

Grow Sustainably™



Title:

Unilever's Contribution to Sustainable Agriculture

Authors:

Garry West, Corporate Affairs Consultant, Unilever Australasia (Presenter)
28 Kite Street, Orange NSW 2800 AUSTRALIA
Ph: 02 63625646, Fx: 02 63627522, Mb: 0418 215 059
Email: garry.west@unilever.com

Jamie McMaster, Consultant, Outsourced Environmental
PO Box 169, THE BASIN, VIC 3154 AUSTRALIA
Ph: 03 9761 0204, Fx: 03 9761 0024, Mb: 0407 317 288
Email: jamie.mcmaster@outsourcedenvironmental.com.au

ABSTRACT:

Since the mid-1990s Unilever has been consulting with experts and engaging with suppliers, customers, consumers and business partners to find a sustainable way forward for agriculture.

As one of the largest consumer goods companies in the world it is highly dependent on agricultural raw materials, such as tea, vegetables and vegetable oils, and therefore on the future of agriculture.

Unilever has experienced a growing interest and willingness to participate in finding ways to make agriculture more sustainable. Ultimately the company wants the market to work for sustainable development and to encourage fully sustainable agricultural systems.

In January 2000 Unilever Australasia & Horticulture Australia began a joint initiative for the Australian processing tomato industry.

Working closely with tomato farming families spread across Northern Victoria and Southern NSW, with input from a range of government agencies, the initiative sought to:

- find ways to monitor environmental sustainability at a farm level,
- develop a farm-based management system to satisfy sustainability and food safety standards and farm safety considerations and,
- implement a change-management process to farm more sustainably.

A wide range of indicators that describe the environment were monitored on tomato farms over tomato growing seasons. 3-seasons of monitoring and subsequent project work have shown that there are ways for growers to improve environmental management and increase their profits at the same time.

An outcome of the Australian Project has been the development of the Grow Sustainably™ farm management system. Grow Sustainably™ brings together the key learning's from recent monitoring and best management practices while integrating food safety, farm safety and environmental management considerations into one simple management tool. This paper provides an overview of the Unilever global sustainable agriculture initiative and the Australian Grow Sustainably™ program.

INTRODUCTION

Unilever & Sustainable Agriculture

As industry has developed so has our impact on natural landscapes and ecosystems. Land clearing and the use of our natural resources for agricultural development have resulted in side effects such as the reduction of natural habitats and biodiversity and increases in ground water salinity.

On a global scale food production has dramatically increased since the 1960's, but as yields and productivity has risen, so has the reliance on high inputs of synthetic fertilizer, pesticides, water and energy.

Food consumers today are very aware and concerned about the environmental impacts associated with production methods used to grow their food. Consumers are now asking questions about the destruction of natural habitats, the effects of agricultural chemicals on wildlife and the wider environment, the sustainable use of fertilizers and the potential impact big companies have on the environment. These concerns are echoed in a global debate about sustainable agriculture.

Figure 1: Unilever's Share of Key Crops



This debate has led the company Unilever to embark on a unique global initiative, to better understand the impact of their activities upon the environment.

Agriculture provides more than two thirds of the raw materials for Unilever's branded goods (Figure 1), making them one of the world's largest consumers of

agricultural raw materials. Unilever is one of the world's largest producers of tomato based sauces and pastes.

Since the mid-1990's, they have been consulting with experts and engaging with suppliers, customers, consumers and business partners from around the world to find a sustainable way forward for agriculture.

The Unilever business has operations in more than 90 countries spanning every continent, with products sold in over 150 countries. The principle food and beverage brands include: Flora, Lipton, Bertolli Five Brothers, Continental and Hellmans just to name a few.

As a business, Unilever has for sometime recognised the need to understand the environmental impacts of their supply chain and to assist their suppliers reduce and better manage their impacts, thereby ensuring a sustainable future for all stakeholders.

In consultation with leading experts, suppliers, customers and other stakeholders around the world, it became clear that sustainable agriculture must support land management practises that maintain or improve;

- agricultural productivity and economic viability,
- the natural resource base and,

- the impact agriculture has on other ecosystems.

In consultation with advisors, four principles have been established to guide the search for more sustainable farming systems. These include:

- Producing crops with high yield and nutritional qualities to meet existing and future needs, while at the same time keeping resource inputs as low as possible;
- Secondly to ensure that adverse effects of our supply on soil fertility, water, air quality and biodiversity from agricultural activities are minimised;
- Thirdly, to optimise the use of renewable resources whilst at the same time minimising the use of non-renewable resources;
- And finally to enable our local communities to protect and improve their well-being and their environment.

Unilever's growth in the future will require a sustainable supply of agricultural produce, in which they are capable of supplying present needs without jeopardising the long term sustainability of their business.

Origins of the initiative: The Motivation and the Vision

In 1998, the Sustainable Agriculture Steering Group (SASG) created the Mission Statement for Sustainable Agriculture. It states that the Sustainable Agriculture Initiative is motivated by two factors. First, agriculture provides two-thirds of Unilever's raw materials, making the sustainable supply of these materials an essential element in the long-term health and prosperity of the business. Second, agriculture is under environmental pressure from a number of sources, including soil erosion, shortages of fresh water, risk of nutrient and pesticide pollution, and the lack of available land. These two factors have prompted Unilever to develop the Sustainable Agriculture Initiative.

It is Unilever's aim to promote sourcing of agricultural raw materials from sustainable supply chains on a global basis. This is an ambitious but necessary aim. Unilever is involved with agriculture on a global scale and therefore has an interest in contributing to the sustainability of global agricultural production. In this way Unilever hopes to sustain long-term access to the agricultural raw materials upon which its businesses are heavily dependent.

Ultimately, Unilever wants market mechanisms to develop that allow consumers and customers to influence the sourcing of agricultural raw materials through their buying habits. Unilever's aim is to contribute to this development and benefit from it.

Unilever has also begun work on similar initiatives for water and fisheries because of environmental pressures upon the water resources and fish stocks essential to their business.

The question Unilever faces is; *"how farming can become more productive, protect the environment, preserve natural resources and contribute to rural communities, while using fewer agrochemicals and other inputs?"* This question poses a huge challenge for all those involved in agriculture: farmers, scientists, experts, governments and businesses such as Unilever's.

THE SUSTAINABLE AGRICULTURE ROAD MAP

Many challenges lie ahead for Unilever as it pursues sustainable sourcing of agricultural raw materials. In many ways, the company is breaking new ground. There is no consensus, for example, on what sustainable agricultural practices are, or how to

recognize an agricultural operation as sustainable. Although most people agree that sustainability is a necessary pursuit, very few are certain of how it can be achieved.

Leaders in Unilever have thought long and hard about the challenges and opportunities that the Sustainable Agriculture Initiative presents. In order to achieve its goal of sourcing Unilever's key crops from sustainable agriculture, the SASG has defined an approach consisting of three general phases. Along this path, Unilever will focus on its key crops, maintain a commitment to stakeholder dialogue, and actively address the three aspects of sustainability in its agricultural operations.

Phase 1: Understand Challenges and Opportunities

Initially, the priority is to understand the implications of sustainable agriculture in the cultivation of several of Unilever's key crops. As the SASG Mission Statement promises, Unilever has proposed, discussed and agreed a set of indicators for sustainable agriculture that covers the three aspects of sustainable development: environmental protection, economic progress, and social development. Pilot Projects around the world are in place and have begun measuring and improving the performance of farm-level agricultural systems delivering Unilever key crops.

The objective of this first phase is to develop Sustainable Agriculture Standards, or best proven practices that are agreed and endorsed by a range of stakeholders. Agreeing Sustainable Agriculture Standards is necessary in order for Unilever to change its sourcing strategy in a meaningful way.

Phase 2: Influence Agricultural Supply Chains

The SASG will use the results of the Pilot Projects, either agreed Standards or best practices, to promote sustainable sourcing of Unilever's key crops. By sourcing as much as possible from sustainable agriculture, Unilever will improve the sustainability of its agricultural supply chains.

Phase 3: Contribute to Market Mechanisms

It is the SASG's position that customer and consumer influence will play a vital role in supporting sustainability in global food production. Thus, in the long-term, the SASG will contribute to developing the market mechanisms necessary to bring consumer and customer power to bear on the issue of agricultural raw material sourcing. This means that the SASG will support the necessary mechanisms to support sustainable agricultural raw material sourcing in the marketplace.

THE PILOT PROGRAMS

The sustainable agriculture initiative began in 1997, and there are now five key crops and fifteen pilot projects, worldwide, seeking ways to achieve sustainable production of raw materials.

These projects include; the Mixed Rotations pilot on Unilever's Colworth Farm, in the United Kingdom, Palm Oil in Ghana and the Ivory Coast, Peas in the United Kingdom, Spinach in Germany and Italy, Tea in India, Kenya and Tanzania and Processing Tomatoes in Australia, Brazil and California.

Program Governance

The Sustainable Agriculture Advisory Board (SAAB) provides independent advice and judgement and strengthens policy making within Unilever. Its principal objectives involve the improvement of environmental impact of primary production, safeguarding social infrastructure and well-being for stakeholders. Profit and continuity are also important aims.

Membership of the SAAB comprises individuals from research institutes in the voluntary sector and academia. Members are selected for their individual qualities, rather than to represent their organisations.

SAAB's role encompasses a number of key functions. Members advise on the overall approach of the sustainable agriculture initiative, including aspects of primary production processes, land use, chain management and consumers' interests. They advise on sustainable standards for Unilever's selected key crops, as well as how to make these standards acceptable to stakeholders.

Progress & Emerging Good News Stories

Given the pilot program activities underway across the globe a range of "Good News Stories" are beginning to emerge as pilot teams learn to measure the sustainability of their operations and activities and implement improved agricultural practices. Pilot teams are realising improvements and advancements in areas relating to renewable energy, integrated pest management (IPM), irrigation and water use efficiency, nutrient management, biodiversity conservation, waste management and community health care. Good news stories from over ten countries can be downloaded directly from the web; www.unilever.com or www.growsustainably.com.

THE SUSTAINABLE AGRICULTURE INITIATIVE (SAI)

In October 2002 the food companies Groupe Danone, Nestlé and Unilever launched the Sustainable Agriculture Initiative (SAI), a partnership to actively develop and promote sustainable agriculture. SAI is a platform created by the food industry to actively support the development of and to communicate worldwide about sustainable agriculture involving different stakeholders. SAI supports agricultural practices and agricultural production systems that preserve the future availability of current resources and enhance their efficiency. This increases agriculture's contribution to the optimal satisfaction of society's environmental, economic and social requirements.

SAI is open to all food companies who want to play an active role in sustainable agriculture. A number of international and European food companies have subsequently joined including Dole, Campina, Danisco, Ecom, Efico, Findus, Friesland Coberco Dairy Foods, Kraft, McCain Europe, McDonald's, Neumann Kaffee Gruppe, Tchibo and Volcafe.

According to SAI, sustainable agriculture is the optimum solution to provide a sustainable supply of high quality raw materials to meet the needs of consumers worldwide and at the same time conserve and possibly improve natural resources.

The objectives of the partnership are to: support development and implementation of internationally accepted principles and standards for sustainable agriculture; by sharing knowledge and expertise among all stakeholders of the food chain; support research programmes and other related local and international activities; communicate with key opinion formers to ensure alignment of best agricultural practices with agriculture policymaking as well as mainstream consumer concerns.

SAI members consider that it is vital that knowledge and experience are spread and shared broadly if the supply of efficiently and sustainably produced crops is to be guaranteed in the long term. SAI strongly encourages other companies and stakeholders to participate, including farmers and consumers' groups, non-governmental as well as inter-governmental organisations, policy makers etc.

Implementing sustainable agriculture is an on going learning process. It will take time to implement sustainable agriculture because it's a true revolution.

More information about SAI can be obtained from the web; www.saiplatform.org & www.unilever.com.

UNILEVER'S CONTRIBUTION FOR AUSTRALIA

Initial Focus on Indicators & Best Practice

The Australian tomato processing industry is one of the most efficient in the world given that tomatoes are produced in a country void of trade barriers & subsidies and in one of the world's harshest environments, often having to combat the unpredictable elements of summer rainfall events and winter drought.

Australian farmers are efficient and on a global scale they are considered by Unilever to be innovative and progressive, possessing many of the desired best management practices required for sustainable production.

A two year indicator monitoring program was initiated by Unilever & Horticulture Australia. This program partnered with five tomato growers to learn about sustainability indicators. The growers involved in this study joined Unilever Australasia and Horticulture Australia on a journey to better understand and improve farm environmental performance.

This study resolved key parameters (indicators) to measure and monitor farm environmental performance and also identified some of the management practices which positively influenced the key indicators.

The journey was initiated with a scoping study in January 2000, followed by a detailed farm environmental review of the five tomato growing properties.

The initial environmental review provided valuable insight into the nature of farm sustainability issues and also helped to select key environmental parameters for monitoring along with an appropriate overall project strategy. With the support of the Australian Greenhouse Challenge Office, the initial environmental review was expanded to a wider grower audience of fifteen tomato growers.

A theoretical and technical "platform" for Unilever's Sustainable Agriculture Project (SAP) was provided by a review of literature. In order to provide a contextual framework to interpret the sustainability indicator / parameter monitoring results, a study of the Natural Resource Base was conducted for each farm; this study involved soil survey, land capability assessment, a biodiversity reconnaissance survey and the development of whole farm plans.

For each of Unilever's ten nominated sustainability indicator clusters a range of parameters were selected to monitor on each farm. Eight sustainability indicators were selected for the two year monitoring study, including - Soil Fertility & Health, Soil Loss, Nutrients, Pest Management, Biodiversity, Energy, Product Value and Water Management.

In addition to resolving a set of sustainability indicators and sub-ordinate parameters, several key themes for sustainable production of tomatoes emerged from the initial environmental review on fifteen farms and the two year intensive monitoring study on the five farms.

Themes included:

Carbon Management: Of the range of parameters associated with soil fertility and health, organic carbon levels provided the central link to beneficial levels for most of the parameters reviewed. Organic carbon levels for tomato soils ranged from 0.7 to 2.5%.

Growers with soils having high organic carbon levels also had trash retention strategies (no burning), higher levels of earthworm activity, microbial biomass and mychorizal colonization of tomato roots. Clearly cultural practices associated with trash burning and stubble removal need to be further reviewed. Links between trash burning and pest and disease management also need further research.

Diagnostics for Fertility Assessment: A range of methods are currently used to determine nutrient application rates. Growers using soil, plant tissue and in-field sap analyses generally used less fertilizer.

Reduction in Fertilizer Inputs: The results of soil nutrient analysis, nutrient leaching studies and crop removal analysis show that for some growers, less fertilizer can be used without any significant yield penalty. Nitrogen input rates ranged from 130 to 360+ kg/ha N, and there was no significant correlation between tomato yield and the amount of nitrogen applied.

Use of Beneficial Species rather than just Chemicals for Pest Management: A review of current pest management practices showed shortfalls against a desired balanced Integrated Pest Management System. The tomato industry in Australia relies heavily on several key pesticides for pest control, a number of which are of concern in Europe and USA due to the issues of eco-toxicity and human health. More extensive monitoring practices and the use of management strategies to encourage beneficial insects is needed in order to reduce dependence upon chemicals for pest management.

Chemical Storage & Equipment Calibration: Controlled chemical management practices reduce risks - to the environment, - to people handling these products and - to wider ecosystems potentially impacted by them. Improved storage and handling procedures & facilities will be a priority for the next phase of this project. The calibration of spray equipment needs to be implemented more widely. The use of aircraft for pesticide spray application is being reviewed, and several farms are converting to ground spray equipment in order to minimize drift and off-target application.

Water Use Efficiency & Conservation: Some 49% of the Australian processing tomato industry grew tomatoes in 2001/2002 with sub-surface drip irrigation. Over the past 10 years a significant transition has occurred from furrow to drip irrigation with water use improving from 12 ML/ha to 4 ML/ha. Even with this transition, the SAP review showed the importance of irrigation design, selection of drip technology and post-installation maintenance. Drip irrigation system distribution uniformities (DU) on the pilot farms ranged from 67% to 91%. Interestingly, the grower with 91% DU designed the system himself and the tube was 22 years old, having been installed and retrieved six times. Water use efficiency ranged from 6.7 to 24.2 tonnes of fresh tomatoes per ML of water used (irrigation and summer rainfall).

Biodiversity & Landscape Health: Ten parameters associated with biodiversity were evaluated on the five farms. Methods to assess biodiversity were developed and applied over the two monitoring seasons to each farm, resulting in the development of farm biodiversity improvement plans. Significant opportunities for biodiversity enhancement were found with existing areas of permanent vegetation per farm ranging <1% to 10%. Enhancement plans considered four parameters including; stock shelter, water table management, surface water management and biodiversity value improvement. All farmers in the project developed plans to significantly enhance biodiversity on their farms in line with project goals, local and regional biodiversity goals.

Renewable Input & Energy Gaps: With the growers involved in this pilot, there was virtually no renewable fertilizer used for growing processing tomatoes and the associated

crop rotations. Several growers have considered organic based fertilizers, but further research is required to verify product effectiveness and manufacturer performance claims. While renewable energy sources such as bio-diesel are emerging in Australia, these technologies are not in use on tomato farms.

Yield & Quality Improvements; Yields in excess of 140 metric t/ha were recorded on drip irrigated tomatoes. A combination of well managed nutrient, water, soil health and pest control were associated with growers consistently achieving high yields. However soluble solid levels across the Australian industry appear to have declined in recent years, possibly due to changes in water management and tomato cultivars. More effective monitoring and improved soil fertility and health are thought to be linked to sustaining high levels of production over consecutive seasons.

Other issues;

For each sustainability indicator and parameter studied in the Sustainable Agriculture Project, a range of best management practices (BMP's) was identified. A condensed version of identified BMP's was then incorporated into the Grow Sustainably™ and formed the basis for developing sustainability standards and the management system.

Grow Sustainably™

The Australian pilot project has developed a farm management system tool kit, called the Grow Sustainably™ Management System.

This tool kit brings together the indicator, research and development of best management practices into one simple system.

Grow Sustainably™ has been designed to meet the needs of the variety of “mixed farming activities” and satisfies the requirements of several standards in one simple management tool.

The Grow Sustainably™ system facilitates the requirements of: an environmental management system and the international environmental standard ISO 14001, Eurepgap, The Processing Tomato Industry Approved Supplier Program, Freshcare and SQF 1000, and integrates with Farm Safety systems.

After careful planning and consultation with tomato growers and other industry experts, the system was designed to identify, manage and monitor the range of risks found with the mixed farming activities of Australian processing tomato farms. A website, a diary and folder information filing system provide the basis for Grow Sustainably™.

The training system and the on farm implementation assistance program are probably some of the most valuable aspects of the tool kit for our tomato growers.

Five training modules have been developed based on Australian Competency Standards to provide growers with the skills and information required to effectively implement the system.

Training modules include: The GS Management System, Soil Fertility & Health, Nutrients, Pest Management, Water Management & Biodiversity Management. Growers are also encouraged to attend Managing Farm Safety training courses offered through FarmSafe Australia etc.

Field days, Backyard Blitz days and one on one support programs have also been developed to facilitate effective implementation of the program.

Implementing the system has involved a careful review of a range of existing farm practices and adopting of high performance standards such as the Fertilizer Industry



Federation of Australia Code of Practice for responsible fertilizer management, and state of the art agricultural chemical storage and handling techniques.

Unilever plan to modify this tool kit and training system for application to other pilot programs offshore (Brazil, Greece, California etc).

Change Management

The next step in our learning process is now underway and involves attempting to improve farm practices and positively influence the level of each sustainability indicator toward a more sustainable level.

If the parameter values move in the right direction, then these new practices will become part of our sustainable agriculture standards and shared amongst our grower community and with other pilot projects.

Results so far show there are several areas that need greater attention. Key areas for change management include: organic matter levels, nutrient management, identifying renewable inputs (fertilizers & others), integrated pest management (IPM) practices, farm biodiversity management and water use efficiency.

Partnering with Others & Leveraging our Investment

It is clear from the Australian pilot project that there is a need for Unilever and their participating farms to link with neighbouring land users and stakeholders, perhaps at a catchment or regional scale to achieve net sustainability improvements.

Looking at biodiversity and ground water table management as two examples, achieving sustainable improvements clearly needs catchment scale change. It's not just what we do on tomato farms, but what happens with neighbouring farms that will enable a step change in environmental performance and ensure the viability of farming in Central Victoria and Southern New South Wales.

Environmental improvements in our catchments will take the participation of all stakeholders who depend upon agriculture; we hope you will join us in building a future and lifestyle which our children and grandchildren can enjoy.

Both Unilever and Horticulture Australia are committed to extending the findings, products and system tools developed of this project to other situations – Unilever to their tomato processing businesses elsewhere in the world, and Horticulture Australia to other Australian horticultural industries.

The Grow Sustainably™ management system, web and training tools are now available for application to other, mixed farming systems. More information about Grow Sustainably™ can be obtained via the web: www.growsustainably.com or www.outsourcedenvironmental.com.au

REFERENCES

Outsourced Environmental (2002) Grow Sustainably™ Project Report – Developing an Environmental Management Systems Framework. June 2002 (www.growsustainably.com & www.outsourcedenvironmental.com.au).

Sustainable Agriculture Initiative (2003) (www.saiplatform.org).

Unilever (2001) Unilever Magazine – Cultivating Sustainable Agriculture. (www.unilever.com & www.growsustainably.com).

Unilever (2001) Growing for the Future – Unilever and Sustainable Agriculture. (www.unilever.com & www.growsustainably.com).

Unilever (2002) Growing for the Future II – Unilever and Sustainable Agriculture. (www.unilever.com & www.growsustainably.com).

Unilever (2003) Growing for the Future – Tomatoes: For a Sustainable Future. (www.unilever.com & www.growsustainably.com).

Appendix 1: Sustainable Agriculture Indicator

10 sustainability indicators were resolved to guide the research activities associated with each pilot, these indicators include:

Soil Fertility/Health:



Soil is fundamental to agricultural systems, and a rich soil ecosystem contributes to crop and livestock performance. Sustainable practices can improve beneficial components of the soils ecosystem. *Parameters: Number of beneficial organisms (e.g. earthworm density and biomass), number of beneficial micro-organisms (microbial biomass), Soil chemical properties (pH, EC, Ca: Mg ratio etc), Soil organic carbon (measure of "health", soil structure).*

Soil Loss:



Soils eroded by water, wind and harvest (exported to factory) can lose both structure and organic matter, diminishing the residual assets of an agricultural system. Sustainable practices can reduce soil erosion and loss. *Parameters: Slope (% Fall), Soil cover index (total bare months of soil, proportion of time soil is covered with crop, cover protects against leaching and erosion, promotes water use), soil erosion (tonnes per hectare soil loss to factory), soil compaction index (compaction caused by crop machine activities).*

Nutrients:



Crops and livestock need a balance of nutrients. Some of these can be created locally (e.g. nitrogen), and some must be imported. Nutrients are lost through cropping, erosion, emissions to the air. Sustainable practices can enhance locally produced nutrients and reduce losses. *Parameters: Amount of inorganic Nitrogen (N)/ Phosphorus (P) / Potassium (K) applied (per hectare or per tonne of product), Balance of N/P/K over crop rotations, Emissions of N-compounds to air, % Renewable Fertilizer Utilized.*

Pest Management:



When pesticides are applied to crops or livestock, a small but significant proportion can escape to water and air or accumulate in foods, affecting ecosystems and human health. Sustainable practices can substitute natural controls for some pesticides and so reduce dependence on synthetic chemicals. Management strategies and cultural practises can be adopted to encourage beneficial insects and enhance non-chemical control of pests. *Parameters: Amounts of pesticides (active ingredient) applied (per ha or per tonne of product), Type applied (profiling, positive list, weighting factor), Percentage of crop under Integrated Pest Management (IPM).*

Biodiversity:



Agriculture has shaped most ecosystems in the world, and biodiversity can be improved or reduced by agricultural practices. Some biodiversity is highly beneficial to agriculture. Sustainable practices can improve biodiversity by strategically revegetating unproductive farm areas, providing habitat for native fauna etc. *Parameters: % Area under permanent vegetation, Boundary to Area Ratio, Vegetation Strata, Species Richness, Conservation Status,*

Grow Sustainably Unilever Corporate Abstract & Paper Oct 2003.doc
Revision 04, Updated: 6th October 2003

Native Vegetation Health, Weed Invasion & Feral Fauna in Native Vegetation, Frog Abnormalities and Aquatic Macro Invertebrates.

Product Value:



Product value is a measure of the desired outputs of an agricultural system. Sustainable practices should be able to maintain or improve product value. *Parameters: Total value of produce per ha, Yield in tonnes per ha, Conformity to quality specifications - Soluble Solids (Brix), Lycopene, Heavy metal and Pesticide residues in produce (mg/kg).*

Energy:



Although the energy of sunlight is fundamental to agriculture, the energy balance of agricultural systems depends on the additional energy supplied from other sources to power machinery. Sustainable practices will improve the energy balance and ensure that it remains positive – that there is more energy gained than lost from the production equation. *Parameters: Ratio of renewable to non-renewable energy inputs, Fuel use (per hectare and per tonne produce), Estimated emissions from cultivation (CO₂/ha), Net emissions per farm (CO₂).*

Water:



Some agricultural systems use water for irrigation and all systems have the potential to pollute or contaminate soil-, ground-, or surface- water with pesticides, nutrients. Sustainable practices can make targeted use of water and other inputs, and reduce loss. *Parameters: Amount of water used per ha or tonne of produce, Irrigation distribution uniformity %, tail water loss %, leaching or runoff of pesticides to surface and ground water, leaching and runoff of N/P/K (nutrients) to surface and ground water.*

Social/Human Capital:



The challenge in using natural resources sustainably is fundamentally a social one. It requires collective action, the sharing of new knowledge and continuous innovation. Sustainable agriculture practices can improve both social and human capital while ensuring normal outputs. The prime responsibility for this should remain with the local community, leading to realistic and actionable targets. *Parameters: Group dynamics/organisational density (farmer groups), (Rural) community awareness of relevance and benefits of sustainable practices/connectivity to society at large, Rate of innovation, Health.*

Local Economy:



Agricultural inputs (goods, labour, services) can be sourced from many places, but when they come from the local economy, the expenditure helps to sustain local businesses and livelihoods. Sustainable agriculture practices draw upon local resources and supplies and contribute to the viability of the local community and business efficiency. *Parameters: Amount of money/profit invested locally, Percentage of goods/labour/services sourced locally, Employment level in local community.*