcome water stress.

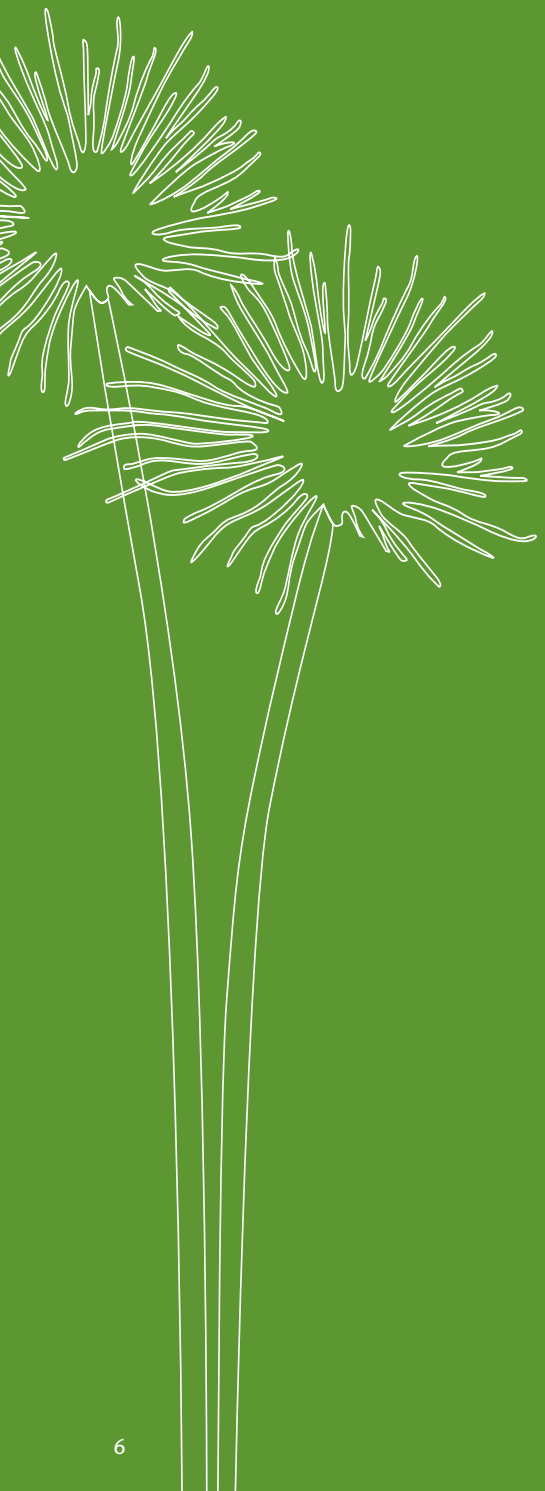
Businesses in the agricultural and forestry sectors address the challenges of land use and climate change in different ways. There is no single, globally applicable sustainable management solution for land use. The examples presented here show how some companies have improved crops or used minimum or zero tillage to sequester carbon and restored lands. Moreover, cases show how business, working with governments, farmers, civil society, academia, non-governmental organizations (NGOs) and others, provide innovative ways to mitigate land-use emissions. Some important ways to reduce emissions and increase the sequestration of GHGs include undertaking life-cycle climate impact studies and developing goals and operational plans to achieve them.

Business is only part of the solution and must work with governments, civil society and other stakeholders to develop a range of land-use approaches that address climate change.

In this report we focus on technology and innovation – where companies are developing new products and services; practices and approaches – where companies are changing their way of doing business; and tools and measurement – where companies are assessing their impacts. The current collection of case studies does not explore demand-side reductions but rather what can be done in the field.

A growing world population requires efficiently and sustainably managed land because resources are limited. There is no silver bullet for managing land, and we hope this report will stimulate discussion and further thinking.

Technology and innovation



This section provides examples of new land management products companies have developed to help tackle climate change.

Make more sugar with less impact

This case study demonstrates an alternative way of making sugar that can then be used for food or conversion into biofuel. **Syngenta** achieved this by creating a new variety of sugar beet that has a range of positive consequences.

Syngenta tackles climate change in different ways, for example by developing: seeds and crop protection products that protect and increase yields, enabling land conservation and protection of carbon sinks; herbicides that reduce the need for tillage, keeping carbon in soils; and crops that confer tolerance to drought, heat and salinity and that use nitrogen more efficiently. Syngenta also supports the development of crops that make biofuel production more efficient and sustainable.

An innovative product that Syngenta offers is the tropical sugar beet as a source of sustainable sugar and ethanol production. As it contains high levels of sucrose and can be grown in subtropical and tropical areas, the beet provides new opportunities for smallholder farmers and increases production in marginal areas where the effects of climate change are most acute. In 2008, Syngenta was awarded the World Business and Development Award for the beet's role in helping to achieve the United Nations Millennium Development Goals.

Advantages of the tropical sugar beet include:

- Wide geographic scope – The beet can be cultivated in a geographic belt between 10° and 30° latitude in the northern and southern hemispheres.
- Fast cycle – The crop's six-month growing cycle is about half as long as the one for sugar cane while producing the same amount of ethanol or sucrose, i.e., one hectare of agricultural land produces about 10 tonnes of white sugar in five to six months instead of a year.
- Less water used – The new variety uses a third to half of the water typically required to irrigate sugar cane, i.e., up to 10,000 cubic meters water per hectare saved.
- Tough conditions – The beet can be cultivated in relatively dry areas and on saline or alkaline soils unsuitable for cane or other crops.
- Quick carbon storage – The plant removes the same amount of atmospheric carbon in half the time as to sugar cane.
- Rotational crop – It is being tested as a rotation crop, which would help safeguard soil quality and reduce water consumption.
- Part of mix – It is being tested as an additive to sugar cane as input for sugar mills and ethanol processing factories. This mix would then be processed using the same machinery and methods as in pure sugar cane processing.
- Efficiency – In temperate conditions, sugar and ethanol plants can only operate two months per year, while tropical sugar beets enable plants to operate up to 330 days per year, depending on the location.

Starting in 1999, Syngenta has conducted successful trials in Brazil, Canada, China, Colombia, Egypt, India, Kenya, Mexico, Pakistan, Peru, South Africa, Sudan, Thailand, the US and Vietnam. In these projects, Syngenta not only helped create jobs, but also provided training for farmers on measures to avoid losses due to pests or diseases, applicable irrigation techniques, good farming practices, among others.

Syngenta continues to grapple with questions such as what the potential consequences are of the tropical sugar beet on the world sugar market and whether the models applied in the pilot projects are replicable and scalable. Moving forward, Syngenta will focus on developing crop rotation systems with other key crops.

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Create a product that helps reduce emissions

This case study shows how using new products on existing crops can reduce emissions. Dow AgroSciences, a wholly owned subsidiary of The **Dow Chemical Company**, developed two products that control the bacteria that convert nitrogen during nitrification, which decreases the amount of greenhouse gases (GHGs) that enter the atmosphere.

Nitrification inhibitor technology from Dow AgroSciences is helping farmers increase production and have a smaller environmental footprint.

As part of normal agricultural practices, nitrogen, an essential plant nutrient, is commonly applied to fields in the form of anhydrous ammonia, urea/ammonium nitrate (UAN), solid urea or liquid manure. Bacteria then biologically transform the ammonium into nitrate in a process called nitrification. Nitrification is the first step in the conversion of ammonium nitrogen into nitrate that can migrate through soil into groundwater or waterways, or into nitrous oxide that is then emitted into the atmosphere as a greenhouse gas. This form of nitrogen has been identified as a possible contributor to hypoxia, a condition that limits the productivity of downstream fisheries. Nitrification inhibitor technology delays nitrification, contributing to healthier, higher-yielding crops and reducing nitrogen loss. More nitrogen remains stable in plant root zones, rather than moving through the environment.

Dow AgroSciences developed two products to control the bacteria that convert nitrogen during nitrification: N-Serve® nitrogen stabilizer and Instinct™ nitrogen stabilizer. The delayed nitrification process of stabilized nitrogen with N-Serve and Instinct withstands early season moisture and decreases the amount of nitrates that can enter the atmosphere or leach into groundwater, drainage and waterways.

Dow AgroSciences also joined grower associations, environmental groups and local governments in outreach efforts to promote best practices that reduce the impact that agriculture has on surface and groundwater. For example, the Missouri Department of Agriculture and the Illinois Council on Best Management Practices led programs to increase awareness and use of nitrification inhibitors to reduce the impact that applied nitrogen fertilizers have on surface and groundwater. Dow AgroSciences is investigating opportunities to expand efforts globally as well.

These Dow AgroSciences technologies and partnerships benefit both growers and the environment:

1. For growers, increased nitrogen availability means optimized yield potential. Fields treated with nitrogen stabilizers slow the nitrification process and ensure more nitrogen is available for healthy plant development.
2. For the environment, keeping nitrogen stable and available for plant uptake reduces the chance of nitrogen loss into waterways and the atmosphere.
3. For both the growers and the environment, the use of N-Serve means that in total less manufactured fertilizers are required.

In a recent examination of peer-reviewed university studies to evaluate the value of nitrapyrin, the active ingredient in N-Serve and Instinct, the ingredient was found to: increase crop yields by 7% overall (189 studies); increase annual or season-long maintenance of inorganic nitrogen within the crop root zone by 28% (50 studies); decrease nitrogen leaching from the root zone by 16% (24 studies); and reduce greenhouse gas emissions by 51% (7 studies).

The US Environmental Protection Agency has recognized the use of nitrapyrin as an effective mitigation option for farmers to reduce nitrous oxide emissions, and N-Serve was nominated for the Agency's Presidential Green Chemistry Challenge Award, which promotes pollution prevention through partnerships with the chemical industry.

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Provide seed treatment for more efficient resource use

This case study shows how protecting individual seeds from diseases and pests during their early development stage saves fuel, water, labor time and costs and increases the ability of healthier plants to absorb more carbon. Bayer has developed seed treatments that have proven over many years that early protection pays off.

Bayer CropScience develops innovative technologies and solutions for sustainable land management approaches. A holistic approach to land and climate change management includes ecosystem health and water conservation. In the future there will be an even greater need for practical measures to mitigate greenhouse gas (GHG) emissions and to adapt to weather-based climate change effects. For Bayer CropScience, the challenge is to anticipate the potential future technology needs of farmers. Two technologies are currently in the pipeline: a) stress-tolerant plant varieties that help plants adapt to short-term abiotic stress, such as drought, salinity, heat or cold and b) nitrogen use-efficient varieties that will help mitigate one of the most potent GHGs: nitrous oxide (N_2O).

Today's healthy and more vigorous plants are already much more resilient and hence adaptable to climate change effects. They produce more biomass and store more carbon than plants whose potential remains unexploited. Worldwide the health of crops is threatened by about 25,000 pest and diseases. A success story in crop protection is found through seed treatment, which restricts product use to individual seeds and especially protects the young vulnerable plants "from within". This technology also contributes to:

- Eco-efficiency, including mitigation of GHG emissions associated with fossil fuel savings from tractor operations
- Higher biomass production (carbon storage) from healthier plants
- Water use reduction
- Labor time and cost savings
- Ecosystem benefits, as application is directly targeted towards the pests.

Seed treatment is done in specialized facilities. As the seeds carry much of their own protection for the first two to three months of their lives, up to two pesticide spray applications can be avoided. Therefore the number of tractor operations are reduced, saving 10 to 20% of total fossil fuel use per crop. At the same time about 200 liters of water, which are used on average to apply crop protection products on one hectare of land, are no longer needed. Seed treatment is also economical for farmers as it saves a lot of labor time and costs. Many large- and small-holder farmers alike prefer seed treatment as it frees up time during a busy period of the year. This gives them time to pursue other important activities, including income generating ones in other sectors.

From an ecosystem's health perspective seed treatment holds many benefits. It is a highly targeted way of applying crop protection products: instead of an area of one hectare, only less than 1% of it comes into contact with the product. The treatment only controls insects and pathogens that suck sap from the plants, eat them or damage them by infestation. Hence, beneficial species that live on and around the plants are protected, an aspect that is widely considered in integrated crop management approaches. Seed treatment, when used properly, also avoids drift to adjacent plants, headlands and water bodies and consequently protects non-target species inhabiting these areas.

While some have argued that this system is preventive and thus may sometimes result in unnecessary application, clear benefits have been demonstrated as a result of plant health in terms of plant vigor and stand quality, as well as protecting non-target and beneficial species.

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Increase efficient use of phosphate

This case study shows how advances in biotechnology can reduce the impact of agriculture on the environment and conserve precious non-renewable resources. **Novozymes** has developed a product that allows phosphate – an essential non-renewable nutrient for crops – to be released in a form that is accessible to plants. This reduces the need for fertilizer and fuel, and increases yields.

Phosphate found in chemical fertilizers is a non-renewable resource from phosphate rock that is mined and processed into chemical fertilizers. The total known global usable reserves only cover the demand for fertilizers for the next 70 years. As phosphate is an essential nutrient for all crops, it is necessary to ensure prudent management of this resource in order to secure future food supply.

The phosphate need of a crop may be met in two ways: 1) applying chemical and/or organic sources of the nutrient and/or 2) drawing upon the pool of the nutrient bound in the soil from previous applications. Phosphate is an essential nutrient for plant growth and as such is important to maximizing a field's yield potential. Phosphate is often present in large amounts in the soil, but in a form that is unavailable to the plant. Even when phosphate fertilizer is applied at the time of planting, it can quickly bind with calcium, magnesium and iron minerals in the soil, resulting in its being inaccessible to the crop.

Novozymes has developed a product known as JumpStart® that is applied as a treatment to the seed prior to planting or with the seed at planting. The active component in JumpStart® is a naturally occurring soil fungus – *Penicillium bilaii.* As the seeds germinate and develop a root system, the JumpStart® fungus and the plant form a mutually beneficial relationship. The fungus grows and multiplies along the crop roots, thriving on root discharges and releasing organic acids into the soil. These acids break the bonds holding the phosphate nutrient in a mineral form, releasing the phosphate into a form the plant can access. The result is enhanced phosphate uptake, allowing the crop to achieve its yield potential.

The JumpStart® technology is currently used in the agriculture sector in Canada and the US on a variety of plants including canola, chickpea, lentil, mustard, soybean and wheat. Results from 338 farmer-conducted field trials show that JumpStart® gives an average 6% higher yield.

In addition to average crop yield increases, a preliminary life cycle assessment documenting the full impact of the product from "cradle to grave" has shown that the environmental benefits of JumpStart® are positive. These include:

- Reduced manufacturing and use of fertilizer
- Fossil fuel savings
- Higher yield and consequently less use of land.

Novozymes is currently conducting a full assessment to further document these effects.

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Help crops adapt to changing climates

This case study demonstrates how it is possible to help crops support changing climates. **BASF** has developed crops that are tolerant to unfavorable conditions and have high yields at the same time.

BASF has joined forces with Monsanto to develop crops that help stabilize agricultural yields in a changing climate.

Climate change is likely to have a negative impact on agricultural yield. Recent studies warn of declining crop yields and global food shortages as a result. The number and duration of dry spells, especially in already drought-prone areas, is expected to increase. Plant biotechnology offers solutions that allow farmers to adapt their agricultural techniques to such shifting climates.

Drought-tolerant corn technology is part of BASF and Monsanto´s research and development in plant biotechnology, which is aimed at developing higher yielding crops and crops more tolerant to unfavorable environmental conditions. The most advanced product of the companies' pipeline is a drought-tolerant corn, which will be the first biotechnology-derived drought-tolerant crop in the world.

The companies' scientists are turning to nature to find mechanisms involved in stress responses. Subsequently, genes responsible for these mechanisms are transferred to staple crops. One such discovery is a naturally occurring gene, the cspB gene from *Bacillus subtilis*, which helps corn plants combat dry conditions and confers yield stability during periods of inadequate water supplies. By mitigating the impact of drought on the plant, cspB helps provide yield stability.

Improved yield stability is of significant value to farmers faced with unpredictable rainfall. In any given year, around 4-5 million hectares of corn-planted farmland in the United States may be affected by at least moderate drought. In field trials conducted last year in the western Great Plains, drought-tolerant corn met or exceeded the 6-10% percent target yield enhancement in some key drought-prone areas, where average yields range from 170 to 320 bushels per hectare. The product is targeted for market launch as early as 2012 pending regulatory approvals.

The first-generation product is part of a multi-generational family of biotech drought-tolerant products that is expected to be brought to market in the next decade. BASF plans to continue working with Monsanto to bolster the joint pipeline with other genes for drought tolerance as well as other abiotic stress tolerance traits, which gives confidence that the two companies can live up to their commitment of delivering successive generations of evermore drought-tolerant crops.

In addition, BASF supports the Water Efficient Maize for Africa (WEMA) partnership with the aim of providing royalty free new drought-tolerant maize varieties for small-scale African farmers.

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Develop advanced biofuel from waste and residues

This case study demonstrates how industrial biotechnology can reduce the climate impacts of the transport sector while securing energy and food security. **Novozymes** has developed a product family of enzymes – known as Cellic® – that breaks down the complex matrix of cellulose contained in a wide variety of biomass to produce cellulosic ethanol.

Second generation biofuels, produced from waste and residues from agriculture, are an important means for preventing the increasing emission of greenhouse gases from the transportation sector, without affecting food security.

Globally, the transport sector is one of the major sources of rising greenhouse gas emissions and the fastest growing CO_2 emitter. In addition, it is almost 100% based on liquid fossil fuels. Bioethanol and other liquid biofuels are the only currently available fuel options that can reduce the dependency on fossil diesel and gasoline, and thereby reduce greenhouse gas emissions. Studies indicate that with advanced biofuels as a major contributor, 25% of the global consumption of gasoline can be replaced by 2030.[5&6]

Until now, bio-ethanol (1st generation) has been produced from starch or sugar-based raw materials, such as maize, wheat and sugar beet, which can also be used as food or feed. Second generation advanced biofuel production can come from agricultural waste such as straw, corn stover or bagasse from sugarcane production, as well as wood waste or municipal solid waste. Advanced biofuels from these sources are expected to produce 90% less greenhouse gas emissions than gasoline. According to WWF the rapid adoption of second generation biofuels and their substitution of about 20% of fuels worldwide has the potential to deliver about 1 billion tonnes of emissions reductions by 2030.[7]

Key to making commercial scale production of 2nd generation advanced biofuels possible is the development of advanced enzyme systems that cost-effectively degrade the cellulosic material that is subsequently fermented by microorganisms into biofuel.

Novozymes has launched a product family of enzymes known as Cellic® that are remarkably efficient at breaking down the complex matrix of cellulose contained in a wide variety of biomass substrates. Application among a range of leading second generation advanced biofuel producers has shown that these enzymes give the best performance/cost ratio seen to date. Novozymes will reach commercial-scale production of Cellic® in 2010 to meet the need of demonstration-scale production plants being planned and built around the globe.

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Practices and approaches

This section provides examples of how companies have changed their land management practices to help tackle climate change.

Conserve water and reduce methane emissions in rice paddies

This case study highlights the opportunities to mitigate and adapt to climate change by using a technique called direct seeding. **PepsiCo**, by engaging community farmers in India, has succeeded in growing a staple food crop, reducing methane emissions and conserving water, and is exploring ways to earn carbon credits as a result.

PepsiCo has made a public commitment to sustainable agriculture, as noted in their Sustainable Agriculture Policy posted on their corporate website. India grows about 130 million tonnes of paddy over about 44 million hectares and is among the largest rice growers in the world. Traditionally in India, paddy is cultivated by sowing seeds in a small nursery, where the seeds germinate into saplings. The saplings are then transferred manually into the main field and then grown with 4-5 inches (10-12.7 cm) of water at the base of the crop for the first 6-8 weeks, mainly to prevent weed growth. In addition to being water intensive, this standing water, in climates of elevated temperatures with organic substrate, can also serve as perfect vectors for disease transmission.

The direct seeding of rice, however, avoids three basic operations: puddling (a process where soil is compacted to reduce water seepage), transplanting and standing water, thereby saving about 1 million liters of water per acre (2.5 million liters per hectare) or 30% of that needed for traditional rice seeding methods.

In 2004, PepsiCo India started trials with the direct seeding of rice in its R&D fields. Once these trials proved successful, the company took direct seeding to farmer fields using a PepsiCo-developed direct seeding machine. PepsiCo has used direct seeding on more than 2,430 hectares this year, conserving over 5 billion liters of water.

Paddy cultivation with traditional flooded irrigation is one of the main sources of methane emissions in the country. The presence of biomass immersed in water over an extended period leads to an estimated 4.5 million tonnes of methane being emitted from the paddy crop in India annually. However, because using direct seeding requires no water at the base of the crop, methane emissions are reduced.

PepsiCo is partnering with the Indian Agricultural Research Institute (IARI) to carry out field experiments to study the impact of conventional puddled transplanted rice and direct seeding on greenhouse gas emissions and the global warming potential of irrigated rice ecosystems. A report issued by IARI indicates a 75% reduction in Global Warming Potential, via the mitigation of methane emissions.

PepsiCo is proposing to work with the United Nations Framework Convention on Climate Change (UNFCCC) to have direct seeding of paddy included as an approved means to earn carbon credits. As land holdings in India are fragmented, once the UNFCCC approvals are received, PepsiCo will look at consolidating carbon credits for all direct seeded fields and pass these on to individual farmers after recovering its own costs.

PepsiCo India has been working with farmers for almost twenty years. The company's policy of testing a new technology thoroughly and expanding the farmer base gradually gives farmers confidence in the credibility and robustness of this approach. Direct seeding of rice requires a totally different system of sowing the seeds as well as irrigating the fields. The farmers accepted the new technology readily in view of successful field trials conducted over the previous years.

This program has helped PepsiCo India become a positive water balance company and illustrates a tangible example of how climate-adaptive measures in agriculture can also promote food and water security.

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Plant more trees to compensate for emissions

This case study highlights how carbon offsets through afforestation can be used to voluntarily compensate for part of a company's greenhouse gas emissions (GHGs). **Novartis** has reduced its carbon footprint while helping to establish a natural forest ecosystem and to foster biodiversity while generating a profitable, long-term wood product business for the local community.

Novartis has made a voluntary commitment in the frame of the Kyoto Protocol to reduce net direct global greenhouse gas emissions by 5% below 1990 levels from 2008 to 2012. This amounts to almost 30% less than today.

GHG emissions from Novartis industrial activities (direct emissions excluding emissions from the vehicle fleet) increased from 1990 to 2009, from 308 to 404 kilotonnes, but have slightly decreased since 2005. Thanks to effective energy-efficiency and climate programs in place in its own operations (see case study page 19), Novartis may be able to further decrease its GHG emissions by about 1% per year until 2012, despite the expected growth of the business.

In order to fill the remaining gap in achieving the Kyoto target, Novartis has purchased land to grow a company-owned forest in the province of Corrientes in northeastern Argentina, a country that has already established bodies for Clean Development Mechanism (CDM) projects. Known as the Santo Domingo project, this afforestation project sequesters CO_2 and helps Novartis compensate for part of its GHG emissions from its facilities worldwide.

Afforestation started in 2007 and will be completed by the end of 2009. It will cover 2,350 hectares, or 70% of the overall land purchased. Planting started with non-native pine (75% in the first years) and selected native species. There will be a shift to more native species and higher-value afforestation and within 10 to 15 years, the percentage of native species will reach 75%.

In March 2008, the project received Forest Stewardship Council certification, a quality label on the sustainable (environmental and social) aspects of the forest's management. Novartis will seek to maintain this certification in the future. Novartis has contracted Grupo Manejo Forestal (GMF), a local forest company, to manage the project. GMF's activities are measured against targets and objectives, which include the rate of planting, the number of trees planted, the percentage of native species, the level of carbon sequestered and, ultimately, the profitability of the operation.

Novartis will seek certification of the majority of the CO_2 sequestered as Certified Emission Reduction Units (CERs) by national and international CDM bodies. The carbon sequestration is expected to amount to 125,000 tonnes of CO_2 equivalent between 2007 and 2012 and up to 3 million tonnes by 2040.

The project is also generating local employment during the planting phase (4 to 5 years) and will do so later as well, with forestry activities (thinning, maintenance, forest enrichments) and logging and wood product manufacture.

The project has also led to infrastructural improvements in the area, including the construction of new, and the rehabilitation of existing, buildings on the farm; the development of passageways for forest management and maintenance across the premises; the improvement of water management (flow paths and bridges); and the establishment of fire fighting requirements and participation in the regional fire protection organization.

The Santo Domingo project is a long-term engagement, and sequestration will last for 35 to 40 years before the forest reaches maturity. A sustainable wood product business will become profitable only after a number of years, but will continue indefinitely, as all cut stems will be replaced and forests naturally rejuvenate.

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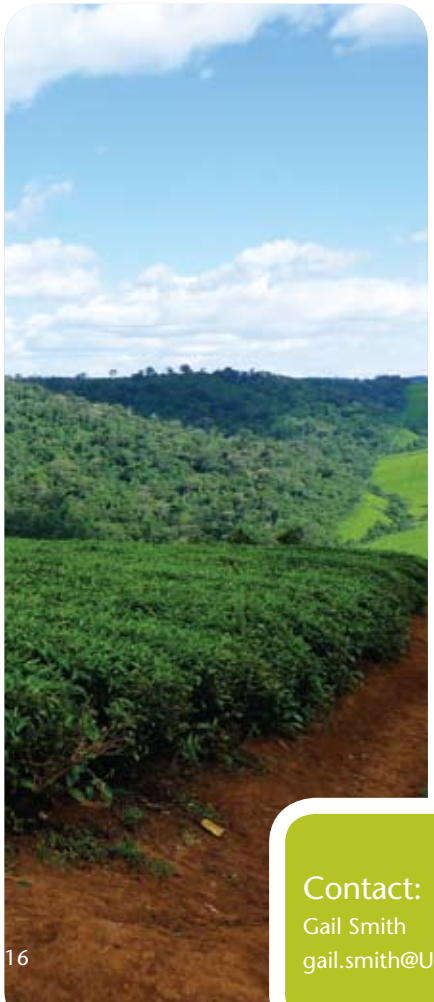
Adapt to local climatic conditions and reduce impacts

This case study demonstrates a multi-pronged approach to climate change. **Unilever** uses drip irrigation and has identified drought-tolerant tea varieties for tea production, resulting in water savings. The company has also planted thousands of trees and has reduced fuel use in its boilers.



Unilever Tea-growing farms in East Africa (UTEA) recognized over 20 years ago that deforestation around Lake Victoria and the Mau Forest in Kenya and in the Eastern Arc mountains of Tanzania was a threat to business. Rainfall patterns are highly dependent on local water cycles, in which the forests play an important role. With the shrinking of forests, rainfall patterns have changed and dry seasons have become longer and more frequent.

In Tanzania, where a 6-month long dry season means that economic sustainability is only achievable by irrigating the tea, Unilever has focused its attention on conserving the high biodiversity value forest within its own concessions and in the surrounding area, and on improving irrigation efficiency.

The company set up rainwater harvesting and storage systems in small valleys on the farm and hosted irrigation trials, managed by local and international researchers. By doing so, the business was among the first to understand and use the research findings on cost-effective and water-efficient irrigation for tea. The company is still working with researchers to improve techniques. Where the terrain is suitable, recent trials have shown that drip irrigation (rather than sprinkler) can save 70 liters of water per kilogram of tea harvested.

In Kenya, UTEA has a program to identify and breed drought-tolerant tea varieties and rootstocks. It invests € 156,000 (US$ 230,000) annually in the program and has recently released two new tea varieties for commercial planting that are comparatively drought tolerant. These will be used throughout the East African business.

Prompted by reduced and poorly distributed rainfall in the tea gardens and the surrounding area (and linking this to the apparent deforestation), the Kenyan business initiated a tree planting project in the year 2000 – Trees2000 – that includes all management and staff. As of June 2009, over 700,000 indigenous trees had been planted on-farm and in the surrounding community. Every year, the company propagates over 100,000 seedlings. Each employee plants at least two trees annually and company visitors are expected to plant at least one tree. The on-farm survival rate for the trees is well over 90%. The scheme has now spread to other Kenyan tea farms, including those of smallholders and outgrowers for the plantation companies, and to the Tanzanian business (where 150,000 indigenous trees will have been planted by 2010).

All the boilers used for drying tea in UTEA factories are wood-fired, and the company – apart from improving forestry and wood-management techniques – has improved boiler efficiency through new, economical installations in order to reduce fuel use and associated greenhouse gas emissions.

The business is therefore not only doing its best to adapt to climate change, but also to reduce its own impacts. Although the motives for the tree-planting program were originally linked to changing local rainfall patterns (and biodiversity value), as awareness of the role of greenhouse gases in worldwide climate change has grown, the company also recognizes the role this program plays in increasing long-term carbon storage. In East African countries heavily burdened by poverty, continued large-scale deforestation and increasing problems of water availability, Unilever Tea companies are helping reduce the problems and adapting to a more uncertain future.

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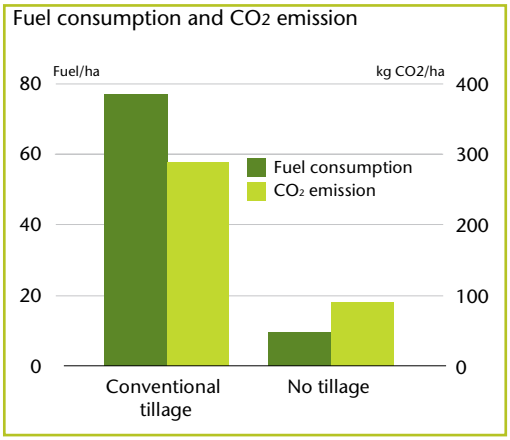
Keep soils healthy, they will store more carbon

This case study explains how conservation tillage benefits soil biodiversity, improves water quality and sequesters CO_2. **Syngenta** has led research in understanding the role soils play in tackling climate change and actively promotes the adaptation of these methods by farmers.

Conservation agriculture is an approach to growing crops that strives to achieve high and sustainable productivity, quality and economic viability, while also protecting the environment. Protecting soil and water are at the heart of this approach. It is based on enhancing natural, biological processes above and below the soil surface. Soil tillage should be reduced to a minimum, and agrochemicals and fertilizers must be applied at optimal rates. Conservation agriculture is based on three interlinked principles that need to be adapted to particular cropping systems:



- Minimum mechanical soil disturbance – for example, conservation, minimal or no tillage
- Permanent soil cover – for example, keeping a vegetative cover over the soil in the absence of a crop has an important role in protecting the soil and enhancing its properties
- Diversified crop rotations – for example, appropriate crop sequences reduce the impact of weeds, pests and diseases.

The fact that tillage is reduced means that:

1. Soils can sequester carbon to counter-balance greenhouse gas emissions. Carbon dioxide fluxes from soils are directly related to the volume of soil disturbed. The ability of soils to sequester carbon presents farmers with additional business opportunities to enter carbon trading schemes. For example, in 2005, according to the Saskatchewan Soil Conservation Association, Canadian no-till farmers could earn almost € 10 per hectare (about US$ 15) to help offset Canada's greenhouse gas emissions.
2. Fuel consumption is significantly reduced.

Recognizing the importance of conservation agriculture, Syngenta was a founder of SOWAP (the Soil and Water Protection project, www.sowap.org), which represents a collaborative attempt by industry, NGOs, academic institutions and farmers to address the environmental, economic and social concerns arising from the practice of conventional agriculture and cultivations.

SOWAP has shown that by reducing soil disturbance and covering the soil with crop residue, conservation tillage can dramatically reduce soil erosion. Conservation tillage benefits above- and below-ground biodiversity, improves water quality and sequesters CO_2. SOWAP's results are based on a 3-year evaluation of a variety of arable crops on different soil types.

Conservation tillage is not widely practiced in Europe. 2005 estimates from the European Conservation Agriculture Federation put adoption rates at only 15% across Europe with an estimated 7% in Belgium, 11% in Hungary, but at 46% in the UK. It is clear that the decision made by farmers to adopt conservation tillage is dependent on the complex interaction between the practice's agronomic, environmental, economic and social costs and benefits. Syngenta will continue to explore future opportunities to tackle climate change through conservation agriculture.

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Offset GHG emissions through land-use activities

This case study shows how companies can help achieve national greenhouse gas (GHG) emissions targets in an environmentally friendly and cost-effective way. **Energias de Portugal** (EDP) has initiated a GHG mitigation project that sows permanent pastures with biodiverse, legume-rich seed mixtures.

Portugal is one of the few countries to choose all of the voluntary agriculture and forestry related activities under Article 3.4 of the Kyoto Protocol, namely forest, cropland and grassland management. This project was designed to demonstrate the potential of such activities in the national greenhouse gas inventory. It was implemented in multiple locations in Portugal, covering more than 1,500 ha: Quinta da França (Covilhã), Herdade das Cruzetinhas (Chamusca), Herdade da Machoqueira do Grou (Chamusca), Companhia das Lezírias (Benavente), Herdade do Azinhal (Grândola), Herdade da Asseiceira (Benavente), Herdade Terra das Freiras and Herdade Lage de Cima (Montemor-o-Novo).

Alongside afforestation, forest management and the agricultural practice of no-tillage, this project also consisted of the installation and management of Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL). SBPPRL is the centerpiece of this project as it is a Portuguese innovation. This land-use system not only sequesters carbon, but also increases soil fertility, reduces erosion, minimizes impacts on the water cycle, reduces fertilizer use and increases yield. Even though Portugal is still the only country using this kind of pasture over a significant area, there is great potential for this system to be replicated in other areas with Mediterranean characteristics.

With this project, EDP contributes to the visibility of these types of pastures, which have yet to be thoroughly studied. In fact, due to the success of the project, the Portuguese government has already decided to support the implementation of new SBPPRL areas throughout the country in order to help it further comply with its Kyoto Protocol target.

Only farms with a history of good environmental and economically viable practices are included in the project. This ensures that forests, no-tillage practices and SBPPRL will be maintained long after the project ends, thus keeping the carbon pool in the soils. The largest forest area in the project is oak forest, which has a long time span before harvesting. This is particularly important as data capture obtained for scientific purposes may continue in the future in order to obtain a longer time series and a deeper knowledge of carbon dynamics in these systems. So far, the data gathered has been used in models and methodologies for the Portuguese inventory.

EDP voluntarily supported this project to demonstrate the sequestration potential of agriculture and forestry-related activities. As a result, these activities are now important for Portugal to decrease its own CO_2 deficit. As an electricity utility, EDP views this as an opportunity to reduce its emissions in a cost-effective way.

The project resulted in the sequestration of 3.69 kilotonnes of CO_2 equivalent in 2006, 7.56 kilotonnes in 2007 and 11.03 kilotonnes in 2008. This project will continue until 2012 to guarantee the maintenance of the CO_2 sequestered in soils. EDP will also use these sequestration results for initiatives covered by the voluntary CO_2 market.

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Explore alternative energy sources: combined heat and power

This case study shows how greenhouse gas (GHG) emissions can be reduced by changing the sources of energy used. **Novartis** is taking measures to reduce its scope 1 emissions by shifting from fossil to renewable fuels for producing heat and electricity.

In a drive toward environmental sustainability, Novartis is focusing, among other things, on reducing its Scope 1 GHG emissions by switching from fossil to renewable fuels. Two Novartis centers, PharmOps in Wehr (Germany) and Sandoz operations in Mahad (India) for Active Pharmaceutical Ingredients, are using locally procured, renewable fuels instead of fossil fuels.

At Novartis PharmOps, Wehr, a US$ 2.2 million investment allowed the operation to switch the steam generation from natural gas to wood chips. The project has a payback time of 4 years with a substantial decrease in CO_2 emissions. An abundant supply of wood from the nearby forests provides continuous and easy access to the required energy. The system became operational in December 2008 and has proven its efficiency for over almost a full year now.

Wood is carbon neutral and the new heating plant reduces the Scope 1 GHG emissions of the site by 3,400 tonnes annually. The old gas-burning furnace still serves as a back-up heating system, reducing gas demand by 75%. Wood only has to be carried over short distances because Wehr is situated in the German Black Forest region, a huge natural and sustainably managed resource for wood. Novartis PharmOps Wehr will use 8,000 m^3 of wood per year, representing only 0.2% of the available resource. A long-term contractual arrangement with a local company guarantees continuous wood supply at a competitive and stable price. Nevertheless, the challenge is to get wood chips of a good and stable quality, with sufficiently low humidity and salt content, and that is not too finely grained, which can easily clog filters.

Bagasse, or fiber waste from sugar cane, is another naturally grown by-product that Novartis is using as a replacement for fossil fuel. The Sandoz center for Active Pharmaceutical Ingredients (API) in Mahad (India) has been using about 5,600 tonnes of this renewable energy source annually since 2004 to replace fuel oil. Thanks to bagasse, Mahad has not only reduced its Scope 1 GHG emissions more than fivefold, but has also largely eliminated sulfur dioxide and other air emissions originating from the fuel oil. Switching to bagasse has also saved about US$ 175,000 per year.

The use of waste forestry and agricultural by-products can create new employment opportunities while reducing dependency on imported fossil fuel. Although the capital costs of wood chip heating systems are higher than those of gas-fired systems, the operating costs are lower. However, if the transportation requires more energy than the release of the burned wood, its use is definitely not recommended. Studies state that for distances of up to about 50 km, material can be transported in loose form. For longer distances, chipping or bundling is necessary before transport is competitive. Wood chips are competitive with other fuels if the transport distance is less than 100 km. These numbers strongly depend on local factors such as infrastructure and plant size.

From an environmental perspective, wood chip and agricultural by-product combustion is less polluting and less carbon intensive as these are renewable resources. The clear advantage of these energy carriers is that the CO_2 released when burned is the same as that absorbed by the tree or plants when they were growing. If energy needs for exploration and refining are small and transportation distances short, greenhouse gas impacts from these resources remain small; therefore, a company can significantly reduce its carbon footprint by installing an energy plant driven by wood or another renewable energy source.

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Join efforts to have greater impact

This case study highlights how partnering with non-business stakeholders and other companies can help tackle climate change by sequestering carbon and protecting ecosystem services. By doing so, **Kimberly-Clark** is working on achieving sustainability in forest landscapes.

In late 2007, Kimberly-Clark Corporation launched the Sustainable Production and Biodiversity Conservation in Forest Mosaics Initiative, together with Conservation International and the Instituto BioAtlântica. Joined shortly after by The Nature Conservancy and forestry companies Suzano Papel e Celulose, Aracruz Celulose and Votorantim Celulose e Papel (now jointly Fibria) – all WBCSD members – and Veracel Celulose, all these partners recognized the potential to transform the pulp and paper industry by promoting an industry-wide movement towards practices that are both environmentally beneficial and economically sound.

The unique Sustainable Forest Mosaics Initiative encompasses three different scales – local, regional, and global. Its design builds on ongoing work in one region of Brazil, while seeking to expand this successful model to the rest of the Atlantic Forest and other regions of the world where plantation forests have a large landscape footprint. Efforts to mitigate and adapt to climate change will include benefits such as carbon sequestration and protection of coastal ecosystems.

Kimberly-Clark, along with its partners, contributes to a vision of integrated landscapes, with a focus on how plantation forest areas fit into a larger "puzzle" of land uses. Kimberly-Clark has contributed US$ 500,000 overall for these projects and is committed to conservation and restoration of key areas.

Kimberly-Clark and other stakeholders work together to plan how the different land uses fit together sustainably in the forest landscape. Looking at all land uses comprehensively helps ensure that demands for food, fiber, fuel, ecosystem services and biodiversity protection are all met. By carefully planning both productive land use and conservation within the larger landscape, the mosaic strategy helps ensure optimal conservation while permitting productive activities that generate employment and income. Kimberly-Clark recognizes that plantation forests can be a key piece of sustainable forest mosaics. When well managed, plantations not only supply fiber, but may provide connectivity between fragments of native forest, protect water courses and fragile slopes, and store carbon reserves. They also are important economic engines, creating rural employment options for local communities. These functions make plantation forests valuable "puzzle pieces" in mosaic landscapes.

The Sustainable Forest Mosaics concept Kimberly-Clark has been contributing to is perhaps most advanced in the states of Bahia and Espirito Santo in Brazil. It looks at ways to answer questions such as: which areas are most suitable for plantation forests, agriculture or mineral extraction; which places do we need to protect in order to conserve our water resources; and which areas are important for carbon storage? This specific initiative builds on previous work by the major forestry companies in the region located between the Jequitinhonha and Doce rivers in the Central Atlantic Forest Corridor (CAFC) of Southern Bahia and northern Espirito Santo states. The aim is to increase the effectiveness of biodiversity conservation efforts in plantation forest mosaics within the CAFC. The project will work to integrate planning and implementation of land-use and conservation activities by the three large pulp and paper companies in the area, support the incorporation of conservation elements into outgrower schemes, and facilitate the creation and management of private reserves.

This project has already achieved significant results:

- Creation or improvement of more than 8,000 hectares of set-asides and new private conservation reserves
- Restoration of 600 hectares of land owned by forestry companies, creating strategic forest corridors, with the engagement of local communities
- Incorporation of sustainability criteria into outgrower contracts and provision of technical assistance on compliance.

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Tools and measurement

This section provides examples of how companies are developing tools to measure their impact on climate change in order to help decision-making.

Assess mitigation options in a practical way

This case study shows why **Unilever** saw value in building a tool to help assess what GHG mitigation options exist in the farming practice.

Agriculture is a major contributor to climate change. It accounts for 13.5% of mankind's greenhouse gas (GHG) emissions – as much as transportation.

Globally, there is increasing understanding that agriculture has a key role in combating climate change. But agriculture will only be able to play this role if we start working with farmers, at field level, and help them reduce their impact.

Reducing GHGs on-farm is not straightforward, though: some practices that reduce GHGs carry a cost, risk or environmental trade-off. Often soil type, climate and input intensity are factors that determine if a certain practice reduces GHGs emissions or not and by how much. For example, minimum tillage may reduce the GHG balance of farming under some circumstances, while it can actually increase emissions under a different set of conditions.

So if farmers want to identify the most effective, financially viable and practicable mitigation measures, they will need specific advice, tailored to their individual farm.

Unilever has a long track record of reducing GHG emissions from manufacturing sites – 39% between 1995 and 2008 – and has committed to further reductions. However, life cycle assessments show that agricultural raw materials contribute around half of the life cycle emissions of Unilever food products, even if this varies from product to product. For example, life cycle GHG shares of raw materials range from <20% in Lipton to 75% in ketchup. So the company needs to work with farmers if it wants to substantially reduce the climate impact of its products.

Unilever's long-standing Sustainable Agriculture Programme has been working with farmers for over ten years, giving the company the credibility and experience to work on GHG reductions with them.

As a practical step, Unilever has developed a GHG calculator (see www.growingforthefuture.com) to assess site-specific GHG emissions and carbon-sequestration on farm. The company is also working with the Sustainable Food Laboratory (www.sustainablefoodlab.org) and a consortium of other industry, NGO and academic partners on developing a consultancy protocol that uses this GHG calculator to help farmers identify the best mitigation options on their farm.

The aim of this work is to build understanding of what mitigation measures are feasible in farming practices. It will help Unilever understand the barriers to mitigation measures that are desirable, but not considered practicable by farmers. Identifying such barriers will give government and business valuable insights into creating the political and market conditions that are needed to leverage the full potential for agricultural GHG reductions. It will also help Unilever get a realistic understanding of the mitigation potential in farming, and how the company and its farmers can all play a part in realizing this potential.

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Use models to identify where carbon footprint is

This case study explores the value of carrying out a carbon footprint assessment. For **Weyerhaeuser**, this exercise highlighted areas of significant carbon sequestration and emissions, which helped to inform sound sustainable business decisions and to better communicate on these issues.

Weyerhaeuser owns or leases 142,000 hectares in Uruguay, of which 60,000 hectares have already been afforested. Weyerhaeuser recently constructed a new plywood mill that is supplied with wood from these and other plantations.

Weyerhaeuser beta tested the Forest Industry Carbon Assessment Tool (FICAT), developed by the National Council for Air and Stream Improvement (NCASI) for the International Finance Corporation, to characterize the full carbon and greenhouse gas impacts of the new mill, the forestry activities and its products. FICAT is available to the public at www.FICATModel.org.

The carbon footprint assessment enabled the company to highlight areas of significant carbon sequestration and emissions, which helps inform sound sustainable business decisions and communicates with customers and stakeholders the inherent advantages of a solid wood production process in a carbon-constrained world. The industry can work on improving this climate benefit by increasing efficiency across all levels of the manufacturing and distribution process.

Weyerhaeuser relied heavily on the FICAT model. The model is divided into 10 elements: land-based carbon, carbon in products, manufacturing emissions, emissions from forestry operations, upstream emissions, emissions associated with purchased electricity, transportation-related emissions, emissions from product use, emissions from end-of-life and avoided emissions.

In early 2009, Weyerhaeuser ran the model internally to gauge the overall impact of one metric tonne of plywood from their facility in Uruguay.

In total, over a 50-year period, the additions to stocks of carbon stored in forests and forest products are expected to offset more than five times the value chain emissions associated with forest practices, manufacturing, transportation, upstream activities and end-of-life.

- Direct emissions (Scope 1 emissions) and emissions associated with electricity purchases (Scope 2 emissions) are a very small part of the footprint.
- The mill's Scope 1 and Scope 2 emissions are far smaller than the annualized removals of CO_2 from the atmosphere associated with the company's establishing plantations on degraded grassland.
- The most important element of the mill's emissions footprint is methane from landfills at end-of-life, which are out of the mill's direct control.
- The mill's direct emissions and electricity consumption are both below the FICAT defaults for plywood and these emissions are a very small part of the overall footprint, suggesting little opportunity for improvement within the mill. The primary options for improving the footprint that are at least in part within the mill's control include working with transport providers to find ways to reduce these emissions and establishing more plantations on low-carbon lands, if this is consistent with other financial, social and environmental goals.
- There are significant uncertainties associated with estimates of the most important emission source in the value chain, for example, end-of-life of products. Efforts to improve the accuracy of the overall footprint might reasonably focus on this element.

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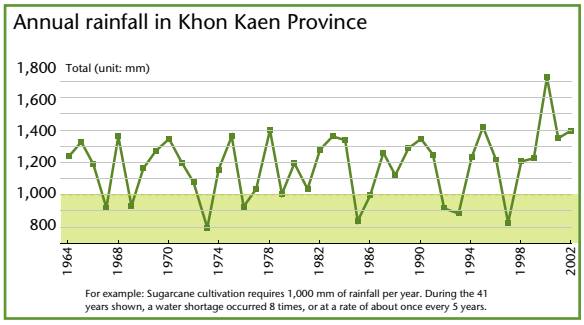
SOMPO JAPAN

Insure yourself against changing climatic conditions

This case study shows a new need by farmers: weather insurance. **Sompo Japan** Group's weather risk management product is an index that allows for a much poorer demographic to protect itself against changing weather conditions.

In recent years, natural disasters such as typhoons, hurricanes, floods and droughts have caused vast amounts of damage all over the world, and these disasters are occurring more frequently today as a result of climate change. Adaptation measures require urgent attention, particularly in developing countries. This requires financial resources to employ adaptation measures, which suggests that private funding via market mechanisms could play a role, in addition to each nation's public funding.



Source: Khon Kaen Province Meteorological Weather Station

Sompo Japan has been jointly studying risk finance schemes that use insurance with Sompo Japan Risk Management (SJRM) and the Japan Bank for International Cooperation (JBIC). Sompo Japan launched a pilot project showing the possibility of using weather index insurance as an effective tool in developing countries. Since 2008, Sompo Japan has been working to develop a product based on this joint study.

Weather index insurance is a financial product that pays out a pre-stipulated amount if certain conditions are met against indexes for temperature, wind speed, precipitation, snow depth or other weather-related indices. This leads to immediate compensation for the loss of profit or expenses, keeping the insured from seeing decreased revenues.

The main target is the agricultural sector in south-east Asia, where weather-related risk is difficult for local farmers to handle. Sompo Japan is especially focusing on farmers in northeast Thailand who rely on rainfall due to a shortage of water resources. As a consequence, harvests can fluctuate greatly depending on weather conditions.

The development of weather index insurance requires highly reliable, long-term meteorological data, and Khon Kaen Province in Thailand has relatively precise meteorological weather stations compared to the rest of the northeast region. Accordingly, this area has been set as the target for product development.

Thai farmers are often unfamiliar with insurance and struggle to pay back loans taken for agricultural equipment, etc. In response, Sompo Japan decided to develop a new scheme to sell an insurance product with loans from Thailand's Bank for Agriculture and Agricultural Cooperatives (BAAC).

The pilot project is ongoing. A simulation for full-scale product introduction started in May 2009, and Sompo Japan is preparing to launch the product in 2010. BAAC expects the project to succeed, as it has been valuable for the government in supporting farmers. Sompo Japan believes its know-how and product development capabilities can be used to help stabilize Thailand's agriculture and economy and aims to widen the use of such private sector risk financing methods for adaptation to climate change in developing countries in Asia.

Private sector risk financing methods have been regarded as an effective adaptation measure due to their mobility and flexibility compared to public funding. However, to ensure the capacity to cover the risk, efficient risk transference to capital markets is needed. Sompo Japan Group will continue to work on helping tackle climate change by developing such tools.

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Understand the impact of hydropower on climate change

This case study explores how **EDF** developed tools for a large hydropower development, which not only help the company understand and adapt its practices to reduce its impacts, but also compensate for the inevitable impacts that occur.

Hydropower is a major renewable energy contributor and was responsible for 89% of the world's renewable electricity production in 2007. Hydro schemes, which are almost always CO_2-free and CH_4-free, except in some particular reservoirs in tropical zones, can limit the impacts of power generation on climate change.

The 1,070 megawatt Nam Theun 2 hydro scheme in Lao PDR, developed by Electricité de France (EDF) as the lead investor (35% shareholder) and head contractor, is under construction and will be commissioned in December 2009.

Understanding the GHG emissions from a reservoir is complex. EDF and the Nam Theun 2 Power Company (NTPC) implemented a € 2.5 million comprehensive monitoring program that aimed to understand the processes responsible for the production and emission of greenhouse gases (GHGs) from the reservoir in order to calculate its net GHG footprint. This would be done by assessing the organic carbon stocks, the evolution of water quality and hydrobiology and the GHG emissions of the reservoir. This qualitative and quantitative assessment will include a reservoir surface ranging from 450 to 80 km^2 between the maximum and minimum water level.

EDF is also developing a 3D-model (with hydrodynamic and biogeochemical data) under the supervision of the Dutch DELTARES Institute to simulate and optimize reservoir management in order to minimize GHG emissions during operation of the scheme.

To date, key elements to consider have included:

- Emissions occur from biomass decay (i.e., decomposition of leaves, branches, trees, etc. in the reservoir), in particular in the first few years after the reservoir is filled.
- Understanding the existing emissions before the reservoir is built is important to calculate net emissions – in this case, natural emissions of CH_4 in the area before reservoir filling is 6,590 tonnes/year (mainly emitted from swamps).
- Comparing emissions with those of alternative power sources can be helpful too. The project estimates savings of some 300 to 500 million tonnes of GHG emissions, compared to those of a combined cycle gas-fired power plant of equivalent size over a generation period of 100 years.

Such a significant hydropower project has both environmental and social impacts. EDF is compensating for these in a number of ways. Those related to climate change are highlighted below.

- EDF – through the NTPC – has contributed US$ 1 million per year during the construction and concession period (31 years) for the protection of the nearby Nam Theun National Biodiversity Conservation Area, which was set up by the Lao PDR government in 1993, along with 19 other areas. Lack of funds means the 4,000 km^2 forested watershed has not been properly protected and therefore unsustainable harvesting of forest products, deforestation and poaching of wildlife have occurred. EDF helped compensate for its GHG emissions by maintaining and enhancing forest-carbon stocks, and avoiding further deforestation. The forest in the protected area is estimated to sequester between 100 and 150 tonnes of carbon per hectare, or between 40 and 60 million tonnes of carbon.
- By protecting the forest, EDF also helps reduce soil erosion and subsequent sediment build-up in the reservoir, which reduces its efficiency but also frees up soil carbon, thereby increasing GHG emissions.

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Next steps

Land-use change (including deforestation) is a major source and sink of GHG emissions. It accounts for approximately 25% of human-caused CO_2 emissions. With increasing populations and changing life styles in developing countries, these emissions are likely to rise further. The WBCSD has realized the importance of the situation, and through this e-document, wants to demonstrate how some businesses are addressing climate change-related challenges, such as mitigation (sequestration) and adaptation in land management through innovative technologies and approaches, as well as through eco-efficient and cost-effective solutions.

There are still significant knowledge gaps in understanding the ways and means to tackle land-use based emissions and adapting to climate change effects. Business is demonstrating and deploying sustainable technologies, approaches, methods and tools to mitigate and adapt to climate change; however it needs enabling governmental frameworks to support their effective dissemination. The WBCSD, as a leading business voice on sustainability, hopes to contribute to effectively bridging the gap between policy-makers and business on these issues. To do so means identifying key policy challenges that companies are facing. This could then help identify what enabling regulatory frameworks would look like.

This is a “living” e-document, meaning we will continue to discuss its contents and add more case studies as they become available. We hope this report stimulates discussion and further innovative thinking. We welcome comments, suggestions and corrections at vats@wbcsd.org.

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About WBCSD

The World Business Council for Sustainable Development (WBCSD) brings together some 200 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress.

Our members are drawn from more than 36 countries and 22 major industrial sectors. We also benefit from a global network of 60 national and regional business councils and partner organizations.

Our mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our objectives include:

Business Leadership – to be a leading business advocate on sustainable development;

Policy Development – to help develop policies that create framework conditions for the business contribution to sustainable development;

The Business Case – to develop and promote the business case for sustainable development;

Best Practice – to demonstrate the business contribution to sustainable development and share best practices among members;

Global Outreach – to contribute to a sustainable future for developing nations and nations in transition.

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