










AgBalance™
A clearer view of
agricultural sustainability

 **BASF**
The Chemical Company

Contents

Page 3		Editorial
Page 5		Section 1: Seeing the big picture
Page 7		Section 2: Viewing it from all angles
Page 11		Section 3: Focusing on the details
Page 17		Section 4: Looking to the future
Page 20		AgBalance FAQs
Page 22		About BASF / Contacts

Dear Reader,

Acting sustainably in agriculture is a prerequisite for protecting the future of global food production and farming.

Despite widespread consensus on the need for more sustainable agriculture, debate continues on what exactly that entails. BASF is convinced that it can only be achieved by considering economic, ecological and social requirements collectively.

For this reason, BASF has developed AgBalance: a holistic method for assessing sustainability in agriculture and identifying key drivers for improvement. AgBalance brings new perspectives and allows a more fact-based dialogue by:

- Capturing a 360 degree view of the sometimes competing indicators that drive social, ecological and economic considerations
- Zooming in on the drivers and hot spots impacting sustainability in agriculture
- Focussing on the complex dependencies between different sustainability indicators
- Scanning the horizon, and guiding us towards the future of sustainable agriculture

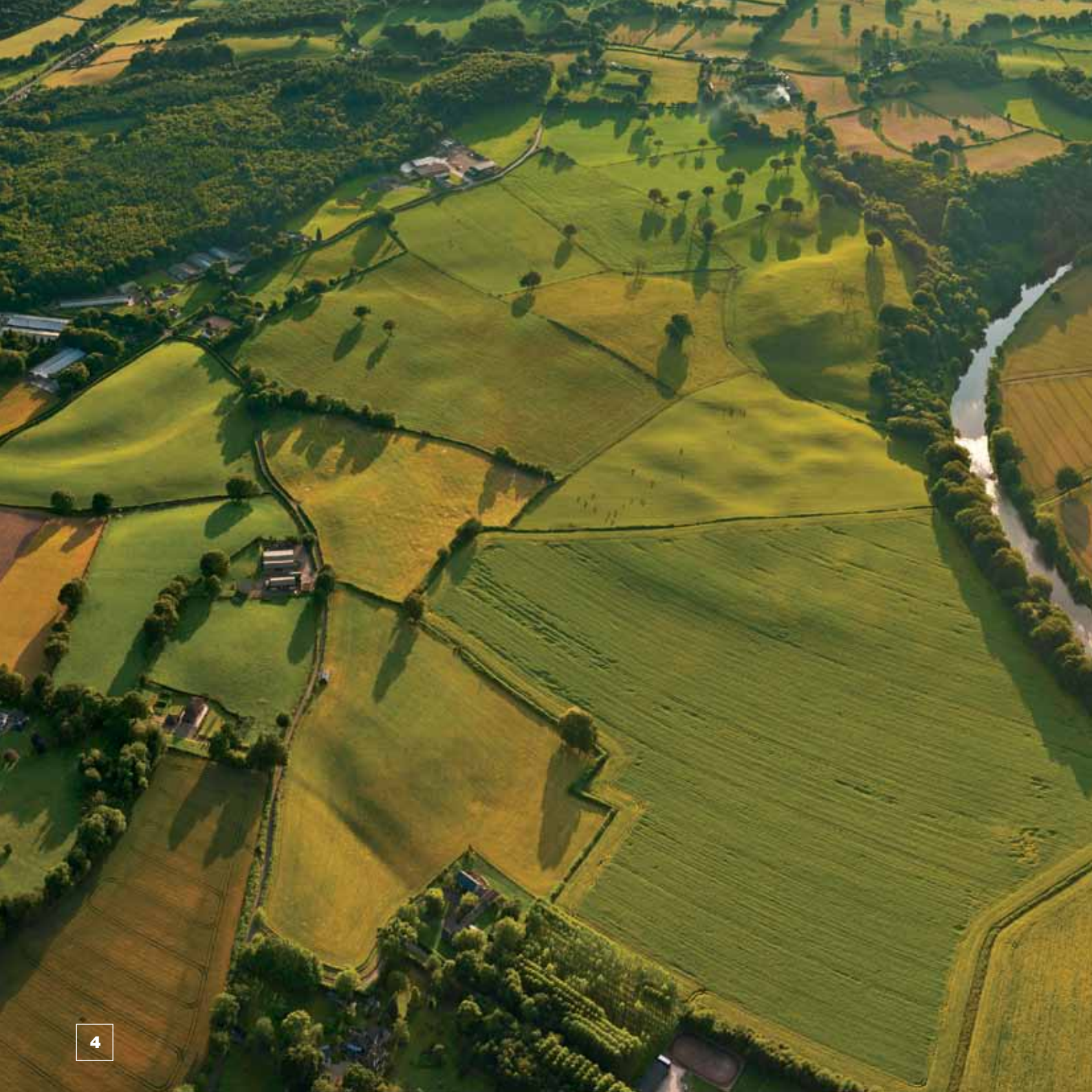
As a global provider of agricultural solutions, we at BASF want to support farmers operating in a highly complex and challenging world. AgBalance will help us to make continuous improvements to sustainable products and practices for farming.

We very much welcome your thoughts and suggestions on AgBalance and the future of sustainable agriculture.

Best wishes,



Dr. Stefan Marcinowski
Member of the Board of Executive Directors,
BASF SE





1

Seeing the big picture

Looking at something from a new angle allows us to challenge existing and sometimes limited perspectives. Just as aerial photography enables a new perspective on the landscape, sustainability in agriculture needs to be looked at differently in order to see all interrelationships and aspects.

AgBalance is an assessment methodology that BASF has specifically designed to analyze sustainability in agriculture and the food value chain from a range of perspectives. It takes into account ecological, economic and social sustainability criteria to help build a broader and more realistic understanding of the facts.

AgBalance provides a detailed evaluation of the benefits and impacts of agricultural innovations, practices and policies - for example, by analyzing the impact of different weed control systems, or different technologies addressing water scarcity.

This methodology does not impose limitations on either the geographical scope or breadth of processes being analyzed. This means that AgBalance can be flexibly applied to a focused evaluation of, for example, a particular technology or the broad assessment of the product lifecycle from the field to the consumer.

Therefore, AgBalance offers farmers, the food industry, retailers, politicians and society the opportunity to objectively assess products, processes and farming systems. This enables continuous improvements to the sustainability of food production and supports a transparent dialogue on agriculture.





2

Viewing it from all angles

Depending on where you stand in a landscape, a view or feature can look different or even be obscured. Similarly, depending on where you are in the food value chain, aspects of farming and food production can be evaluated differently.

A topic as essential, emotional and complex as sustainable agriculture needs to be viewed from all angles to understand the priorities of each different stakeholder. For example, society prefers farmers to grow a variety of crops on the landscape, however, this might not always offer them the maximum profits. The same is true for higher agricultural wages which meet the approval of farm laborers, but impose greater costs on farms.

Each different perspective is entirely legitimate. It is understandable that depending on which part of the value chain an individual represents they will

view issues differently, and as being of either of economic, ecological or social priority. However, to progress beyond individual perspectives towards improved practices, a neutral assessment is required that promotes dialogue and builds common acceptance.

AgBalance takes into account inter-linkages and possible trade-offs between different issues. By unveiling them and making them transparent, sensible solutions are made possible that enable all parties to connect their wishes to the common ground of agricultural sustainability.

Along the food value chain, stakeholders view sustainability with different interests and needs.

AgBalance enables all stakeholders to test their views against the common ground of sustainable agriculture.



Agricultural input providers such as BASF want to increase knowledge about sustainable agriculture and contribute to a fact-based dialogue. The industry uses new insights on sustainable agriculture as guidance for R&D, in order to develop new, innovative and sustainable solutions for their customers.

Farmers want to optimize farm processes, either by directly analyzing their farm or by considering the results and conclusions from other studies. Acting sustainably enables farmers to be better prepared for upcoming challenges in addition to meeting consumer demand.



Editorial



Seeing the
big picture



Viewing it
from all angles



Focusing
on the details



Looking to
the future



FAQs



About BASF



Processors view sustainability from the perspective of improving their own production process, and increasing the basis for fact-based dialogue with suppliers and retailers.

Retailers need to address consumer needs transparently. Properly assessing their operations enables businesses to provide credible information on the sustainability of their products and practices, as well as driving improvements.

Consumers and society want more sustainable food production and the identification and spread of best practice.





3

Focusing on the details

To ensure a holistic view, we explore agriculture from all perspectives. As well as making sure that we see the big picture, it is important to zoom in on small details that can have a huge impact on agricultural sustainability – like tiny organisms affecting soil fertility, or damaging fungi spores endangering crop yields.

AgBalance draws inspiration from previous BASF tools for assessing sustainability, Eco-Efficiency Analysis and SEEBALANCE® that have been successfully applied in over 450 studies during the past 15 years.

With the integration of an expanded range of agriculture specific sustainability indicators, AgBalance can conduct full life cycle analysis and evaluate sustainable practices along the entire food value chain. BASF scientists worked in collaboration with experts from academia, non-governmental organizations, government and consumer groups in the EU, USA and Brazil to identify, select and weight each indicator.

Over 200 evaluation criteria are required in order to build the 69 sustainability indicators on which AgBalance is based. This level of detail is needed to underpin the methodology and validity of the assessment it generates; helping to provide credible insight into the sustainability of products and processes used in agriculture and the food value chain.

Following its development, global expert agencies - the TÜV SÜD, DNV Business Assurance and the NSF International - have also reviewed AgBalance and given it their independent assurance.



How AgBalance works:

AgBalance is a methodology that assesses the sustainability of agricultural products and processes. It achieves this through a three step process:

Data collection

Agronomists, biologists, soil experts, social scientists, economists and modellers (amongst others) cooperatively define the scope and boundaries of the agricultural practice or process to be assessed. Using data from scientific, expert or governmental sources (e.g. the International Union for Conservation of Nature’s (IUCN) bird indicator or FAO statistics), together with field studies, 69 sustainability indicators are calculated.



Editorial



Seeing the big picture



Viewing it from all angles



Focusing on the details



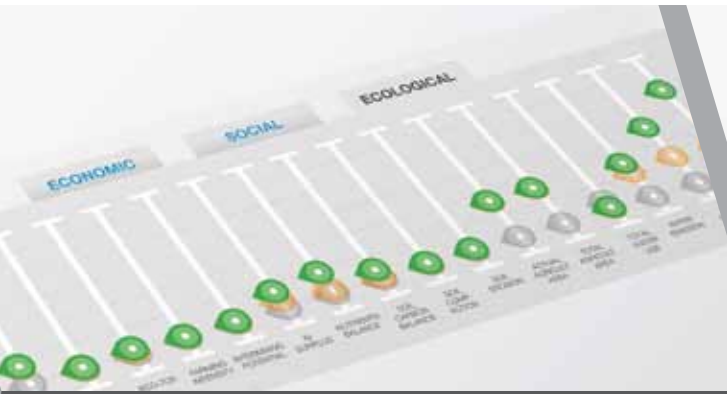
Looking to the future



FAQs



About BASF



Calculation

The gathered data is put into several algorithms to quantify results for 16 indicator categories from the 69 separate indicators. It then consolidates these into economic, ecological and social sustainability profiles. In order to ensure the accuracy and validity of this methodology a broad range of stakeholder groups have participated in the development and weighting of these criteria. This included undertaking direct research via representative consumer surveys in several countries such as Germany, France, UK and the USA.

Results

AgBalance produces a range of results that compare the relative sustainability of the alternative production methods, processes or systems being analyzed. To ensure the transparency and precision of the assessment, four separate layers of results are generated that:

- Provide absolute figures (e.g. megajoule of energy, litres of water) or scores (e.g. biodiversity score) for each of the 69 sustainability indicators
- Calculate results for the 16 indicator categories of economic, ecological and social sustainability
- Assess the economic, ecological and social contribution to the overall sustainability of each alternative
- Benchmark the sustainability of each alternative against other practices.

Overview of indicators

Ecology

BIODIVERSITY	SOIL	LAND USE	WATER USE	ENERGY CONSUMPTION	RESOURCE CONSUMPTION	EMISSIONS	ECO-TOXICITY POTENTIAL
<ul style="list-style-type: none"> State indicator Agri-environmental schemes Protected areas Crop rotation Eco-toxicity Farming intensity Intermixing potential N-surplus 	<ul style="list-style-type: none"> Nutrients balance Soil carbon balance Soil compaction Soil erosion 	<ul style="list-style-type: none"> Actual agricultural area Assessed total area, prechain 	<ul style="list-style-type: none"> Assessed total water use 	<ul style="list-style-type: none"> Non-renewable energy Renewable energy 	<ul style="list-style-type: none"> Abiotic resource depletion 	<ul style="list-style-type: none"> Air emissions Greenhouse gases Acidification potential Ozone depletion potential Photochemical oxidation creation potential Water emissions Solid waste 	<ul style="list-style-type: none"> Assessed eco-toxicity potential

Society

FARMER AND ENTREPRENEURS	CONSUMER	LOCAL & NATIONAL COMMUNITY	FUTURE GENERATIONS	INTERNATIONAL COMMUNITY
<ul style="list-style-type: none"> Risk potential Toxicity potential Wages Wages and salaries in the prechain and downstream chain Professional training Association membership Strikes and lockouts within value chain 	<ul style="list-style-type: none"> Residues in food & feed Presence of unauthorized/unlabelled GMOs Toxicity potential Functional product characteristics Other risks 	<ul style="list-style-type: none"> Access to land Employment Gender equality Integration Qualified employees Employees Part time workers Family support 	<ul style="list-style-type: none"> Trainees Social security Research & development (company expenditure) Capital investments 	<ul style="list-style-type: none"> Imports from developing countries Fair trade Foreign direct investment Child labor

Economy

FIXED COSTS	VARIABLE COSTS	MACRO ECONOMY
<ul style="list-style-type: none"> Labor Deprecations Maintainance / general repair Insurances Investment Other fixed costs 	<ul style="list-style-type: none"> Soil preparation Seeding Crop protection Fertilization Machinery 	<ul style="list-style-type: none"> Farm profits Subsidies Productivity, gross value of production Wider economic effects

■ ■ ■ Indicator category
■ Indicator



Examples



◀ Soil

Soil is the basis for food production today and in the future. Indicators such as nutrient balance or levels of organic matter affect the growth of plants and the conditions for organisms in the soil.

Water ▶

The efficient use of water – e.g. with drip irrigation – is critical, especially when water is a scarce resource. Water use is measured and assessed along the whole life cycle of products and processes.



◀ Future generations

The 'Trainees' indicator relates to the development of farming's next generation and considers their educational requirements. It shows whether future generations are considered in a manner that ensures the future development of the sector.

Consumer ▶

Consumers expect their food to be safe and meet legal requirements. Thus exceeding maximum residue limits of crop protection products or poisonous fungi on crops would result in a negative sustainability score.



◀ Fixed costs

Farm costs such as rents, labor costs and the maintenance and repair costs of technical equipment are substantial in agriculture and can make smaller scale agriculture challenging, as it does not usually benefit from economies of scale.

Macro economy ▶

There is almost no other business that faces such a volatile macro-economic situation: e.g. farm profit, a key indicator, depends on global commodity prices. High farm profits result in a high sustainability score since it is a prerequisite for economic viability.







4

Looking to the future

The earth's population is expected to grow from 7 billion people today to 9 billion by 2050. Additionally, the increasing production of biofuels and changing dietary habits, such as the predicted 60% increase in meat consumed in China by 2050 are already resulting in higher demand for agricultural production.

Given the limits on the amount of land available for agricultural production, the challenge will be to increase productivity with available farmland resources; a problem most keenly felt in South America, where expansion of agricultural production needs to be limited in order to protect unique natural habitats such as the Amazonian rain forest.

In addition, the impacts of climate change, including changing weather patterns and environments require farmers to adapt to new growing conditions, agricultural practices and crops. This can have positive as well as negative effects, in extreme cases changes to rainfall levels are causing flooding and desertification. Climate change is also promoting the spread of new plant pests and diseases into unprepared territories.

On a regional level, agriculture also faces separate and unique sustainability challenges in each continent. For example, especially in Europe and North America consumers expect affordability while demanding higher ethical standards for food production (e.g. animal welfare, product traceability, fair conditions for workers, and protection of landscape, biodiversity and environment), therefore challenging the economic viability of farming.

In Africa and parts of South-East Asia, limited infrastructure, education and access to the latest technologies poses major constraints for food production, while the practice of 'land grabbing' (the purchase of prime agricultural land by companies and sovereign states) can impact the social sustainability of the local populations.




AgBalance can help to identify solutions to all these local, regional and global challenges by taking a multiple perspective view of agriculture, the food value chain and their sustainability:



In the **United States**, corn production is one of the pillars of agriculture. How can corn production systems be improved to make them more sustainable in water scarce regions?

In **areas and crops with high risk of erosion** reducing or avoiding tillage can have very positive effects on soil, but can increase weed pressure. How and to what extent can tillage be reduced sustainably?

In **Brazil**, sugarcane production plays an important economic role. How could production become more sustainable, especially with regard to social aspects?



In **Europe**, farmers are increasingly expected to contribute to the protection of biodiversity. A variety of so-called agro-environmental measures are in place all over the EU. What are the drivers for impacting and enhancing biodiversity in agriculture, and what are most practicable and effective measures?

The **EU Directive** on renewable energy sets out sustainability criteria for biofuels (e.g. with regard to greenhouse gas emission savings). What are the most efficient solutions to come to a reduction of greenhouse gas emissions in the production of oilseed rape for biofuels?

In **Asia**, there are regions with little land availability, combined with intensive agricultural use of the remaining land. What crops and crop rotations are the most sustainable under these conditions?

In **developing countries**, the use of technologies to increase yields provides huge opportunities, but needs to be checked for practicability. Which fertilization system can be used most sustainably in these areas to increase productivity?

AgBalance FAQs

■ Who can request an AgBalance assessment?

In principle, AgBalance can be used by anybody interested, but it is expected to be of particular value to businesses in the agriculture and food value chain, as well as policy makers and educational and research institutes. Prerequisite is that the quality of data is sufficient.

■ Is AgBalance used globally or locally?

AgBalance is a method that can be applied globally. However it provides regional or local assessments, using largely regional or local data. Clearly, the database in one country might differ from others. An AgBalance analysis can only be done if the quality of data is sufficient. To meet regional conditions best, important factors that are not already covered by the indicators will be

addressed through a separate evaluation called a hotspot analysis.

■ What's unique about AgBalance?

AgBalance is a holistic method, assessing all the sustainability dimensions (economical, ecological and social). AgBalance assessments are based on a huge data set, gathered during BASF's 15-years of experience with Eco-Efficiency Analysis. AgBalance includes 69 agriculture-specific indicators such as land use, crop rotation and nutrient balance of soil. On the one hand, it can show results in a quantitative, detailed manner. On the other hand, it aggregates all the individual elements of information into a single result, showing the most sustainable option in relative terms. AgBalance can assess all steps of the agricultural production chain.

■ Will you publish all studies?

AgBalance studies will be published provided that the study partners agree to it. There will be studies on internal processes of enterprises that contain business confidential data and thus cannot be published. However, we will publish as many studies as possible in order to share findings and results with a broader community interested in sustainable agriculture.

■ Will these studies be peer-reviewed?

Yes, all studies that are published will be peer-reviewed beforehand.

■ Is AgBalance the only methodology to measure progress in sustainable agriculture?

No, there are a number of established methodologies, each with a different focus, that can measure progress in sustainable agriculture. AgBalance is an expert system from BASF, unique in the scope, depth and breadth of its analysis. It is complementary to other measurement methodologies in sustainable agriculture.

■ What external partners have you worked with?

BASF consulted a wide number of stakeholders with farming and agro-science backgrounds to ensure the incorporation of a profound and global understanding of sustainable farming in the AgBalance tool. Deep consultation has also been undertaken with ADAS, the UK's largest independent provider of environmental consultancy, rural development services and policy advice. To ascertain the functionality and coherence of AgBalance, BASF submitted it to global expert agencies such as TÜV SÜD, DNV Business Assurance and the NSF International and has received their independent assurance.



More details on the assurance can be found at:
www.agbalance.agro.basf.com



Editorial



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About BASF

About BASF

BASF is the world's leading chemical company. It offers intelligent system solutions and sophisticated products to most industries, with agriculture being a key pillar of our current and future business.

For BASF, sustainability means combining long-term business success with environmental protection and social responsibility. The company defines sustainable agriculture as achieving more yield on existing land using less water and energy, while ensuring the profitability of farming, caring for the environment and meeting the expectations of the society and future generations.

The business of BASF depends on understanding the needs of farming and providing solutions that are grounded in the realities of agriculture. Making

this tool available to other interested parties gives BASF the opportunity to analyze sustainability in all parts of the agricultural and food value chain, and to develop solutions to best improve it. By integrating the result of the AgBalance analysis into its research and development processes, BASF hopes to lead development of the new technologies and services that will support the future of sustainable agriculture.

AgBalance draws inspiration from previous BASF research tools, Eco-Efficiency Analysis (1996) and SEEBALANCE® (2005) that have been successfully applied in over 450 studies during the past 15 years. With the integration of an expanded range of indicators, AgBalance can conduct full life cycle analysis and evaluate sustainable practices along the entire food value chain.

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Order Number: AP 1/1 2011 e



Published by:
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